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Executive Compensation Inequality and Corporate Innovation

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Abstract

Compensation packages are widely used to motivate top executives to generate and sustain a constant flow of innovations. Pay structures characterized by inequality, however, trigger two antithetic effects: social comparison and individual motivation. We investigate the effect of executive pay inequality on corporate innovation activities by considering these two opposing forces, and we find that executive pay inequality acts as a double-edged sword for corporate innovation. On the one hand, inequality in variable pay significantly increases innovation; on the other hand, fixed pay inequality depresses innovation. Studying contextual variations, we find that executive pay inequality matters primarily in innovative industries.

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Keywords: top executives; pay inequality; innovation

1. Introduction

It is well established that innovation activities spur corporate success by favoring the introduction of new products and processes, generating absorptive capacity and sustaining learning (Cohen and Levinthal, 1990). Successful innovation activities are typically the result of strongly interconnected work at the apex of companies (Siegel and Hambrick, 2005), and are thus particularly sensitive to mechanisms that alter the individual propensity to share knowledge and cooperate for a common organizational goal. A managerial incentive system designed to foster organizational capabilities to innovate is crucial because top executives, who are at the summit of the organization, have a decisive influence on the allocation of resources and are ultimately positioned to create the conditions for successful innovation processes (Carpenter and Sanders, 2002).

Compensation packages are the quintessential instrument used to motivate executives. Due to uncertainty between senior management action and firm performance, financial incentives for top management tend to be loosely linked to observed firm performance, but are instead more closely aligned to innovation outcomes, especially for high-technology firms. (Balkin, Markman, Gomez-Mejia, 2000). The design of compensation schemes can indeed be tailored to increase executive commitment towards long-term projects (Manso, 2013) and better align manager and shareholder interests (Balkin, Markman, and Gomez-Mejia, 2000; Lerner and Wulf, 2007).

One central aspect of a firm’s compensation package is pay inequality within its top executive team. However, the empirical evidence on the corporate implications of such inequality is ambiguous: extant works show that pay inequality at the apex of companies can both hurt (Carpenter and Sanders, 2004; Fredrickson, David-Blake, and Sanders, 2010; Siegel and Hambrick, 2005) and improve business outcomes (Kale, Reis, and Venkateswaran, 2009). To resolve this long-debated division (Bloom, 1999), recent works (e.g. Shaw, Gupta, and Delery, 2002; Trevor, Reilly, and Gerhart, 2012) pinpoint the importance of integrating tournament and behavioral theories as "the theoretical background for arguing for either a positive or a negative relationship between pay disparity and firm performance may not have yet been addressed in full" (Ridge, Aime, and White, 2015, p: 619). However, extant research has exclusively focused on the relationship between pay inequality and corporate performance, mostly measured in terms of accounting and stock market returns, and has delivered mixed evidence. We add to this literature by investigating how the configuration of pay dispersion (with its fixed and variable components) within a firm's top executive team influences corporate innovation – a crucial driver of corporate success, whose sensitivity to pay structure remains underexplored to date.

We study the nexus between pay inequality and innovation with a parsimonious theoretical model containing references to both the configuration of pay elements (Trevor et al., 2012) and their degree of legitimization or normative acceptance (Shaw et al., 2002). The main idea is that the distribution of executive rewards through pay inequality impacts on innovation by means of two antithetic effects: i) incentives to organizational commitment and effort provision, when inequality is likely to be perceived as legitimate and accepted; and ii) obstacles to cooperation and knowledge sharing, increment in conflict and thus harmful consequences for business goals requiring intense and coordinated work effort such as innovation, when there is a weak legitimization of such pay dispersion.

Borrowing from further observations about how pay contingency impacts on individuals' performance and commitment (Pazy and Ganzach, 2009), we explicitly take into consideration, both theoretically and empirically, whether or not pay is tied to effort by explicitly differentiating between fixed or variable pay elements. To the best of our knowledge, this is the first attempt to integrate the two conflicting views and effects of pay disparity by using the fixed and variable components of pay packages. Building on Shaw et al. (2002), we posit that high inequality in *variable* executive pay (i.e. pay closely attributable to individual effort and incentives) would be *favorably* perceived as justified, thereby representing the trait of an organization promoting competency and merit, and would thus positively impact innovation. By contrast, high inequality in *fixed* executive pay is likely to trigger the *negative* effects of social comparisons and ultimately become detrimental for firm innovative outcomes: being detached from individual contributions, a high fixed pay inequality is likely to be perceived as inequitable and therefore unlikely to be considered a legitimate or normatively accepted.

