Internal and Market Pay References in Firms

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We examine how firms balance internal and external reference points when determining employee pay. Analyzing nearly 19 million confidential U.S. employee records, our analysis reveals three key findings. First, the relative sensitivity of pay to internal over external benchmarks increases with firm innovation intensity, employee skill level, and the combination of the two. Second, this relationship appears at least partly causal: we document similar patterns using an instrumental variables analysis based on regional inflation shocks and a differences-in-differences analysis of CEO transitions. Third, firms with a stronger internal pay orientation produce more and higher-quality patents, including more breakthrough innovations. Altogether, our findings reveal that, while some firms maintain close market alignment, knowledge-intensive firms appear to decouple pay from market forces. This is particularly the case for their skilled workers, consistent with firms prioritizing internal social dynamics in contexts where cooperation and creativity are important for value creation.

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1. INTRODUCTION

How do firms balance market and internal forces when setting employee pay? Research in the "theory of the firm" tradition has long recognized that firms operate simultaneously as economic actors competing in markets (e.g., Holmstrom 1999) and as social communities that coordinate production internally (Selznick 1948; Barnard 1938). Managing the firm as both a market actor and a social community creates a tension for leaders: competitive pressures demand market responsiveness, while effective internal cooperation requires trust and cohesion. This tension has likely intensified in recent decades as firms increasingly rely on cooperative inputs such as knowledge, skills, and creativity (Peters and Taylor 2017; Crouzet et al. 2022) while simultaneously facing pressure for more market-oriented employment relationships (Cappelli 1999; Bidwell et al. 2013). A key domain where this challenge manifests is compensation: firms must decide how much to align employee pay with external market rates while maintaining cohesion internally.

Prior research has highlighted the internal challenges in setting compensation in a social context. Studies find that perceptions of unfair compensation lead to increased turnover, lower productivity and satisfaction, and unethical behavior (Carnahan et al. 2012; Obloj and Zenger 2017; Kacperczyk and Balachandran 2018; Siegel and Hambrick 2005; Wade et al. 2006; Pfeffer and Langton 1993). To mitigate these costs, firms compress pay differences among employees (Gartenberg and Wulf 2017; 2020), mute incentives (Zenger 1992; 1994) and divest businesses with divergent pay levels (Feldman et al. 2018)— practices that prioritize internal equity over incentive provision (Nickerson and Zenger 2008; Larkin et al. 2012). Yet despite this evidence that social factors shape compensation, we know little about how firms balance these concerns against market forces when setting pay. This is the aim of our study.

Our study examines how firms balance market and internal forces by analyzing their relative reliance on external versus internal pay benchmarks. We focus particularly on how this balance varies with both employee skill level and firm innovation intensity—two factors that shape the tension between market forces and internal cooperation. Market forces may exert distinctive pressure for scarce technical and creative talent, but value creation through innovation also requires collaboration and creativity that are difficult to specify in formal contracts (Holmstrom 1989; Manso 2011). The challenge is particularly

pronounced because innovation outcomes are inherently uncertain and long-term, making it harder to align individual incentives with collective goals. Understanding how firms reconcile these competing pressures—particularly in settings where internal collaboration and talent are central—requires data that permits comparisons of pay against both internal and external benchmarks.

To conduct the analysis, we use detailed compensation data to construct internal and market reference groups and then calculate the relative sensitivity of employee pay to pay within these groups. We obtain confidential data from a leading compensation consultancy whose benchmarking services require detailed classification of jobs by skill level, occupation, and geographic region. This granular system enables us to construct precise measures of both internal and external pay benchmarks that are specific to each employee. The data is extensive, covering nearly 19 million employee records across 479 public and private companies within the United States. The public companies comprise 21.6% of total market capitalization and 9.6% of the assets of all public companies within the United States, while the private companies are also large. This combination of detailed job classifications and broad coverage allow us to measure pay co-movement across jobs within companies across a large cross-section of jobs.

To construct employee-specific internal and market pay benchmarks, we partition our data to avoid mechanical correlation between dependent and explanatory variables. We set aside the median-paid employee from each firm-occupation-skill-region-year combination as our dependent variable, using the remaining employees to construct reference groups.

The market pay benchmark for a focal employee is defined as the average pay of workers at other firms in the same occupation, skill level, and geographic region. For instance, for an employee in the occupation "Retail Operations Sales Staff" (nested within the function "Retail Operations") at a skill level of 3 (on a scale of 1 to 22) in the "New York Metro Area" in 2017, we calculate the average 2017 pay of all similarly classified employees at other firms.

The internal pay benchmark is defined as average compensation of same-skill employees within the firm but occupying different functions. We adopt this conservative definition to capture skill- (and therefore status-) equivalent peers while excluding direct collaborators. For our retail example, this

includes skill level 3 employees within the company in functions such as "Administration / Support / Service" and "Loss Prevention" but not "Retail Operations." Our final dataset merges these benchmarks with focal employee data, yielding 177,608 observations. We then measure the sensitivity of employee pay to these two benchmarks.

Our analysis yields three main findings. First, we find that internal pay orientation increases with both firm innovation intensity and employee skill level. In low knowledge-intensive firms, pay is equally sensitive to internal and market benchmarks, while in high knowledge-intensive firms, pay is highly sensitive to internal benchmarks and nearly insensitive to market ones. The same patterns hold for low- and high-skilled workers. Among low-skilled workers, pay is equally sensitive to internal and market pay, while among high-skilled workers, pay is highly sensitive to internal pay and effectively insensitive to market pay. This pattern is particularly pronounced at the intersection of high innovation intensity and high skill levels. This first set of results suggests that firms rely more heavily on internal benchmarking precisely where collaborative effort and knowledge sharing are most important for value creation.

Second, we explore the identification challenges raised by this analysis: i) common unobserved factors that influence pay of both the focal employee and the internal reference group and ii) common unobserved factors that influence the relationship between innovation intensity and internal pay orientation. We explore these challenges through two complementary approaches. First, we use regional inflation shocks as an instrument and find that internal reference group pay continues to predict focal employee pay, with effects concentrated in innovation-intensive firms and among skilled workers. Second, we explore CEO transitions, examining how pay orientation changes when new leaders announce different strategic priorities. When new CEOs prioritize innovation, firms tend to shift toward internal pay orientation, particularly for skilled workers. When new CEOs prioritize market growth or efficiency, firms exhibit no changes in pay orientation. Together, these analyses suggest innovation and internal pay orientation are complementary strategic choices rather than merely reflections of omitted firm factors.

Third, we examine whether greater internal pay orientation in innovative contexts corresponds with better innovation outcomes. We find this to be the case: firms that emphasize internal benchmarks

generate more patents overall and more highly cited and breakthrough patents in particular. This last analysis suggests that internally-oriented pay enables, or at least is consistent with, superior innovation performance.

Our study makes several contributions. First, we contribute to active research within strategy that explores the relationship between economic and social factors within organizations, such as incentives, fairness, and social comparison (e.g., Nickerson and Zenger 2008; Gartenberg and Zenger 2023; Larkin et al. 2012). Prior research has shown that firms compress pay differences and dampen incentive pay to mitigate negative effects of social comparison (Gartenberg and Wulf 2017; Wade et al. 2006), while internal pay dispersion has detrimental effects on performance and employee turnover (Obloj and Zenger 2017; Carnahan et al. 2012; Pfeffer and Langton 1993; Siegel and Hambrick 2005). To the extent that our findings are explained by social factors, our findings provide a deeper understanding of how firms navigate the tension between market-based pay and internal social dynamics when setting pay.

Second, our study contributes to research on the role of firms in labor markets. A longstanding question in this field is whether an individual's earnings are primarily determined by whom they work for or by external market forces (Lazear and Oyer 2004; Bidwell 2011; Bidwell and Keller 2014; Card et al. 2018). Our findings support a contingent answer based on the combination of the firm knowledge intensity and employee skills. Our study also has implications for the ongoing discussion about the firm's role in driving income inequality in the population (Cobb 2016; Amis et al. 2020; Barth et al. 2016; Wallskog et al. 2024; Song et al. 2019; Gartenberg and Wulf 2020). The relationship between intangible capital and internal pay sensitivity suggests one potential mechanism driving wage disparities within and across firms. Within high skill and innovation-intensive settings, we find that pay becomes effectively decoupled from market forces. Our findings support the intuition that, as the economy becomes increasingly knowledge-intensive, we will see a growing divergence in pay between innovative firms and their less innovative peers, as well as between high- and low-skilled workers.

Third, we contribute to the literature on the relationship between incentives and innovation. Previous research on incentives and innovation has focused on the role of incentives that reward long-

term success in driving innovation (Lerner and Wulf 2007; Manso 2011; Ederer and Manso 2013; Azoulay et al. 2011). Our study highlights the importance of internal pay alignment, suggesting that pay is a social phenomenon in addition to a tool for individual motivation. Fostering internal cooperation through pay practices may be an important, yet previously underexplored, driver of innovative output.

The remainder of our paper is structured as follows. Section 2 provides our research question. Section 3 describes the research design, including our overall approach, data, and benchmark construction. Section 4 provides the results. Section 5 presents a discussion of the implications of our findings, and Section 6 concludes.

2. BACKGROUND

In this section, we explore the factors influencing firms' decisions to align pay more closely with internal or market references, and the tension underlying these decisions.

2.1 How Do Firms Balance Internal and Market Forces in Setting Pay?

Phillip Selznick once observed that: "Organization may be viewed from two standpoints which are... empirically united.... On the one hand, any concrete organizational system is an economy; at the same time, it is an adaptive social structure" (1948: 25-26). In other words, firms exist both in market and social contexts in which competitive and social forces simultaneously act on the organization. One important context in which this tension manifests is compensation: firms must decide how much to align employee pay with external market rates versus maintaining coherence inside the organization.

Labor markets influence firms' pay-setting by providing external benchmarks and outside options for employees. Firms routinely compare jobs within their organizations to equivalent positions elsewhere (Bizjak et al. 2008, de Vaan et al. 2019, Li 2024), and these market comparisons shape compensation in ways that reflect the relative bargaining positions of firms and employees. When employees possess scarce or valuable skills, competition can compel firms to align compensation upward with prevailing market rates to attract and retain talent (Gerhart and Milkovich 1990, Lazear and Oyer 2004). Conversely,

when labor is more substitutable, market forces can exert downward pressure on wages (Acemoglu and Autor 2011).

Empirical work suggests, however, that firms frequently deviate from purely market-based approaches to compensation. Pay increases for certain workers often correspond with increases for others in similar positions (Gartenberg and Wulf 2020, Hjort et al. 2022) and those at higher organizational levels (Cenzig et al. 2019). Firms frequently limit the use of incentive-based pay, even when marginal productivity varies significantly among employees (Zenger 1992, 1994; Lawler 1965; Cobb and Lin 2017). Firms tend to maintain identical pay for comparable positions across geographic locations, despite variations in living costs (Hazell et al. 2022). In multi-business firms, market-driven pay inequality among division managers predicts unit divestment (Feldman et al. 2018). These patterns suggest that internal considerations can significantly influence compensation strategies.

Social factors may explain an orientation toward internal pay. First, social comparison relative to "similar others" (Festinger 1954) leads employees to form reference groups based on organizational boundaries, comparing their compensation to others within the firm (Nickerson and Zenger 2008). When these comparisons are perceived to be unfair, they can reduce job satisfaction, productivity, and retention (Rebitzer and Taylor 2011; Larkin et al 2012; Bloom and Michel 2002; Kacperczyk and Balachandran 2018; Obloj and Zenger 2017). Second, organizational identification may create pressure for internal pay alignment as firms seek to reinforce collective identity and shared purpose. Incentives such as profit-sharing and group rewards foster a sense of organizational identification and shared fate (Knez and Simester 2001; Hamilton et al. 2003; Cappelli et al. 2020). These practices in turn may result in a more internally-oriented pay, in which pay covaries more internally than relative to the market.

Economic factors may also drive firms to orient pay internally. Performance interdependence makes individual contributions difficult to isolate, both through team-based collaboration and from firm-wide shocks that affect performance. Cross-functional team production is increasingly common (Deming 2017) as specialized workers rely on each other to create complex outputs (Brynjolfsson and Hitt 2000; Autor et al. 2003; Bartel et al. 2007), while firm-wide shocks can affect output overall. This

interdependence complicates the use of external market benchmarks and leads firms toward internally-oriented pay that better reflect collective contributions (e.g., Holmstrom 1982; Alchian and Demsetz 1972). Beyond interdependence, firm-specific human capital and correlated efficiency wages may lead to a decoupling from market pay as employees develop skills and capabilities uniquely valuable to their current employer (Coff and Kryscynski 2011; Lazear 2009; Akerlof 1982). These investments in firm-specific knowledge may be particularly valuable with interdependent work (Hitt et al. 2001; Huckman and Pisano 2006), making external market benchmarks less relevant for determining employee value.

In summary, while labor markets exert an important influence on compensation, firms may also aim to moderate their influence through practices that foster cooperation, maintain social cohesion, and account for the complexities of modern production.

2.2. Why Might Innovation and Skill Level Affect Internal Pay Orientation?

The influence of both innovation intensity and employee skill level on internal pay orientation can be understood through a common lens: both factors increase the importance of intangible inputs and outputs that are difficult to measure and value in external markets. In innovation-intensive settings, creative and knowledge outputs are often ambiguous and challenging to quantify (Polanyi 1966; Kogut and Zander 1992), while in high-skill contexts, work increasingly involves abstract tasks with complex causal relationships between inputs and outputs (Adams 1963; Coff 1997). This fundamental measurement challenge shapes how firms approach compensation through both social and economic mechanisms.

In settings characterized by high innovation or skill requirements, social factors become salient mechanisms affecting pay. When outputs are ambiguous, employees are more likely to engage in social comparison within the organization (Festinger 1954; Goodman 1974). This tendency is particularly pronounced among highly skilled employees engaged in abstract tasks for which the nature of work is difficult to specify formally (Argo et al. 2006; Poortvliet 2013). Moreover, both innovative firms and those employing highly skilled workers benefit significantly from creating and maintaining strong organizational identification. This shared identity facilitates knowledge generation, transfer, and

recombination (Arrow 1974, Kogut and Zander 1992; 1996; Nahapiet and Ghoshal 1998; Henderson 2021), while helping to align highly skilled employees with organizational objectives (Ashforth and Mael 1989; Gartenberg et al. 2019). Internal pay referencing can reinforce this identity by emphasizing the collective nature of work and fostering "shared fare" incentives.

Economic factors also drive internal pay orientation in these contexts. Both innovation-intensive firms and highly skilled employees tend to develop specialized, firm-specific human capital that is less readily priced in external markets (Hatch and Dyer 2004; Wang et al. 2009). This specificity can manifest in tacit knowledge about proprietary technologies and processes (Faraj and Sproull 2000; Alchian and Demsetz 1972). Additionally, both innovative and high-skill work typically involve significant interdependence, making individual contributions difficult to isolate and evaluate (Holmstrom 1982), and complicating the use of external market benchmarks for compensation.

The combination of innovation intensity and high skill level may create particularly strong pressure for internal pay orientation, as these factors reinforce each other in making internal coordination more valuable. High-skilled employees in innovative firms are often key drivers of both the firm's innovative culture and strategic direction, making their organizational identification especially important for success. Moreover, their work typically involves complex, interdependent tasks central to the innovation process, making their individual contributions particularly difficult to disentangle and benchmark externally. These arguments suggest that the impact of innovation intensity on internal pay orientation may be most pronounced among highly skilled employees, with a complementary relationship between these factors. Given these considerations, we propose the following research question:

How does the relative sensitivity of pay to internal versus market reference points vary with (a) a firm's innovation intensity, (b) employee skill level, and (c) their interaction?

3. RESEARCH DESIGN

3.1. Structure of Analysis

Our analysis examines how firms balance internal and market forces in setting employee pay, with particular focus on differences across innovation contexts and worker skill. To address our research question, we employ a three-part analysis that first establishes the relationship between pay orientation and innovation/skill intensity, then explores causal interpretation using two identification strategies, and finally examines the implications for innovation outcomes.

3.1.1 Pay Orientation, Innovation Intensity, and Employee Skill

Our first analysis examines how the relative sensitivity of pay to internal versus market benchmarks varies with firm innovation intensity and employee skill. We begin by measuring baseline sensitivities for the full sample, then analyze how these sensitivities vary across subsamples based on innovation intensity (measured using industry knowledge capital intensity) and employee skill level (using our granular skill measure). This first analysis allows us to explore whether innovative firms and high-skilled employees exhibit stronger internal pay orientation, as well as examine the interaction between these two factors.

3.1.2 Identifying Pay Orientation

Our analysis faces two key identification challenges. First, firm-wide factors such as productivity gains or market conditions could affect both internal reference group pay and focal employee pay. While how firms handle these shocks is arguably part of our story, we still would like to establish our results while controlling for them. Second, unobserved characteristics may drive both firms' pay orientation and their strategic choices around innovation, making it difficult to interpret our findings as reflecting deliberate decisions rather than omitted factors.

To address these challenges, we perform two complementary analyses. First, we use an instrumental variable approach that leverages regional inflation shocks to create exogenous variation in internal reference group pay. This strategy aims to isolate the causal effect of internal benchmarks on focal employee pay. The identifying assumption is that differences in regional inflation should only affect focal employees through their impact on internal reference group compensation. Second, we analyze CEO

transitions to examine how pay orientation evolves when new leaders announce different strategic priorities. This approach aims to distinguish whether shifts in innovation focus drive changes in pay orientation, rather than unobserved factors simultaneously determining both. We discuss the details of both analyses in more detail in Section 4 prior to presenting our results.

3.1.3 Innovation Outcomes Analysis While our first two analyses establish that innovative firms deliberately choose to emphasize internal over market benchmarks when setting pay, particularly for skilled workers, they do not explore whether this organizational choice in fact enhances a firm's innovative capabilities. This is the objective of our third analysis, which examines the association between internal pay orientation and innovation outcomes. We construct firm-year measures of internal and market pay sensitivity and merge these with patent data to analyze their relationship with innovation quantity (number of patents), quality (citations), and breakthrough innovation measures. While this analysis is not causal, we adopt the approach of earlier studies on the determinants of innovation (e.g., Lerner and Wulf 2007) and lag our explanatory variables--internal and market pay sensitivities--as well as control for factors known to influence innovation, including R&D spending and firm characteristics.

In summary, our research design explores the relationship between pay orientation, knowledge and skill intensity, and innovation outcomes through a set of sequential analyses. We now turn to a detailed discussion of our data (Section 3.2), measure construction (Sections 3.3-3.4), and model specification (Section 3.5).

3.2. Data

Our primary dataset consists of compensation data provided by a leading compensation consultancy. The dataset contains 18,974,767 compensation records of employees across 479 companies based in the United States from 2008 to 2020. The data covers a substantial proportion of companies across the United States, with the public companies in the sample accounting for 22% of the assets of all publicly traded companies. The consultancy provided us with all their data for employees working at companies based in

the United States, allowing us to construct detailed and precise measures of internal and market benchmarks and to observe their covariance with pay.

The consultancy constructed this data to benchmark compensation for clients both against the market and within the organization. To this end, every employee in the dataset is tagged with *Skill, Function, Occupation,* and *Region. Skill* is the central measure for benchmarking pay within and across firms. The consultancy developed a proprietary system to construct the measure, which it has been using for more than sixty years to provide benchmarking services to thousands of client firms around the world. It sends out extensive surveys and its own consultants to client firms to gather detailed data on job requirements and salary. The consultancy then categorizes the job requirements and computes a job's score along four dimensions of i) knowledge (which further breaks down to technical, managerial, and communicative knowledge), ii) problem-solving capabilities, iii) discretionary power, and iv) impact to an organization. Finally, the scores are combined to compute *Skill*, a standardized cardinal measure of skill that ranges from 1 to 22. Importantly, while the measure increases with job level within the organization, it is not equivalent to hierarchical level inside an organization. Instead, it varies widely within hierarchical levels and occupations with the tasks required. As such, this measure forms the core of the consultancy's ability to compare and benchmark the worth of different jobs across occupations, industries, regions, and firms and we similarly use it for our analysis.

Function includes 61 categories, such as "Retail Operations" function. *Occupation* is nested within *Function* and consists of 206 detailed categories. For example, the "Retail Operations" function includes occupations such as "Retail Operations Sales Staff", "Store Operations," "Supervision and Sales Staff," and others.

Region includes 10 categories, with five corresponding to metropolitan areas and five corresponding to non-metro regions of the United States: New York Metro Area, Chicago Metro Area, Texas Metro Dallas and Houston, Northern California (primarily San Francisco Bay Area), Southern California (primarily Greater Los Angeles Area), Western States, Southern States, Northeast States, Midwest States, and missing.

Our compensation data includes three components: base salary, cash bonus (short term variable pay), and long-term incentives or LTI (equity and options, valued at time of grant). We focus on employee's annual cash compensation (base plus bonus) for this study to avoid concerns of pay correlations among employees introduced in the LTI valuation process.

3.3. Benchmark Construction

We create two benchmarks for our study, which we refer to as *Internal Pay* and *Market Pay.* To create these benchmarks, we employ a two-step approach that avoids the problem of mechanical correlation between the dependent variable and the explanatory variables.

In the first step, we partition our dataset into two parts, one part that we set aside to be used for the dependent variable and the second that we use to construct *Internal Pay* and *Market Pay*. To do this, we allocate the 18,974,767 individual observations in our dataset into 177,540 unique combinations of "firm-*Skill-Occupation-Region-Year.*" From each "firm-*Skill-Occupation-Region-Year*" combination, we select the median-paid employee as our dependent variable. This subset of data therefore incudes 177,540 employees that we refer to as *Focal Employee*.

In the second step, we use the remaining 18,797,227 employees (18,974,767 minus 177,540 *Focal Employees*) to construct *Internal Pay* and *Market Pay.* For a given "firm-*Skill-Occupation-Region-Year*" combination, the *Internal Pay* benchmark is the average cash compensation (sum of base salary and cash bonuses) of an internal reference group. There is no definitive way to designate an internal reference group, and research has shown that people use multiple reference groups against which to compare themselves (e.g., Festinger, 1954). For this study, we define the internal reference group as all employees who i) work at the same firm as the focal employee and ii) are at the same *Skill level* iii) in the same year, but critically, iv) outside the focal employee's *Function*. Consider the example of an employee in 2017 that works for a large retailer ("Large Retailer A") at skill level 3 and in the occupation "Retail Operations Sales Staff" ("Large Retailer A – Skill Level 3 – Retail Operations Sales Staff – 2017"). This focal employee's internal reference group therefore consists of employees who also worked for "Large

Retailer A" in 2017 at *Skill* level 3 but *outside* the "Retail Operations" function, such as "Administration/Support/Service" and "Loss Prevention" functions. This definition is a research design choice that we make to limit, to the extent possible, the degree to which team production is driving internal pay co-movement. For example, those in a sales function – even in different occupations – may obtain similar pay because they work together to improve sales across stores.[1] While this may still occur across functions, it is less likely to be the case. Consequently, our choice of internal reference group is conservative, as it includes more distant similar others, potentially underestimating the true strength of internal pay references in determining employee compensation.[2]

For each focal employee, *Market Pay* is the average cash compensation of market reference group. Specifically, our market reference group includes all employees in our dataset that meet the following criteria: i) work at the same *Skill* level as the focal employee, ii) are employed in the same *Occupation* iii) in the same *Region* iv) in the same year and iv) at firms other than the focal employee's employer. To illustrate, consider our previous example of a focal employee at "Large Retailer A – Skill Level 3 – Retail Operations Sales Staff – New York Metro – 2017." The market reference group for this employee consists of all individuals who have a *Skill* level 3 work in the "Retail Operations Sales Staff" *Occupation* in "New York Metro Area" in 2017 at any other firm except for "Large Retailer A." This definition of the market reference group allows us to capture the most relevant external market comparisons for each focal employee, providing a robust measure of market pay for our analysis.[3]

Once we construct these benchmarks for each "firm-*Skill*-*Occupation*-*Region*-*Year*" combination, we merge the measures with our individual *Focal Employee* subsample to create an analysis dataset with 177,608 observations of focal employee pay and their *Market Pay* and *Internal Pay* benchmarks.