We conduct the empirical analysis using a panel of US listed firms for the period 1992-2006. Following a consolidated approach in the innovation literature (e.g. Griliches, 1990; Hall, Jaffe, and Trajtenberg, 2001, 2005), we measure innovation activities using patent metrics. Consistent with our hypotheses, our results indicate that *fixed* and *variable* executive pay inequalities have statistically significant effects of opposite sign on patenting activities: higher inequality in fixed executive pay leads to worse innovation outcomes (i.e. fewer granted patents and less forward citations), whereas higher inequality in variable executive pay leads to more innovation. Moreover, we find that these two effects interact in shaping corporate innovation: the negative innovation effect of fixed pay inequality is weaker if the inequality in variable pay is large (and *vice versa*). Finally, we highlight the importance of the context by showing that pay inequalities are particularly crucial for firms operating in R&D-intensive industries.

Our paper contributes to various streams of research. First, we relate to a growing literature about the determinants of firms' innovative ability by extending recent insights on executive compensation schemes (e.g. Bebchuk, Cremers, and Peyer, 2011; Manso, 2011; Kale et al., 2009). For instance, Ederer and Manso (2013) find that an ideal compensation package should provide a combination of tolerance for early failure and reward for long-term success. We contribute to this debate by expanding the research that goes beyond the analysis of compensation for given executives considered in isolation (e.g. Carpenter and Sanders, 2002), and thus providing, to the best of our knowledge, the first investigation on the complex relationships between corporate innovation and configurations of executive pay inequality. As such, our work also complements recent studies (e.g., Lim, 2015) that emphasize the importance of *relative* CEO compensation from a temporal perspective (i.e., negative or positive deviations from past CEO compensation) for a firm's innovation expenditures.

Second, our study contributes to the debate (Ridge et al. 2015; Shaw et al. 2002; Trevor et al. 2012) seeking to reconcile the literature on the "bright side" of executive pay inequality, which suggests that, via tournament incentives, compensation inequality can be a powerful device to motivate managers (e.g. Kale et al., 2009), with that on the "dark side" of pay inequality, which delineates negative corporate consequences due to problems arising from social comparisons (e.g. Carpenter and Sanders, 2004; Fredrickson et al., 2010) and poor corporate governance (e.g. Bebchuk et al., 2011). Our contribution to this literature is to theoretically and empirically demonstrate that these positive and negative effects may co-exist within the context of corporate innovation, which is especially interesting given its high sensitivity to the quality and interdependence of managerial service. Additionally, we contribute to existing studies by considering the variable and fixed components of the executive pay and isolating the specific effects that each of these components have on corporate innovation. In this way, we significantly extend Yanadori and Cui (2013), who explore the innovation implications of pay inequality among R&D workers, as well Sharma (2011), who focuses on top executives but does not conceptualize and empirically disentangle the antithetic innovation effects of inequality in variable and fixed pay items.

2. Theory and Hypotheses

2.1. Executive compensation: Incentive and Social comparison

Although there is an agreement on the idea that executive compensation inequality does shape executive actions and corporate outcomes (e.g. Carpenter and Sanders, 2002), the theoretical and empirical views on the direction of such impact are conflicting. On the one hand, existing studies have explained how pay inequality can be leveraged to serve as effective incentivizing devices. In this perspective, tournament incentive systems consist of compensation structure configurations that by means of pay inequalities induce motivation for managers and workers (Lazear, 1988). Following this view, it has been shown that pay increases with hierarchical level and in order to strengthen the motivation effect of such tournaments, the prize for the winner of the CEO tournament is proportional to the number of participants (Bognanno, 2001). Other empirical studies show that higher executive pay inequality (measured with the pay differential between the CEO and the other board members) is a key feature of tournament systems, which have a strong incentivizing effect and relate positively to firm performance (Kale et al., 2009). Further, the incentives structures in the form of tournament have repercussions to the broader activities of the firms as a whole. For instance, greater tournament incentives are likely to promote riskier corporate policies and increase the level of R&D investment and leverage (Kini and Williams, 2012), findings that suggest how pay inequality among executives increases managerial effort and risk-taking in valuable business activities.