[1] The "Retail Operations" function includes this example focal employee's occupation "Retail Operations Sales Staff," as well as other occupations such as "Store Operations" and "Supervision and Sales Staff".
[2] In alternative specifications where we have included more proximate occupations to the internal reference group, overall internal pay sensitivity (unsurprisingly) increases, while our main results are effectively unchanged.
[3] Our current measure of market reference groups accounts for prominent factors that influence a worker's employer choice, such as region and occupation. We do not further restrict market reference groups to firms in the same industry as product market competitors are not necessarily labor market substitutes; for instance, typical industrial categories do not represent skill relatedness (Neffke and Henning 2013).

3.4. Dependent Variable

Our dependent variable is *Employee Pay*, a cash compensation (sum of base salary and cash bonuses) of the focal employee. We use cash compensation as our primary measure rather than total compensation (cash compensation plus LTI) to avoid concerns that LTI valuation may induce mechanical correlations between our internal pay benchmark and the focal employee pay. We have also replicated our analysis including LTI compensation in our measure, with the unchanged results.

3.5. Model

We estimate our main model as follows:

$$EmployeePay_{isort} = \alpha + \beta_1 InternalPay_{isort} + \beta_2 MarketPay_{isort} + \eta_{isor} + \nu_t + F_{it} + \epsilon_{isort} \quad (1)$$

where the subscript *i* denotes a firm, *s* denotes a skill level, *o* denotes an occupation, *r* denotes a region, and *t* denotes a year. Here, *EmployeePay* is our dependent variable, a cash compensation of the *Focal Employee*. *InternalPay* and *MarketPay* are the main explanatory variables. η represents "firm-*Skill-Occupation-Region*" four-way fixed effects. ν represents *Year* fixed effects. With these fixed effects, the estimates of the model can be interpreted as the sensitivity of changes in pay and to changes in the two pay benchmarks by comparing employees only against those that belong to the same fine-grained unit of firm-*Skill-Occupation-Region* and those in the same year. To absorb firm performance shocks, we also include two measures of firm performance: *Return on assets* and log *Revenues,* represented by F_{it}. The coefficient on *InternalPay* estimates the sensitivity of employee pay to the internal pay benchmark. The coefficient on *MarketPay* estimates the sensitivity of employee pay to the market pay benchmark. Standard errors are clustered at a firm level (Abadie et al. 2023).

Table 1 presents summary statistics on the data and the main variables.

<< Insert Table 1 here >>

4. RESULTS

4.1 Pay Orientation, Innovation Intensity, and Employee Skill

Table 2 presents our initial analysis of pay sensitivity to internal and market benchmarks. Column (1) shows that a $1.00 change in *Internal Pay* corresponds to a $0.24 change in focal employee pay (p<0.01), while Column (2) shows a $1.00 change in *Market Pay* corresponds to a $0.08 change (p<0.01). When both benchmarks are included simultaneously in Column (3), the coefficients remain stable at 0.236 for *Internal Pay* and 0.072 for *Market Pay* (both p<0.01). To address the concern that these findings may be driven by a choice of model, we assess the stability of our estimates using range of models and fixed effects. Appendix Figure A1 plots these results of this exercise. While the magnitude of the estimates varies across specifications, the internal pay benchmark consistently emerges as a stronger predictor of pay. This pattern emerges despite our conservative definition of internal reference group as excluding employees in the same functional category as the focal employee.

<< Insert Table 2 here >>

Next we explain how pay sensitivity varies with innovation intensity. We categorize industries into three groups based on knowledge capital intensity as defined by Peters and Taylor (2017).[4] Low knowledge industries (e.g., Retailers, Restaurants) have less than 1% knowledge capital intensity, moderate knowledge industries (e.g., Construction, Insurance) range from 1-3%, and high knowledge industries (e.g., Chemicals, High Technology) exceed 3%. Figure 1 presents the coefficients from estimating the model in Equation (1) separately for each knowledge intensity category. In low knowledge industries, internal and market pay sensitivities are relatively similar (11.6% vs 8.5%, both p<0.01). However, in high knowledge industries, internal pay sensitivity increases dramatically to 44.5% (p<0.01) while market pay sensitivity drops to 3.2% (p<0.01), suggesting that innovative firms orient pay primarily toward internal benchmarks.

<< Insert Figure 1 here >>

[4] Peters and Taylor (2017) explain their measure as follows: "A firm develops knowledge capital by spending on R&D. We estimate a firm's knowledge capital by accumulating past R&D spending using the perpetual inventory method: $G_{it} = (1 - \delta_{R\&D})G_{i,t-1} + R\&D_{it}$ where G_{it} is the end-of-period stock of knowledge capital, $\delta_{R\&D}$ is its depreciation rate, and $R\&D_{it}$ is real expenditures on R&D during the year" (p. 256).

Next, we analyze pay sensitivity by employee's skill level. We divide employees into deciles by *Skill* level and rerun our specification in Table 2 Column (3) for each decile. Figure 2 Panel A presents estimates of pay sensitivity across employee skill deciles for each of these ten regressions. For employees in the lowest skill decile, internal and market pay sensitivities converge. However, as skill level increases, internal pay sensitivity rises substantially while market pay sensitivity remains flat or declines slightly. This divergence is most pronounced among the highest-skilled workers, indicating that firms rely more heavily on internal benchmarking for their most skilled employees.

Finally, Figure 2 Panels B and C explore how the relationship between skill level and pay sensitivity varies with innovation intensity. Within low knowledge firms (Panel B), internal pay sensitivity in the lowest decile is 0.00% (SE 0.02) compared to market pay sensitivity of 6.32% (SE 0.04, $p<0.10$). This pattern only reverses among the highest skill levels, where internal pay sensitivity reaches 17.7% (SE 0.04, $p<0.001$) compared to market pay sensitivity of 2.08% (SE 0.05). In contrast, high knowledge firms (Panel C) show consistently higher internal pay sensitivity across all skill levels, starting at 15.2% (SE 0.04, $p<0.001$) versus 2.24% (SE 0.01) in the lowest decile and reaching 50.1% (SE 0.06, $p<0.001$) versus 0.00% (SE 0.02) in the highest decile. These results suggest that both innovation intensity and skill level independently and jointly relate to firms' relative emphasis on internal versus market benchmarks in setting pay.

<< Insert Figure 2 here >>

4.2 Identifying Pay Orientation

Our analysis so far reveals that internal pay sensitivity is higher in innovation-intensive settings and among high-skilled employees. However, these results raise two interpretation challenges. First, firm factors such as productivity gains could drive both internal reference group pay and focal employee pay, potentially creating a mechanical correlation between our measures. Second, these factors and others may also simultaneously influence both pay orientation and innovation strategy. To address these challenges, we adopt two complementary approaches: an instrumental variables (IV) approach using regional

inflation shocks and an analysis of how pay orientation changes when new CEOs announce different strategic priorities.

4.2.1 Instrumental Variables Analysis

For our first analysis, we exploit regional variation in inflation as a source of exogenous changes in internal reference group pay. We construct our instrument, *Regional CPI Differential*, by subtracting an employee's regional Consumer Price Index (CPI) from the weighted average CPI of their internal reference group, lagged by one year. The logic underlying the instrument is as follows: regional inflation may affect local wages but should not directly influence the wages of employees in other regions within the same firm. The identifying assumption is that differences in regional inflation rates are unrelated to firm-wide performance shocks and only affect a focal employee's pay through their impact on the pay of internal reference group members in other regions. For example, if a New York employee's internal reference group includes colleagues in Chicago and Los Angeles, higher inflation in Chicago and Los Angeles should only affect the New York employee's pay through its effect on their reference group's compensation, not directly. The instrument satisfies the relevance condition, therefore, if regional price changes affect local wages, and it satisfies the exclusion restriction if differences in regional inflation only affect focal employee pay through their impact on internal reference group compensation. Assuming these two conditions are satisfied, therefore, this approach helps isolate the causal effect of internal benchmarking from other firm-wide factors that might simultaneously influence both reference group and focal employee pay.

Tables 3 and 4 present the second stage of the IV estimation (see Appendix Tables A1-2 for the first stage results). Table 3 Column (1) shows that across the full sample, a $1.00 change in *Internal Pay* leads to a $0.61 change in focal employee compensation, though this effect is only moderately significant. Columns (2)-(4) repeat the analysis by industry knowledge intensity subsamples. These results reveal that the positive internal pay sensitivity is driven by innovation-intensive firms. Columns (2)-(3) show a statistically null relationship, while Column (4) indicates that within high-knowledge firms, a $1.00

change in *Internal Pay* corresponds to a $0.89 change in compensation ($p<0.01$). Table 4 examines how these causal effects vary with employee skill level. Columns (1)-(3) show no significant effects for employees in the first three skill quartiles. However, Column (4) reveals that among employees in the highest skill quartile, a $1.00 change in *Internal Pay* causes a $0.73 change in pay ($p<0.1$, F-statistic = 4.9). Columns (5) and (6) show this effect is concentrated among highest-skilled workers in innovation-intensive firms, where a $1.00 change in internal pay leads to a $0.62 change in compensation ($p<0.1$, F-statistic = 8.4).

In summary, while our instrument is weak (as indicated by low first stage F-statistics), the pattern of results reinforces our main findings: changes in internal reference group pay appear to influence focal employee pay primarily in innovation-intensive settings and among highly skilled workers, with the strongest effects at the intersection of the two.

4.2.2 CEO Transition Analysis

Our results thus far suggest that innovation focus and internal pay orientation are linked, but this relationship could reflect unobserved firm characteristics driving both simultaneously. To better understand this relationship, we use CEO transitions to examine whether shifts in strategic focus lead to corresponding changes in pay orientation. CEO changes provide a useful setting because they often mark significant shifts in firm strategy, and new CEOs typically articulate their strategic vision clearly in their first interactions with investors. If innovation focus drives internal pay orientation, we would expect to see shifts toward internal benchmarking specifically when new CEOs emphasize innovation, but not when they announce other strategic priorities. Among 257 public firms in our sample, we identify 113 CEO transitions during our sample period. To classify these transitions, we analyze the new CEOs' first earnings call transcripts using GPT 4.0 to score their strategic focus along three dimensions: innovation, market growth, and cost efficiency. We classify firms based on which dimension receives the highest score, resulting in 23 firms with innovation-focused CEOs, 40 with market growth focus, and 40 with cost efficiency focus. Appendix Tables A3-A5 reports details on the prompt and sample scores.

To analyze how pay orientation changes following CEO transitions, we employ a differences-in-differences (DiD) framework that compares changes in pay sensitivity before and after CEO transitions to changes in firms without CEO turnover. Since CEO changes occur at different times, we use a stacked DiD approach (Cengiz et al. 2019, Deshpande et al. 2019) that groups treated units by transition year and ensures treated units are only compared with control units from the same "stack." Our specification includes interactions between CEO transition, post-transition period, and both internal and market pay benchmarks, allowing us to examine how the relative importance of these benchmarks shifts following CEO transitions with different strategic emphases. Our goal with this approach is to explore whether an innovation focus and internal pay orientation are complementary choices by leaders; hence, an endogenous and deliberate CEO change represents an opportunity to observe whether shifts in strategic focus and pay orientation occur in conjunction.

Table 5 presents the results of this analysis. Column (1) shows that all firms with new CEOs generally exhibit increased internal pay sensitivity relative to control firms. However, Columns (2)-(4) reveal that this effect is driven entirely by firms whose CEOs emphasize innovation. The coefficient on *CEO change* × *Post* × *Internal Pay* is positive and significant (0.092, $p<0.01$) and *CEO change* × *Post* × *Market Pay* is negative and significant (-0.069, $p<0.05$) only for innovation-focused CEOs. Firms whose CEOs emphasize market growth or efficiency show no significant changes in pay orientation. These results suggest that firms with new CEOs exhibit increases in internal pay sensitivity and decreases in market pay sensitivity, but only when new CEOs announce a strategic focus on innovation.