In parallel, adopting an agency perspective, Bebchuk et al. (2011) illustrate a negative relationship between the share of total executive pay captured by the CEO (her/his "pay slice") and firm performance, likely as a result of managerial entrenchment. Moreover, dating back to Festinger (1954), social comparison theory suggests that individuals evaluate their own characteristics with reference to peers with whom they share similar traits, occupations etc. (Nickerson and Zenger 2008). Recent studies (e.g. Carpenter and Sanders, 2004; Ridge et al., 2015) have adopted this framework to understand how pay inequality within executive teams can affect work relationships among the various executives and ultimately the functioning of the whole team itself. Specifically, it has been suggested (e.g. Fredrickson et al., 2010) that earning a much lower pay than given peers can trigger negative feelings of inequity, dampen effort provision and motivation, reduce satisfaction and organizational commitment (Trevor and Wazeter, 2006), create obstacles to cooperation (Pfeffer and Langton, 1993) and knowledge sharing (Siegel and Hambrick, 2005), thereby undermining individual productivity (Cohn, Fehr, Herrmann, and Schneider, 2014) and the whole effectiveness of decision-making processes. As Trevor et al. (2012) point out, many of these conflicting results can be ascribed to one particular shortcoming in the main theoretical framework adopted to study the pay inequality-firm performance relationship: the implicit connection between unequal pay allocation and its potentially perceived inequity. Indeed, unequal pay allocation does not necessarily imply inequity, and may even be perceived as equitable if the pay is tied to productive contributions of useful inputs (Shaw et al., 2002).

Building on these considerations, we argue that the two competing effects related to pay inequality can be disentangled by considering the multi-faceted nature of executive pay. In particular, by jointly examining the unexplored combination of the *levels* of pay inequality (i.e. the ratio of compensation for the highest and the lowest paid executive) and the *forms* of executive pay (i.e. the fixed and variable components) it is possible to predict when pay inequality is likely to be associated with desirable firm outcomes.

With a framework that integrates the different degrees to which executive pay is considered as legitimate and accepted, we are able to pinpoint the two antithetic effects arising from the inequality in executive rewards: i) incentivizing device; ii) determinant of social comparison.

To this end, following Shaw et al. (2002) we consider that *variable* pay – in addition to firm-specific factors such as company size common to all executives and that we empirically account for – is a widely used and highly legitimate reward system that links the compensation of executives to their work contributions and productivity. In contrast, *fixed* pay components are often designed based on certain criteria that do not necessarily directly reflect individuals' current productivity and may to some extent be attributed to factors such as favoritism, politics, or even randomness.

We argue that the psychological costs of executive pay inequality arising from social comparisons would be especially prevalent for larger *fixed* pay gaps, i.e. remuneration not strongly or directly tied to performance, and therefore more likely to be perceived as non-legitimate or normatively accepted. Indeed, in this fixed-pay contingency, low-pay non-CEO executives would be more prone to perceive a high CEO fixed pay as unfair and undeserved, legitimized by political power and status rather than individual effort (Finkelstein, 1992; Shaw et al., 2002; Trevor et al. 2012). This effect has been isolated through randomized control trials showing the negative "morale" effect of pay dispersion: Breza, Kaur and Shamdasani (2015) find that the degree to which pay is perceived as justified by workers mediates the negative effects of pay dispersion on effort provision (the more pay is perceived as justified, the less the negative morale effect).

On the contrary, we expect that high pay variability justified by subjective contributions to broader organizational goals would entail inequality, which is not expected *per se* to produce negative corporate outcomes given its high degree of legitimization and acceptance. Instead, failure to reward executives based on their productivity-related inputs would constitute inequity, and the legitimization of such pay schemes is likely to be low (Trevor et al., 2012, Shaw et al., 2002). To serve as an effective motivating device, executive pay should not be independent of performance (Bebchuk and Fried, 2003, Gomez-Mejia and Wiseman, 1997). Moreover, recent intriguing evidence shows that in order to effectively serve as motivation for innovation activities, compensation schemes should combine some fixed components (to offer a protection from early failure and reward for long-run success), with variable or pay-per-performance components (needed to encourage an exploratory behavior) (Ederer and Manso, 2013). These insights provide further support to our choice of focusing on the *fixed* and *variable* dimension of executive pay.