Next, we further whether the complementarity of innovation focus and internal pay orientation is most pronounced among high-skilled employees. Column (5) estimates the coefficients on pay-benchmark sensitivities among below-median skilled employees. While the estimate on *CEO change* × *Post* × *Internal Pay* is positive and the estimate on *CEO change* × *Post* × *Market Pay* is negative, neither is statistically significant. Column (6) estimates the coefficients on sensitivities among above-median skilled employees. The estimate on *CEO change* × *Post* × *Internal Pay* is positive and significant, and the estimate on *CEO change* × *Post* × *Market Pay* is negative and significant. These estimates indicate that

for firms whose new CEOs' focus is on innovation, internal (market) pay sensitivity increases (decreases), but only for their high-skilled workers. This result suggests that following new CEOs' announcement of a strategic focus on innovation, the shift toward internal pay orientation and away from market orientation is primarily driven by skilled employees.

<< Insert Table 5 here >>

We present an event study plot of the analysis in Figure 3. Panel A shows that firms whose new CEO is focused on innovation exhibit an increase (decrease) in internal (market) pay sensitivity following the CEO change. Importantly, this panel indicates that there is no evidence of trends in these pay-benchmark sensitivities before the CEO change. In contrast, Panel B shows that firms with CEOs with other focuses (efficiency and growth) do not undergo changes in pay orientation after a new CEO joins. Panels C and D further split employees at firms with innovation-focused new CEOs. Panel C shows that the increase in internal pay sensitivity and decrease in market pay sensitivity at these firms are concentrated in high-skilled employees, whereas Panel D shows that change in pay orientation among low-skilled employees is not as pronounced or consistent.

<< Insert Figure 3 here >>

Together, these results suggest that when firms shift toward innovation-focused strategies, they also increase internal pay orientation, particularly for high-skilled employees.

4.3 Innovation Performance Analysis

Our analyses suggest that firms orient pay internally in innovation-intensive settings for skilled workers, and that this orientation strengthens when firms shift toward innovation-focused strategies. These findings raise a natural question: do firms with stronger internal pay orientation produce better innovation outcomes?

To conduct this analysis, we construct firm-year measures of internal and market pay sensitivity for the 94 public firms in our sample that filed at least one patent during the sample period.[5] For each firm-year, we estimate the sensitivity of pay to internal and market benchmarks using a three-year lagged rolling window (*t-3* to *t-1*), estimated relative to non-patenting firms. *Internal Pay Sensitivity* is the coefficient on *Internal Pay* for each firm-year relative to other firms. *Market Pay Sensitivit*y is the corresponding measure for *Market Pay*. Because we combine all non-patenting firms to form the base firm-year variable, the resulting estimated coefficients on patenting firms' firm-year variables represent the three-year average firm-year pay sensitivities *relative to* non-patenting firms. A positive (negative) *Internal Pay Sensitivity*, therefore, values denote higher (lower) internal pay sensitivity relative to the average non-patenting firm.

We then merge these measures with patent data from the DISCERN database, which provides comprehensive coverage of patents, publications, and citations while accounting for changes in firm ownership structure (Arora et al. 2021). Using this database, we identify 94 firms out of 257 public firms in our sample as having filed at least one patent or publication from 2008 (starting year of our compensation data) to 2015 (last year available from the DISCERN database). We also merge our data with the breakthrough innovation (CD index) database (Funk and Owen-Smith 2017). Lastly, we include Compustat data to create control variables that may simultaneously influence pay orientation and innovation outcomes, such as knowledge capital intensity, sales, and leverage. We report summary statistics for the variables in this analysis in Appendix Table A6.

Figure 4 plots an index of z-scored measures of innovation outcomes (the sum of z-scored number and stock of patents and publications, forward citations by the most cited patent, and the breakthrough index of most breakthrough innovation) against each firm-year measure of pay orientation. Panel A shows a positive correlation of the index with *Internal Pay Sensitivity*, while Panel B shows a negatively associated with *Market Pay Sensitivity*.

[5] Our compensation data, although available at individual level, does not include employee identifier (e.g., name), and we are unable to match this data to individual inventor or scientist.

<< Insert Figure 4 here >>

Table 6 examines this relationship more formally. Following prior work on incentives and innovation (Lerner and Wulf 2007, Yanadori and Cui 2013), we include industry and year fixed effects and control for knowledge intensity, revenues, and leverage. Panel A shows that higher internal pay sensitivity predicts more patents, more impactful patents (as measured by citations), and more publication activity. A one standard deviation increase in internal pay sensitivity is associated with a 137% increase in patents (Column 1, $p<0.01$) and an 87.5% increase in breakthrough innovations (Column 4, $p<0.01$). Panel B reveals the opposite pattern for market pay sensitivity, while Panel C shows similar results using the difference between internal and market sensitivity. Notably, the adjusted R-squared values are consistently highest in Panel A, suggesting internal pay orientation has the greatest predictive power for innovation outcomes.[6, 7]

<< Insert Table 6 here >>

These results indicate that firms with stronger internal pay orientation tend to produce more and better innovations. While we cannot definitively establish causality, this pattern is consistent with internal pay orientation supporting the collaboration and knowledge-sharing needed for innovation. The clear trade-off between internal and market orientations, combined with the robust relationship between internal orientation and innovation outcomes, suggests that how firms orient pay may meaningfully influence their innovative capacity.

Taken together, our empirical analyses reveal a consistent pattern: innovative firms tend to prioritize internal pay benchmarks over market pay benchmarks, and this internal pay orientation is associated with better innovation outcomes.

5. DISCUSSION

[6] In Appendix Table A7, we also report the estimates from models with additional control variables that account for compensation of corporate R&D leaders (Lerner and Wulf 2007), and the results are unchanged.
[7] Since *Internal Pay Sensitivity* and *Market Pay Sensitivity* are highly correlated, we do not include them in a regression at the same time to avoid multicollinearity.

Our analysis reveals several key patterns in how firms balance internal and market forces when setting employee pay. First, we find that the relative sensitivity of pay to internal over market benchmarks increases with both firm innovation intensity and employee skill level, with the strongest effects at their intersection. Second, our instrumental variables and CEO transitions analyses suggest that these patterns reflect strategic choices. Third, our analysis of innovation outcomes indicates these choices matter - firms with more internally oriented pay generate superior innovation outcomes, producing higher quantities and quality of patents, including more breakthrough innovations. These results have implications across several areas that we now discuss.

5.1 Social versus Economic Mechanisms

Our evidence cannot definitively separate the four mechanisms we propose: two social mechanisms, social comparison and organizational identification, and two economic mechanisms, production interdependence and firm-specific human capital. Indeed, these mechanisms likely are all at play, particularly in innovative settings where both social cohesion and economic complementarities are important. However, several aspects of our analysis suggest that social mechanisms play a meaningful role beyond purely economic factors.

First, our research design defines internal reference groups conservatively by excluding employees in the same function as the focal employee. While this approach might underestimate economic mechanisms by omitting direct collaborators, we still find strong internal pay orientation. This pattern suggests mechanisms beyond production interdependence are at work, as employees appear to benchmark their pay against colleagues with whom they are less likely to directly collaborate.

Second, our instrumental variables estimation using regional inflation shocks also is supportive of a social interpretation. When regional inflation creates variation in reference group pay, there is no corresponding change in production processes, interdependencies, or firm-specific human capital that would affect focal employee value creation. Yet we still find significant pay co-movement, particularly in innovative firms. This pattern appears more consistent with social mechanisms driving pay orientation.

Finally, our results remain stable when controlling for firm performance, suggesting that the patterns we observe are not simply driven by shared economic outcomes affecting all employees simultaneously. Altogether, these patterns point to social mechanisms as a factor in internal pay orientation, even as economic factors likely play an important role as well.

5.2 Implications of Analysis

Our results provide a new perspective on the relationship between pay orientation and innovation, complementing previous research that has focused primarily on incentive structures. Earlier studies have emphasized the role of incentives that reward long-term success in fostering innovation: higher LTI ratio among corporate heads of centralized R&D departments (Lerner and Wulf 2007) and pay schemes that reward long-term performance and tolerate early failure (Manso 2011; Ederer and Manso 2013) are associated with more and higher-quality innovation results. Our findings suggest that the social nature of incentives may be equally, if not more, important in innovative firms.

This study also has implications for wage inequality. Our results suggest the emergence of two distinct employment bundles: market-oriented pay for low-skill and low-innovation contexts, which contrast internally-oriented pay for high-skill, high-innovation contexts. This dichotomy has important implications for wage inequality both within and between firms. Within firms, the stronger internal orientation for high-skilled employees may create challenges between skilled employees in innovative roles and those in other functions who might be subject to market-oriented pay (Nickerson and Zenger 2008; Garicano and Rayo 2016). Between firms, this divergence in pay orientation could lead to a concentration of high-skilled workers in innovative firms, further driving wage inequality between high-skill, high-innovation firms and other firms (Song et al. 2019; Barth et al. 2016). This pattern is consistent with recent work on the rise of "superstar" firms (the most productive firms in the economy), which generate a disproportionate share of innovations and accumulate a disproportionate share of intangible capital (Autor et al. 2020; Autor et al. 2023; Tambe et al. 2020).

The results also have implications for corporate strategy on mergers, acquisitions, and corporate scope. The large variation in internal-or-market orientation of pay across firms suggests that firms may consider these divergent practices in setting organizational boundaries. Firms considering mergers and acquisitions may also need to account for differences in pay philosophies, especially when innovative and non-innovative units are involved (Larsson and Finkelstein 1999; Ranft and Lord 2002; Zollo and Singh 2004). Pay orientation can therefore influence target selection and post-acquisition integration in mergers and acquisitions and shape the structure of diversified firms.

Finally, our findings have implications for broader labor market dynamics. Prior work suggests that pay practices, particularly pay disparities among peers inside the firm, shape employee's intent or decision to exit the firm (Card et al. 2012, Dube et al. 2019). Internally-oriented pay in innovative firms may be an attempt by firms to limit mobility of high-skilled workers in these sectors (Kacperczyk and Balachandran 2018). This could lead to more stable employment relationships in innovative firms. But by constraining the flow of talent and knowledge between firms, it might also reduce the overall market efficiency and induce localization of knowledge (Almeida and Kogut 1999, Rao and Drazin 2002; Rosenkopf and Almeida 2003; Lazear and Oyer 2004, Fallick et al. 2006).

6. CONCLUSION

In this study, we set out to examine how firms balance internal and market forces when determining employee pay, with a particular focus on innovation-intensive environments. Our analysis of nearly 19 million U.S. employee records from 479 firms reveals that the relative sensitivity of pay to internal over market pay benchmarks increases with the firm's knowledge intensity, the skill level of employees, and the combination of these two factors. We also find that firms with internally oriented pay produce more innovation, generating higher quantity and quality of patents.

These findings contribute to our understanding of the interplay between pay and innovation. By demonstrating that innovative firms are likelier to prioritize internal over market pay benchmarks, especially for high-skilled employees, our study challenges the conventional wisdom about the

predominance of market forces in wage determination. It suggests that in high innovation contexts in which collaboration and trust are particularly valuable, firms may find greater value in pay practices that foster internal equity and collective effort.

Future research could build on these findings in several ways. While our data offers unique advantages in measuring pay benchmarks through its standardized skill measures, it does not contain employee identifiers that would allow examination of individual outcomes. Studies within organizations could help unpack how internal pay orientation influences employee attitudes, motivation, and propensity to cooperate. Additionally, research could explore which of the mechanisms we discuss - social comparison costs, organizational identification, production interdependencies, and firm-specific human capital - most strongly drives internal pay orientation in different contexts.

Our findings reveal fundamental differences in how firms structure employment relationships in innovative versus other contexts. As the economy continues to shift toward knowledge-intensive activities, firms increasingly face a challenge in maintaining market-based employment relationships and fostering internal social communities that support innovation. Our evidence suggests that successful innovation requires the latter: firms that prioritize internal pay harmony over market alignment generate superior innovation outcomes. This finding challenges the common view that market forces primarily determine wages, particularly for high-skilled workers. Instead, we find that precisely where markets for talent are strongest—in innovative firms employing skilled workers—employee pay is least tied to market forces. This decoupling appears to serve a strategic purpose, helping firms create the collaborative, trust-based environments necessary for sustained innovation. As the importance of innovation in the economy grows, these findings suggest we may see an increasing divergence in employment practices between innovative and traditional firms, with corresponding implications for wage inequality, labor mobility, and the broader organization of economic activity.

REFERENCES

Acemoglu D, Autor D. 2011. Skills, tasks and technologies: Implications for employment and earnings. *Handbook of labor economics* 4, 1043-1171.

Adams JS. 1963. Towards an understanding of inequity. *The Journal of Abnormal and Social Psychology, 67*(5), 422–436.

Akerlof, G.A., 1982. Labor contracts as partial gift exchange. *The Quarterly Journal of Economics*, *97*(4), pp.543-569.

Alchian, AA, Demsetz, H. 1972. Production, information costs, and economic organization. *The American Economic Review, 62*(5), 777–795.

Autor DH, Levy F, Murnane, RJ. 2003. The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics* 118 (4), 1279.

Autor D, Dorn D, Katz L, Patternson C, and Van Reenen J. 2020. The Fall of the Labor Share and the Rise of Superstar Firms. *The Quarterly Journal of Economics*, 135(2), 645–709.

Autor D, Salomons A, Seegmiller B. 2023. Patenting with the Stars: Where are Technology Leaders Leading the Labor Market? NBER working paper.

Almeida, P., & Kogut, B. (1999). Localization of Knowledge and the Mobility of Engineers in Regional Networks. *Management Science*, 45(7), 905–917.

Amis, J. M., Mair, J., & Munir, K. A. (2020). The organizational reproduction of inequality. *Academy of Management Annals, 14*(1), 195–230.

Argo JJ, White K, Dahl DW (2006) Social comparison theory and deception in the interpersonal exchange of consumption information. *Journal of Consumer Research*. 33(1):99–108.

Arora A, Belenzon S, Sheer L. 2021. Knowledge Spillovers and Corporate Investment in Scientific Research. *American Economic Review*, 111(3), 871-898.

Arrow, K. J. (1974). *The limits of organization*. W.W. Norton & Company.

Azoulay P, Graff Zivin JS, Manso G. 2011. Incentives and creativity: evidence from the academic life sciences. *The RAND Journal of Economics* 42(3), pp. 527-554.

Barnard CI (1938) *The Functions of the Executive* (Harvard University Press, Cambridge, MA).

Bartel A, Ichniowski C, Shaw K. 2007. How does information technology affect productivity? Plant-level comparisons of product innovation, process improvement, and worker skills. *Quarterly Journal of Economics*. 122(4): 1721–1758.

Barth, E., Bryson, A., Davis, J. C., & Freeman, R. (2016). It's where you work: Increases in earnings dispersion across establishments and individuals in the U.S. *Journal of Labor Economics, 34*(S2), S67–S97.

Bidwell, M. (2011). Paying more to get less: The effects of external hiring versus internal mobility. *Administrative Science Quarterly*, 0001839211433562.

Bidwell M, Briscoe F, Fernandez-Mateo I, and Sterling A. 2013. The employment relationship and inequality: How and why changes in employment practices are reshaping rewards in organizations. *Academy of Management Annals* 7(1), p. 61-121.

Bidwell M, Keller JR. 2014. Within or without? How firms combine internal and external labor markets to fill jobs. *Academy of Management Journal*, 57(4), 1035-1055.

Bizjak JM, Lemmon ML, Naveen L. 2008. Does the use of peer groups contribute to higher pay and less efficient compensation? *Journal of Financial Economics*, 90(2), 152-168.

Bloom M, Michel JG (2002) The relationships among organizational context, pay dispersion, and among managerial turnover. *Academy of Management Journal*. 45(1):33–42.

Brynjolfsson B, Hitt LM. 2000. Beyond computation: Information technology, organizational transformation and business performance. *Journal of Economic Perspectives*, 14(4), pp. 23–48.

Cappelli, P. 1999. *The New Deal at Work: Managing the Market-Driven Workforce*. First edition. Boston: Harvard Business School Press.

Cappelli, P., Conyon, M., Almeda, D. 2020. Social Exchange and the Effects of Employee Stock Options. *ILR Review*. 73(1), pp. 124-152.

Card D, Mas A, Moretti E, Saez E. 2012. Inequality at work: The effect of peer salaries on job satisfaction. *American Economic Review* 102 (6), 2981-3003.

Card D, Cardoso AR, Heining J, and Kline P. 2018. Firms and labor market inequality: Evidence and some theory. *Journal of Labor Economics* 36 (S1), S13-S70.

Carnahan S, Agarwal R, Campbell BA (2012) Heterogeneity in turnover: The effect of relative compensation dispersion of firms on the mobility and entrepreneurship of extreme performers. *Strategic Management Journal,* 33(12):1411–1430.
Cengiz D, Dube A, Lindner A, Zipperer B. 2019. The effect of minimum wages on low-wage jobs. *The Quarterly Journal of Economics* 134, 3: 1405-1454.
Cobb, J. A. (2016). How firms shape income inequality: Stakeholder power, executive decision making, and the structuring of employment relationships. *Academy of Management Review, 41*(2), 324–348.
Cobb, J. A., & Lin, K.-H. (2017). Growing apart: The changing firm-size wage premium and its inequality consequences. *Organization Science, 28*(3), 429–446.
Coff, R. W. (1997). Human assets and management dilemmas: Coping with hazards on the road to resource-based theory. *Academy of Management Review* 22.2: 374-402.
Coff R, Kryscynski D. 2011. Invited editorial: Drilling for micro-foundations of human capital–based competitive advantages. Journal of Management. 37(5), 1429-1443.
Crouzet, N., Janice C. Eberly, Andrea L. Eisfeldt, and Dimitris Papanikolaou. 2022. The Economics of Intangible Capital. *Journal of Economic Perspectives*, 36 (3), pp. 29–52.
de Vaan M, Elbers B, DiPrete T. 2019. Obscured Transparency? Compensation Benchmarking and the Biasing of Executive Pay. *Management Science*, 65(9), pp. 4299–4317.
Deming, D. J. (2017). The growing importance of social skills in the labor market. *The Quarterly Journal of Economics, 132*(4), 1593–1640.
Deshpande, Manasi, and Yue Li. 2019. “"Who is screened out? Application costs and the targeting of disability programs”" *American Economic Journal: Economic Policy* 11, 4: 213-48.
Dube A, Giuliano L, Leonard J. 2019. Fairness and Frictions: The Impact of Unequal Raises on Quit Behavior. *American Economic Review*, 109(2): 620–663.
Fallick B, Fleischman C, Rebitzer JB. (2006) Job-Hopping in Silicon Valley: Some Evidence Concerning the Microfoundations of a High-Technology Cluster. *The Review of Economics and Statistics* 88 (3): 472–481.
Festinger L (1954) A theory of social comparison processes. *Human Relations* 7(2):117–140.
Funk RJ, Owen-Smith J. 2017. A Dynamic Network Measure of Technological Change. *Management Science*, 63(3), pp. 791–817.
Ederer F, Manso G. 2013. Is Pay for Performance Detrimental to Innovation? *Management Science*, 59(7), pp. 1479-1724.
Faraj, S., & Sproull, L. (2000). Coordinating expertise in software development teams. *Management Science, 46*(12), 1554–1568.
Feldman, E. R., Gartenberg, C., & Wulf, J. (2018). Pay inequality and corporate divestitures. *Strategic Management Journal, 39*(11), 2899-2920.
Garicano L, Rayo L. 2016. Why Organizations Fail: Models and Cases. *Journal of Economic Literature, 54*(1), 137-192.
Gartenberg C, Wulf J (2017) Pay harmony? Social comparison and performance compensation in multi-business firms. *Organization Science*, 28(1):39–55.
Gartenberg C, Prat A, and Serafeim G. 2019. Corporate purpose and financial performance. *Organization Science* 30 (1), 1-18.
Gartenberg C, Wulf J. 2020. Competition and Pay Inequality Within and Between Firms. *Management Science, 66*(12), 5925-5943.
Gartenberg C, Zenger T. 2024. The Firm as a Subsociety: Purpose, Justice, and the Theory of the Firm. *Organization Science*. Forthcoming.
Gerhart B, Milkovich GT. 1990. Organizational Differences in Managerial Compensation and Financial Performance. *Academy of Management Journal*. 33(4): 663–691.
Goodman, P. S. (1974). An examination of referents used in the evaluation of pay. *Organizational Behavior and Human Performance, 12*(2), 170–195.
Hamilton, B. H., Nickerson, J. A., & Owan, H. (2003). Team incentives and worker heterogeneity: An empirical analysis of the impact of teams on productivity and participation. *Journal of Political Economy, 111*(3), 465–497.
Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, 25(12), 1155-1178.
Hazell J, Patternson C, Sarsons H, and Taska B. 2022. National Wage Setting. NBER working paper.
Henderson R (2021). Innovation in the 21st Century: Architectural Change, Purpose, and the Challenges of Our Time. *Management Science* 67(9), pp. 5479-5488.

Hitt, M. A., Bierman, L., Shimizu, K., & Kochhar, R. (2001). Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective. *Academy of Management Journal*, 44(1), 13-28.
Hjort J, Li X, and Sarsons H. 2022. Across-Country Wage Compression in Multinationals. NBER working paper.
Holmström B. 1982. Moral hazard in teams. *The Bell Journal of Economics, 13*(2), 324–340.
Holmström B. 1989. Agency costs and innovation. *Journal of Economic Behavior & Organization, 12*(3), 305–327.
Holmström B. 1999. Managerial incentive problems: A dynamic perspective. *The Review of Economic Studies, 66*(1), 169–182.
Huckman, RS, Pisano GP. 2006. The firm specificity of individual performance: Evidence from cardiac surgery. *Management Science*, 52(4), 473-488.
Kacperczyk A, Balachandran C (2018) Vertical and horizontal comparisons and mobility outcomes: Evidence from the Swedish microdata. *Organization Science* 29(1):17–38.
Knez, M., & Simester, D. (2001). Firm-wide incentives and mutual monitoring at Continental Airlines. *Journal of Labor Economics, 19*(4), 743–772.
Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science, 3*(3), 383–397.
Kogut, B., & Zander, U. (1996). What firms do? Coordination, identity, and learning. *Organization Science, 7*(5), 502–518.
Larkin I, Pierce L, Gino F (2012) The psychological costs of pay-for-performance: Implications for the strategic compensation of employees. *Strategic Management Journal*, 33(10):1194–1214.
Larsson R, Finkelstein S. 1999. Integrating strategic, organizational, and human resource perspectives on mergers and acquisitions: A case survey of synergy realization. *Organization Science*, 10(1), 1-115.
Lawler EE. 1965. Managers' perceptions of their subordinates' pay and of their superiors' pay. *Personnel Psychology* 18(4): 413–422.
Lazear EP, Oyer P. 2004. Internal and external labor markets: a personnel economics approach. *Labour Economics*, 11 (5): 527-554.
Lazear EP 2009. Firm-specific human capital: A skill-weights approach. *Journal of Political Economy, 117*(5), 914–940.
Lerner J, Wulf J. 2007. Innovation and Incentives: Evidence from Corporate R&D. *The Review of Economics and Statistics*, 89(4): 634–644.
Li C. 2024. Are Top Management Teams Compensated as Teams? A Structural Modeling Approach. *Management Science*. Forthcoming.
Manso, G. (2011). Motivating innovation. *The Journal of Finance, 66*(5), 1823–1860.
Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review, 23*(2), 242–266.
Neffke F, Henning M. 2013. Skill relatedness and firm diversification. *Strategic Management Journal*, 34: 297–316.
Nickerson, J. A., & Zenger, T. R. (2008). Envy, comparison costs, and the economic theory of the firm. *Strategic Management Journal, 29*(13), 1429–1449.
Obloj T, Zenger T (2017) Organization design, proximity, and productivity responses to upward social comparison. *Organization Science*. 28(1):1–18.
Peters, R. H., Taylor, L. A. 2017. Intangible capital and the investment-q relation. *Journal of Financial Economics*, 123(2), 251–272.
Pfeffer J, Langton N (1993) The effect of wage dispersion on satisfaction, productivity, and working collaboratively: Evidence from college and university faculty. *Administrative Science Quarterly.* 38(3):382–407.
Polayni M. 1966. The logic of tacit inference. *Philosophy, 41*(155), pp. 1 - 18
Poortvliet PM (2013) Harming others' task-related efforts: The distinct competitive effects of ranking information on performance and mastery goal individuals. *Soc. Psych.* 44(6):373–379.
Rao, H., & Drazin, R. (2002). Overcoming resource constraints on product innovation by recruiting talent from rivals: A study of the mutual fund industry, 1986-94. *The Academy of Management Journal*, 45(3), 491.
Rebitzer JB, Taylor LJ (2011) Extrinsic rewards and intrinsic motives: Standard and behavioral approaches to agency and labor markets. Ashenfelter O, Card D, eds. *Handbook of Labor Economics* (Elsevier, Amsterdam), 701–772.
Rosenkopf, L., & Almeida, P. (2003). Overcoming Local Search Through Alliances and Mobility. *Management Science*, 49(6), 751–766.
Selznick P (1957) *Leadership in Administration: A Sociological Interpretation* (University of California Press, Berkeley, CA).