2.2 Executive Pay Inequality, Inequity, and Firm Innovation

The decisions process related to innovative activities on behalf of top management teams can be viewed as a combination and synthesis of different paradoxical cognitions (Smith and Tushman, 2005). Without such cognitive conflicts – i.e. conflict among different point of views – the quality of the decisions suffers (Amason, 1996). A form of cognitive conflict is therefore a cornerstone element for the well-functioning of executives' decision process. However, under the circumstances of high variability in fixed pay (which is more likely to be perceived as non-justified and inequitable) we expect the conflict to be more likely of the form of *affective conflict*, which is "emotional and focused on personal incompatibilities and disputes" (Amason, 1996 p:129), and therefore dysfunctional to the quality of decisions concerning innovation. Affective conflict is likely to negatively impact complex decisions such as innovation and R&D investment. Furthermore, higher fixed pay inequality is likely to obstacle a fluid flow of information within the top executives (West and Anderson, 1996, Henderson Frederickson 2001), a contingency particularly negative for innovation since information sharing is crucial (Siegel and Hambrick, 2005). Sharing of information is particularly important for innovative activities, because the right understanding of complex projects such as R&D investments is crucial to generate successful investments. In sum, we argue that inequality in fixed pay is likely to be perceived as inequitable, which in turn would imply the weakening of any of the positive effects of pay on motivation and effort provision: lower-paid executives cannot directly fill the fixed-pay gap relative to the higher-paid colleagues by working harder. They are less likely to engage in tasks requiring coordination, and to share resources and knowledge. Affective conflicts and obstacles to information sharing will be more likely to occur, thereby significantly impacting innovation, with an overall detrimental effect for the firm.

Our first hypothesis is:

Hypothesis 1a. *Greater inequality in fixed executive pay is negatively associated with innovation*.

Due to its contingency upon individual task performance (especially in the case of individual bonuses), inequality in variable pay is less likely to be perceived as inequitable or non-legitimate, and instead would tend to be justified by differences in individual work effort or objective success (Cohn et al., 2014). We contend that compensation inequality in the form of variable pay would result in strong incentive provision to exert effort. Observing peers receiving higher compensation in terms of variable pay would spur lower-paid executives' commitment and effort provision in order to secure similar compensation packages and rewards, and thus fill the pay gap with higher-paid colleagues. In other words, inequality in monetary compensation tied to individual inputs would incentivize greater effort, since agents do not perceive that their effort will be unrewarded (Sheppard, 1993 and references therein, Breza, Kaur and Shamdasani, 2015). In connection to innovation-related activities, i.e. under circumstances characterized by higher profit uncertainty, learning by doing generates a positive relation between profitability uncertainty and incentives: "greater effort, induced by high-powered incentives, leads to more informative signals about uncertain project profitability, improving the firm's future investment decisions" (He, Li, Wei, and Yu, 2014). Higher level of effort are thus likely to positively impact firms' innovative output.

Perceived justice (i.e. equitable distribution but not necessarily equal) regarding the pay structure has a strong impact on the dynamics of team interactions. Breugst, Pazelt and Rathgeber (2014) show that when team members perceive high distributional justice they are likely to experience the feeling of belonging to a strong entity, and the dynamics associated to the dissolution of teams decrease substantially (Breugst, Pazelt and Rathgeber, 2014). High gaps in variable pay are likely to be perceived as accepted and just and thus foster a virtuous circle for top executive team dynamics: decrease the emergence of affective conflict and improve the quality of top managers' decisions including innovation. Further, team cohesion improves the flow of information and ultimately results in better evaluation of decisions regarding innovation. Overall, we expect that the incentivizing effects of variable pay inequality will promote managerial effort, high quality learning, and desirable team dynamics, which would ultimately result in greater innovation output. Combining these arguments, we posit that:

Hypothesis 1b. *Greater inequality in variable executive pay is positively associated with innovation.*

2.2. Interaction between Pay Inequality Gaps

The previous hypotheses concern variable and fixed pay inequalities separately considered. Yet, the two types of pay inequality can well co-exist within a given top executive team, and such co-existence may enact a concurrence of effects. To account for such concurrent effects, we investigate how fixed and variable executive pay inequalities interact in shaping corporate innovativeness.

In an attempt to theoretically integrate tournament research with social comparison theories (Ridge, Hill, and Aime, 2014; Ridge et al., 2015; Shaw et al., 2002), the existing literature suggests that when tournament participants make social comparisons the "perceived unfairness and increased political behavior" tends to harm incentives to increase productivity (Connelly et al., 2014). Building on this idea, we suggest that variable pay inequalities can alter the influence of fixed pay inequality on innovation. First, the use of variable pay (i.e. legitimate reward systems) is likely to produce positive spillovers on the degree of legitimization of fixed pay inequality thereby rendering the perception of fixed pay as less inequitable. Second, the use of variable pay creates stronger incentives for executive teams to achieve an effective level of coordination and knowledge sharing in order to perform well in such an interdependent task as innovation effort (Shaw et al., 2002).