Siegel PA, Hambrick DC (2005) Pay disparities within top management groups: Evidence of harmful effects on performance of high-technology firms. *Organization Science* 16(3):259–274.
Song, J., Price, D. J., Guvenen, F., Bloom, N., & von Wachter, T. (2019). Firming up inequality. *The Quarterly Journal of Economics, 134*(1), 1–50.
Tambe P, Hitt L, Rock D, and Brynjolfsson E. 2020. Digital capital and superstar firms. NBER working paper.
Wade JB, O'Reilly CA III, Pollock TG (2006) Overpaid CEOs and underpaid managers: Fairness and executive compensation. *Organization Science* 17(5):527–544.
Wallskog M, Bloom N, Ohlmacher SW, Tello-Trillo C. 2024. Within-Firm Pay Inequality and Productivity. NBER Working Paper.
Wang HC, He J, and Mahoney JT. 2009. Firm-specific knowledge resources and competitive advantage: the roles of economic- and relationship-based employee governance mechanisms. *Strategic Management Journal* 30(12): 1265.
Yanadori Y, Cui V (2013) Creating incentives for innovation? The relationship between pay dispersion in R&D groups and firm innovation performance. *Strategic Management J*. 34:1502-1511.
Zenger, T. R. (1992). Why do employers only reward extreme performance? Examining the relationships among performance, pay, and turnover. *Administrative Science Quarterly*, 198-219.
Zenger 1994. Explaining Organizational Diseconomies of Scale in R&D: Agency Problems and the Allocation of Engineering Talent, Ideas, and Effort by Firm Size. *Management Science, 40*(6), 708-729.
Zollo M, Singh H. 2004. Deliberate learning in corporate acquisitions: post-acquisition strategies and integration capability in U.S. bank mergers. *Strategic Management Journal*, 25(13), 1233-1256.

Figure 1. Relative strength of internal-versus-market benchmark by industry knowledge intensity.

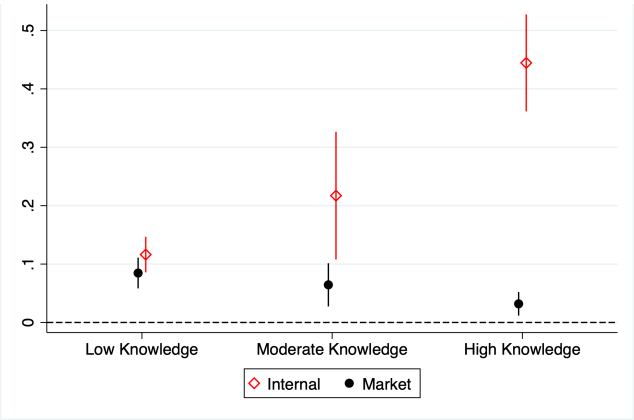
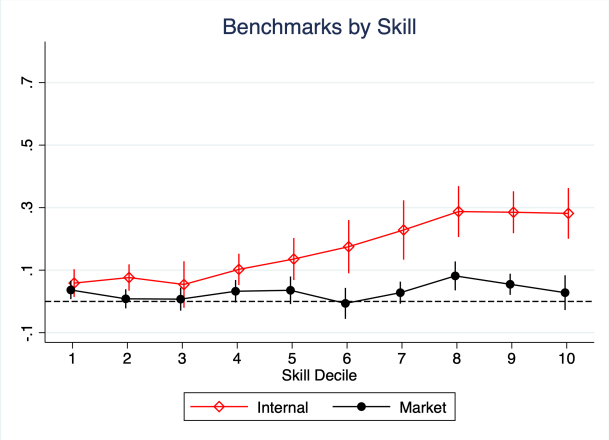
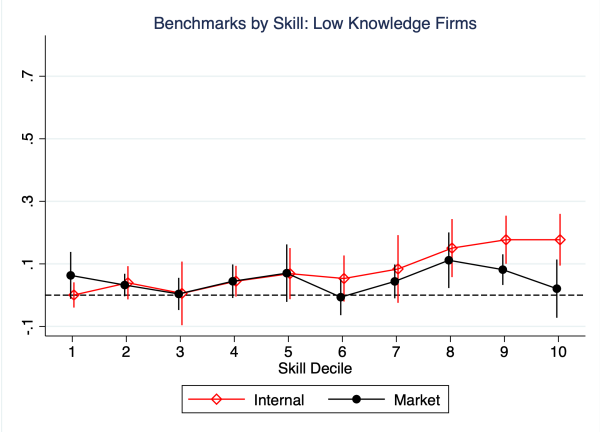


Figure 2. Relative strength of internal-versus-market benchmark by employee *Skill* distribution.

Panel A



Panel B



Panel C

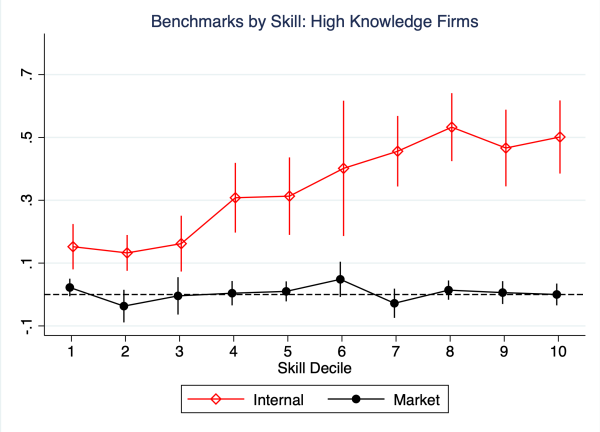
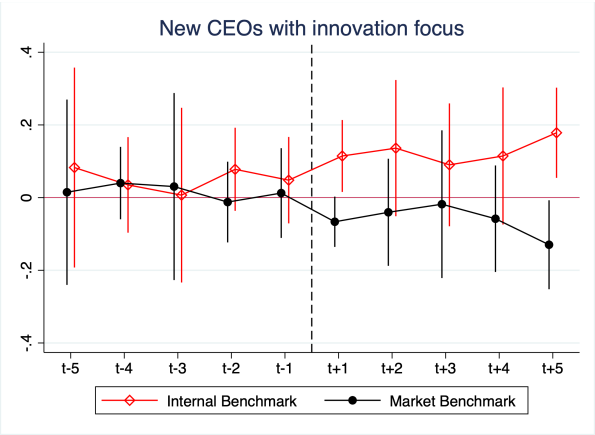
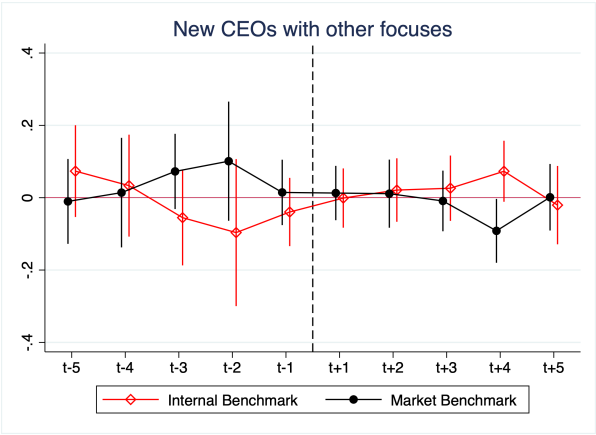


Figure 3. Event study of CEO strategic shift in focus and change in pay benchmark orientation.

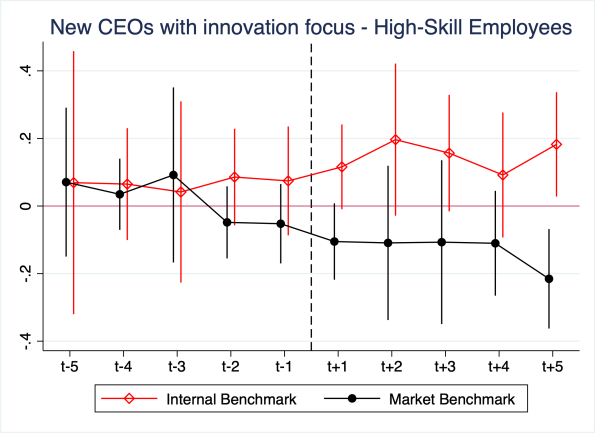
Panel A.



Panel B.



Panel C.



Panel D.

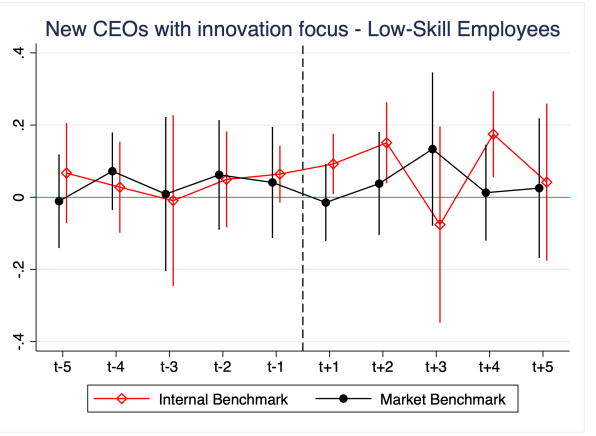


Figure 4. Relationship between benchmarks and innovation measures.

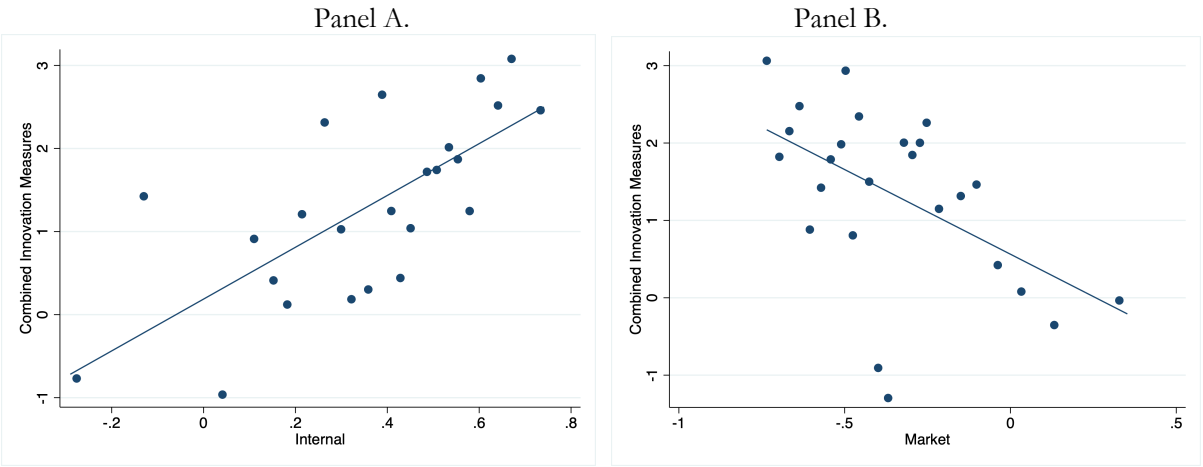


Table 1. Summary statistics of all employee records.

Variable	Count
Employee	18,974,767
Focal employee*	177,540
Benchmark employee	18,797,227
Firm	479
Public firm	257
Public firm with new CEO (2008-2020)	113
Public firm with patent (2008-2020)	94
Year	13 (2008-2020)
Skill	22 (1-22)
Function	61
Occupation	206
Region	10
"Firm-year-skill-occupation-region" unit	177,540

* Each focal employee represents a "firm-year-skill-occupation-region" unit.

Variable	Mean	St. Dev.	25th	50th	75th
Panel A. Compensation data statistics					
Skill	11.23	3.08	9	12	13
Employee pay ($)	85,912	42,159	54,000	76,894	108,577
Internal pay benchmark ($)†	87,890	45,455	56,329	79,127	109,527
Market pay benchmark ($)‡	86,574	44,628	55,053	77,702	109,214
Number of employees per internal pay benchmark group	1,332.51	12,161.55	36	124	445
Number of employees per market pay benchmark group	2,328.61	15,973.66	38	148	567
Number of firms per market pay benchmark group	18.86	18.32	6	13	26
Number of employees per "firm-year-skill-occupation-region" unit	725.23	7,058.33	6	19	84
Panel B. Control variable statistics					
Return on assets	0.105	0.073	0.067	0.102	0.127
Revenues (in million $)	41,611.67	90,234.17	4,222.9	11,145.9	36,595.9

† Cash compensation of internal pay benchmark group, which consists of employees with the same "firm-year-skill" as focal employee but working in different functions. To create the pay benchmark group, we use 18,797,227 benchmark employees (18,974,767 employees minus 177,540 focal employees).
‡ Cash compensation of market pay benchmark group, or employees with the same "year-skill-occupation-region" as focal employee but at different firms.

Table 2. Relationship between employee pay and internal and market pay benchmarks.

	Dependent variable: Employee pay		
	(1)	(2)	(3)
Internal Pay	0.238***		0.236***
	(0.024)		(0.024)
Market Pay		0.082***	0.073***
		(0.009)	(0.009)
Firm-skill-occupation-region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes
Observations	177,540	177,540	177,540
Adjusted R-squared	0.957	0.956	0.957

Notes: Significant at ***1%, **5%, and *10%.
Unit of analysis is "firm-year-skill-occupation-region."
Firm controls include ROA and log revenues.

Table 3. Instrumental variables analysis by industry knowledge intensity.

Industry Type	*Dependent variable: Employee pay*			
	All	Low Knowledge	Moderate Knowledge	High Knowledge
	(1)	(2)	(3)	(4)
Internal Pay	0.608*	-0.133	0.838	0.891***
	(0.33)	(0.956)	(0.865)	(0.236)
Market Pay	0.074***	0.122***	0.024	0.02
	(0.024)	(0.042)	(0.036)	(0.022)
Firm-skill-occupation-region FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Observations	36,890	13,763	7,884	15,243
F-statistic in first stage	2.997	0.524	0.889	2.711

Notes: Significant at ***1%, **5%, and *10%.
Unit of analysis is "firm-year-skill-occupation-region."

Table 4. Instrumental variables analysis by employee's skill levels.

	Dependent variable: Employee pay					
Employee Skill Level	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	4th Quartile	4th Quartile
Industry Type					Low Knowledge	High Knowledge
	(1)	(2)	(3)	(4)	(5)	(6)
Internal Pay	-0.668	-0.001	1.868	0.733*	0.153	0.617*
	(11.991)	(0.675)	(3.506)	(0.386)	(0.703)	(0.357)
Market Pay	-0.001	0.051**	0.094	0.062	0.128*	-0.009
	(0.139)	(0.022)	(0.070)	(0.045)	(0.073)	(0.027)
Firm-skill-occupation-region FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,609	11,111	10,091	5,223	1,922	2,498
F-statistic in first stage	0.000	2.997	0.197	4.921	0.552	8.438

Notes: Significant at ***1%, **5%, and *10%.
Unit of analysis is "firm-year-skill-occupation-region."

Table 5. New CEO's strategic focus and change in pay benchmark orientation.

	Dependent variable: Employee pay					
New CEO Strategic Focus	All	Cost Efficiency	Market Growth	Innovation	Innovation	Innovation
Employee Skill Level					Below Median	Above Median
	(1)	(2)	(3)	(4)	(5)	(6)
Post × CEO change	**0.055****	**0.062**	**0.072**	**0.092*****	**0.060**	**0.102*****
× Internal pay	**(0.024)**	**(0.042)**	**(0.045)**	**(0.034)**	**(0.049)**	**(0.035)**
Post × CEO change	**-0.029**	**-0.057**	**-0.054**	**-0.069****	**-0.016**	**-0.108*****
× Market pay	**(0.024)**	**(0.039)**	**(0.039)**	**(0.033)**	**(0.042)**	**(0.035)**
Post	0.003	0.006	0.006	0.005	-0.044	-0.159**
× Internal pay	(0.012)	(0.011)	(0.012)	(0.011)	(0.066)	(0.072)
Post	0.043***	0.042***	0.042***	0.042***	0.074***	0.041**
× Market pay	(0.011)	(0.011)	(0.012)	(0.011)	(0.014)	(0.017)
CEO change	-0.070**	-0.037	-0.046	-0.120*	0.012	0.005
× Internal pay	(0.035)	(0.053)	(0.061)	(0.070)	(0.012)	(0.016)
CEO change	0.022	0.074*	0.015	0.054*	-0.071**	0.136***
× Market pay	(0.025)	(0.042)	(0.037)	(0.029)	(0.031)	(0.039)
Internal pay	0.193***	0.188***	0.189***	0.189***	0.032**	0.276***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.015)	(0.014)
Market pay	0.025*	0.022	0.022	0.022	0.028*	-0.001
	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)	(0.017)
Post × CEO change	-1,263.926	733.303	377.358	-2,704.551	-4,096.772	885.852
	(915.151)	(1,277.915)	(1207.157)	(1,686.224)	(2,967.829)	(5,580.955)
Constant	57,184.258***	55,504.052***	55,766.906***	55,699.971***	49,662.595***	80,423.107***
	(1,073.757)	(1,065.72)	(1,052.195)	(1,135.09)	(776.384)	(2,205.219)
Stack Firm-Skill-Occupation-Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Stack Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	202,917	165,627	164,028	159,849	102,484	55,150
Treated Observations	54,925	17,635	16,036	11,857	6,760	4,862
Control Observations	147,992	147,992	147,992	147,992	95,724	50,288
Adjusted R-squared	0.963	0.963	0.963	0.963	0.943	0.916

Notes: Significant at ***1%, **5%, and *10%.
Unit of analysis is "stacked firm-year-skill-occupation-region."

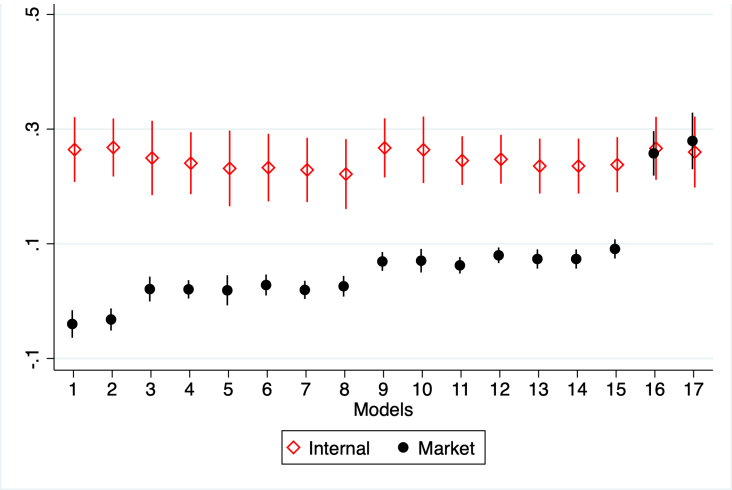
Table 6. Benchmarks and innovation outcomes.

	Dependent variable					
	Number of Patents (logged) $_t$	*Stock of Patents (logged)* $_t$	*Highest Forward Citations (logged)* $_t$	*Most Breakthrough Innovation (logged)* $_t$	*Number of Publications (logged)* $_t$	*Stock of Publications (logged)* $_t$
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Internal Pay Sensitivity						
Internal Pay Sensitivity $_{t-1}$	**1.370*** **	**1.484*** **	**0.875** **	**0.064*** **	**0.586**	**0.964** **
	(0.398)	**(0.516)**	**(0.362)**	**(0.023)**	**(0.367)**	**(0.471)**
Knowledge Intensity $_{t-1}$	6.104***	6.178***	2.513**	0.202***	6.134***	6.680***
	(1.533)	(1.667)	(0.979)	(0.048)	(0.907)	(1.097)
Revenues (logged) $_{t-1}$	0.837***	0.843***	0.414***	0.032***	0.737***	0.915***
	(0.099)	(0.116)	(0.069)	(0.004)	(0.101)	(0.121)
Leverage $_{t-1}$	-1.948**	-1.988*	-0.424	-0.072*	-0.683	-0.694
	(0.925)	(1.041)	(0.739)	(0.041)	(0.823)	(0.996)
Observations	337	337	337	229	337	337
Adjusted R-squared	0.581	0.559	0.338	0.471	0.638	0.640
Panel B: Market Pay Sensitivity						
Market Pay Sensitivity $_{t-1}$	**-1.134*** **	**-1.270** **	**-0.900*** **	**-0.047** **	**-0.378**	**-0.668**
	(0.385)	**(0.497)**	**(0.324)**	**(0.022)**	**(0.326)**	**(0.418)**
Knowledge Intensity $_{t-1}$	6.322***	6.414***	2.654***	0.210***	6.226***	6.832***
	(1.561)	(1.701)	(0.968)	(0.048)	(0.923)	(1.117)
Revenues (logged) $_{t-1}$	0.832***	0.838***	0.410***	0.032***	0.736***	0.913***
	(0.102)	(0.119)	(0.069)	(0.004)	(0.101)	(0.121)
Leverage $_{t-1}$	-1.899**	-1.948*	-0.445	-0.065	-0.631	-0.621
	(0.940)	(1.056)	(0.736)	(0.042)	(0.818)	(0.994)
Observations	337	337	337	229	337	337
Adjusted R-squared	0.575	0.554	0.342	0.458	0.634	0.634
Panel C: Internal Pay Sensitivity Minus Market Pay Sensitivity						
Internal Minus Market $_{t-1}$	**0.636*** **	**0.702*** **	**0.457*** **	**0.028** **	**0.245**	**0.413***
	(0.198)	**(0.257)**	**(0.172)**	**(0.011)**	**(0.175)**	**(0.225)**
Knowledge Intensity $_{t-1}$	6.220***	6.301***	2.580***	0.206***	6.187***	6.767***
	(1.546)	(1.682)	(0.970)	(0.048)	(0.917)	(1.108)
Revenues (logged) $_{t-1}$	0.835***	0.841***	0.412***	0.032***	0.736***	0.914***
	(0.101)	(0.118)	(0.069)	(0.004)	(0.101)	(0.121)
Leverage $_{t-1}$	-1.926**	-1.972*	-0.439	-0.068	-0.658	-0.658
	(0.933)	(1.048)	(0.736)	(0.042)	(0.821)	(0.995)
Observations	337	337	337	229	337	337
Adjusted R-squared	0.578	0.557	0.341	0.464	0.636	0.637
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry* FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Significant at ***1%, **5%, and *10%.
Unit of analysis is "firm-year."
* Industry is classified according to the SIC one-digit industry classification

Appendix

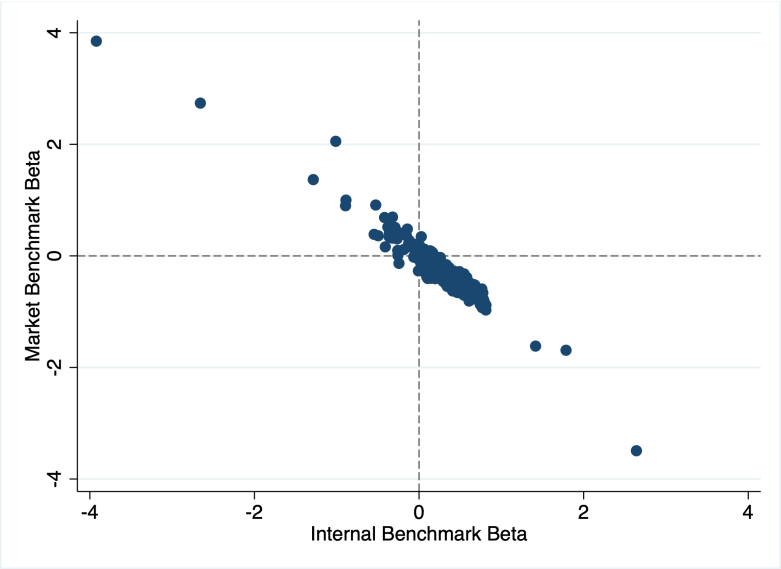
Figure A1: Pay-benchmark sensitivity across various model specifications.



Estimated coefficients across various specifications:

1. Main specification but with year fixed effect, firm fixed effect, and skill-occupation-region three-way fixed effect
2. Main specification but with year fixed effect, firm fixed effect, and skill-occupation-region three-way fixed effect, and no weight
3. Main specification but first-differenced dependent and explanatory variables, and no weight
4. Main specification but first-differenced dependent and explanatory variables, with year fixed effect, and no weight
5. Main specification but first-differenced dependent and explanatory variables
6. Main specification but first-differenced dependent and explanatory variables, with year fixed effect
7. Main specification but first-differenced dependent and explanatory variables, with year fixed effect and firm fixed effect, and no weight
8. Main specification but first-differenced dependent and explanatory variables, with year fixed effect and firm fixed effect
9. Main specification but with year fixed effect, firm fixed effect, and skill-occupation two-way fixed effect, and no weight
10. Main specification but with year fixed effect, firm fixed effect, and skill-occupation two-way fixed effect
11. Main specification but with no weight
12. Main specification but with year fixed effect and firm-skill-occupation three-way fixed effect, and no weight
13. Main specification
14. Main specification but weighted by number of observations in "firm-year-skill-occupation-region"
15. Main specification but with year fixed effect and firm-skill-occupation three-way fixed effect
16. Main specification but with year fixed effect, firm fixed effect, skill fixed effect, and occupation fixed effect, and no weight
17. Main specification but with year fixed effect, firm fixed effect, skill fixed effect, and occupation fixed effect

Figure A2. Correlation between internal pay sensitivity and market pay sensitivity among innovative firms.



Notes: The betas are created by comparing firm-year benchmarks of public firms with patent against those of all other firms and therefore may take on negative values.

Table A1. First-stage equation of the IV analysis by industry knowledge intensity.

	Dependent variable: Internal Benchmark			
Industry Type	All	Low Knowledge	Moderate Knowledge	High Knowledge
	(1)	(2)	(3)	(4)
Regional CPI Differential	97.441*	43.724	115.904	199.232*
	(54.639)	(58.956)	(120.483)	(119.26)
Firm-skill-occupation-region FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Observations	36,890	13,763	7,884	15,243
R-squared	0.962	0.954	0.954	0.971

Notes: Significant at ***1%, **5%, and *10%.
Unit of analysis is "firm-year-skill-occupation-region."

Table A2. First-stage equation of the IV analysis by employee's skill levels.

	Dependent variable: Internal Benchmark					
Employee Skill Level	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	4th Quartile	4th Quartile
Industry Type					Low Knowledge	High Knowledge
	(1)	(2)	(3)	(4)	(5)	(6)
Regional CPI Differential	-5.208	97.912*	66.448	455.33**	228.22	653.502***
	(93.48)	(56.646)	(154.07)	(205.038)	(305.996)	(224.551)
Firm-skill-occupation-region FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,609	11,111	10,091	5,223	1,922	2,498
R-squared	0.912	0.833	0.849	0.866	0.860	0.877

Notes: Significant at ***1%, **5%, and *10%.
Unit of analysis is "firm-year-skill-occupation-region."

Table A3. Summary statistics of firms used for the new CEO analysis.

Firm type	Number of firms	Number of "firm-year-skill-occupation-region" units	Number of employees
All firms	479	177,540	18,974,767
Public firm	257	122,590	16,865,144
Public firm with new CEO	113	54,925	10,421,227
New CEO's focus: Innovation*	23	11,857	2,346,259
New CEO's focus: Market growth†	40	16,036	2,479,823
New CEO's focus: Cost efficiency‡	40	17,635	2,597,206

* Firms with new CEO whose first earnings call scored above median of the *Innovation* score.
† Firms with new CEO whose first earnings call scored above median of the *Market growth* score.
‡ Firms with new CEO whose first earnings call scored above median of the *Cost efficiency* score.

Table A4: Final Prompt for ChatGPT

You are the top McKinsey Analyst in area CEO transcript analysis. Given a list of quotes from an earnings call transcript, evaluate the relative focus of the CEO speaker on the following criteria from 0 to 1 (1 means this criteria is the dominant focus, 0 means not at all) (Note: CEOs can have multiple focuses):

1. Innovation, purpose, long-term and non-financial objectives
2. Cost, margin, and other quantitative objects focused on efficiency, cost reduction, and profitability.
3. Market growth with a focus on quantitative metrics including but not limited to growth rates, new market entry, capital and IT investments, and customer growth; exclude cost-related metrics

return only these scores as comma separated values. do not give them a label.

Notes: Effective input prompts are critical to generating relevant and accurate responses from LLM-based AI chatbots, so we tested multiple input prompts on a subset of earnings call transcripts.

Table A5. Summary statistics of scores used for the CEO strategic focus analysis.

Score	Mean	SD	25th	50th	75th
Innovation	0.56	0.15	0.50	0.60	0.67
Market Growth	0.47	0.28	0.20	0.50	0.70
Cost Efficiency	0.38	0.22	0.20	0.30	0.60

Notes: We analyze these new CEOs' first earnings call transcripts to measure their strategic focus.

Table A6. Summary statistics of firm-year level benchmarks and innovation measures.

Variable	Count	Mean	St. Dev.	25th	50th	75th
Company characteristics						
Knowledge capital intensity	337	0.10	0.12	0.02	0.07	0.14
Revenues (in million $)	337	18,906.56	30,905.52	3,023.19	7,949.42	19,884.00
Leverage	337	0.29	0.14	0.20	0.27	0.39
Summary statistics						
Number of patents	337	126.37	289.09	2	17	81
Stock of patents	337	654.77	1,330.28	19.29	113.34	485.00
Highest forward citations	337	13.92	33.28	0	2	11
Most breakthrough innovation	229	0.48	0.45	0.04	0.33	1.00
Number of publications	337	43.07	164.45	0	5	16
Stock of publications	337	307.66	1,057.89	5.54	47.98	129.52
Internal pay sensitivity	337	0.32	0.41	0.16	0.37	0.55
Market pay sensitivity	337	-0.31	0.46	-0.54	-0.37	-0.14

Notes: Unit of analysis is "firm-year."

Table A7. Innovation outcomes analysis with additional control variables.

	Dependent variable					
	Number of Patents (logged)	*Stock of Patents (logged)*	*Highest Forward Citations (logged)*	*Most Breakthrough Innovation (logged)*	*Number of Publications (logged)*	*Stock of Publications (logged)*
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Internal Pay Sensitivity						
Internal Pay Sensitivity $_{t-1}$	**1.815****	**1.999****	**1.209****	**0.088****	**0.822**	**1.273**
	(0.688)	**(0.864)**	**(0.560)**	**(0.037)**	**(0.634)**	**(0.765)**
Knowledge Intensity $_{t-1}$	4.972**	5.567***	2.090	0.286***	6.125***	6.220***
	(1.879)	(1.999)	(1.345)	(0.067)	(1.375)	(1.688)
Revenues (logged) $_{t-1}$	0.739***	0.762***	0.311**	0.036***	0.772***	0.941***
	(0.212)	(0.228)	(0.135)	(0.007)	(0.145)	(0.171)
Leverage $_{t-1}$	-2.117	-3.343**	-1.239	-0.163**	-2.169*	-2.793**
	(1.558)	(1.608)	(1.191)	(0.068)	(1.159)	(1.300)
R&D leadership's total compensation	0.490	0.282	0.283	-0.012	0.066	0.092
	(0.487)	(0.508)	(0.364)	(0.022)	(0.349)	(0.455)
R&D leadership's LTI-to-total ratio	-1.859	-1.017	-0.365	-0.062	0.083	0.363
	(1.656)	(1.633)	(1.167)	(0.074)	(1.231)	(1.475)
Observations	185	185	185	139	185	185
Adjusted R-squared	0.581	0.566	0.343	0.474	0.63	0.641
Panel B: Market Pay Sensitivity						
Market Pay Sensitivity $_{t-1}$	**-1.474****	**-1.639****	**-1.058***	**-0.069****	**-0.438**	**-0.857**
	(0.633)	**(0.812)**	**(0.529)**	**(0.034)**	**(0.571)**	**(0.692)**
Knowledge Intensity $_{t-1}$	5.139***	5.754***	2.217	0.294***	6.154***	6.301***
	(1.922)	(2.050)	(1.371)	(0.068)	(1.406)	(1.729)
Revenues (logged) $_{t-1}$	0.743***	0.767***	0.315**	0.036***	0.770***	0.941***
	(0.221)	(0.238)	(0.139)	(0.007)	(0.150)	(0.176)
Leverage $_{t-1}$	-2.129	-3.361*	-1.269	-0.161**	-2.107*	-2.75**
	(1.615)	(1.685)	(1.186)	(0.071)	(1.206)	(1.361)
R&D leadership's total compensation	0.594	0.396	0.353	-0.007	0.110	0.163
	(0.486)	(0.502)	(0.360)	(0.022)	(0.367)	(0.474)
R&D leadership's LTI-to-total ratio	-1.91	-1.076	-0.414	-0.062	0.106	0.364
	(1.685)	(1.668)	(1.166)	(0.074)	(1.252)	(1.497)
Observations	185	185	185	139	185	185
Adjusted R-squared	0.571	0.557	0.338	0.463	0.623	0.633
Panel C: Internal Pay Sensitivity Minus Market Pay Sensitivity						
Internal Minus Market $_{t-1}$	**0.830****	**0.916****	**0.580****	**0.040****	**0.317**	**0.533**
	(0.331)	**(0.423)**	**(0.277)**	**(0.018)**	**(0.304)**	**(0.368)**
Knowledge Intensity $_{t-1}$	5.065**	5.670***	2.160	0.291***	6.152***	6.272***
	(1.902)	(2.025)	(1.356)	(0.068)	(1.394)	(1.711)
Revenues (logged) $_{t-1}$	0.742***	0.766***	0.314**	0.036***	0.772***	0.942***
	(0.217)	(0.233)	(0.138)	(0.007)	(0.148)	(0.174)
Leverage $_{t-1}$	-2.126	-3.354**	-1.259	-0.162**	-2.143*	-2.774**
	(1.587)	(1.646)	(1.189)	(0.070)	(1.185)	(1.334)
R&D leadership's total compensation	0.550	0.348	0.322	-0.009	0.095	0.136
	(0.486)	(0.504)	(0.362)	(0.022)	(0.358)	(0.465)
R&D leadership's LTI-to-total ratio	-1.905	-1.069	-0.406	-0.063	0.083	0.348
	(1.670)	(1.649)	(1.165)	(0.074)	(1.244)	(1.488)
Observations	185	185	185	139	185	185
Adjusted R-squared	0.576	0.561	0.341	0.469	0.626	0.637

Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry* FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Following Lerner and Wulf (2007), we control for compensation characteristics of R&D leadership. R&D leadership refers to VPs, directors, and corporate heads whose job titles include the following keywords: research, science, engineering, creative, software, project development, and design.
Significant at ***1%, **5%, and *10%.
Unit of analysis is "firm-year."
*Industry is classified according to the SIC one-digit industry classification