We conjecture that the negative innovation incentives stemming from high inequality in fixed pay are weaker in contexts simultaneously characterized by high variable-pay inequality. In other words, high inequality in variable executive salary could diminish or even nullify the negative effects triggered by inequality in fixed pay.[1]

Combining these arguments, we posit that:

Hypothesis 2. *Greater inequality in variable compensation reduces the negative effect of fixed pay inequality on innovation.*

2.3. Industry Context

We proceed by studying the importance of the innovative context. Organizational scholars (e.g. Bloom and Michel, 2002) have long noted that the effect of pay inequality on firms is context-dependent. Specifically, innovative contexts are high effort-based and require organizations to adopt and implement effective incentive mechanisms (Manso, 2013).

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[1] For this argument it is important that the two inequality dimensions do not display a high positive correlation, which would make us unable to capture the contrasting effects. We will check empirically that this is indeed not the case.

Towards this goal, several exiting works (e.g. Balkin et al., 2000; Yanadori and Marler, 2006) document that firms operating in R&D-intensive industries, for which innovation output is a key factor of success, rely heavily on compensation to motivate their managers to produce a steady stream of innovations. Moreover, successful innovation requires organizational commitment, collaboration and knowledge sharing among key employees (Yanadori and Cui, 2013). Siegel and Hambrick (2005) confirm this notion by discussing how task interdependence is higher in tech-intensive industries due to larger information processing requirements and higher frequency of information exchanges and mutual adjustments among executives.

Drawing on these arguments, we ascertain that executive pay inequality should have more pronounced effects on innovation efforts if the company operates in innovative contexts (as compared to low-innovation contexts):

Hypothesis 3. *The effects of fixed and variable executive pay gap on corporate innovation are stronger for firms operating in innovation-intensive industries.*

3. Data and methods

3.1. Sample

Our sample comes from three different reliable data sources widely used in previous empirical research. We gather patent data from the National Bureau of Economic Research (NBER) patent dataset. The NBER patent dataset is a comprehensive source of information for all patents granted by the US Patent and Trademark Office (USPTO) and all citations made to these patents starting from 1976 and up to 2006 (Hall et al., 2001).

Executive compensation data come from the Standard&Poors' Execucomp database, which contains information on the top executives of a large set of US listed companies. Specifically, Execucomp provides, for all the 5-top executives of a given firm (though a few firms report data for more than 5), data on the various items forming executive pay packages as well as a few demographic characteristics such as executive age and tenure in the company. This approach is consistent with many existing works (e.g., Fredrickson et al., 2010), which have studied the importance of social comparisons among members of the CEO's top team.

Finally, firm-level accounting data come from the Compustat dataset, which we merge with the NBER patent dataset following the procedure described in Bessen (2009). We select a time-period spanning from 1992 (i.e. the first year available in the Execucomp dataset) through 2006 (i.e. the last year for which we have citation data from the NBER patent dataset).

3.2. Dependent Variables

Consistent with the innovation literature, we construct two measures of innovation that will be used as dependent variables. The first, *patent counts*, is the raw number of patents granted to a firm in a given year. Given the typical average lag between application and granting years, we follow the literature (e.g., Hall et al., 2005) and date patent counts at the time of the patent application, which better reflects the actual time of innovation. While this variable measures the raw output of a firm's innovation effort, it is well known that patents vary greatly in their economic and technological importance. To better account for these differences, we again follow the existing literature (e.g. Hall et al., 2005) and adopt the number of forward citations received by a firm's patents (*citation counts*), which offer a precise and reliable proxy for the economic and technological importance of patents (Jaffe, Fogarty, and Trajtenberg, 2000;

Hall et al., 2005). Consistent with the literature, we mitigate the usual problem of truncation (i.e. that patents filed at a later stage have less time to be cited) by adjusting citations using the weights provided by the NBER. Summary statistics for the innovation variables are reported in the upper part of Table 1.

[[INSERT Table 1 about Here]]

3.3. Independent Variables

We proceed by constructing the key measures of executive compensation inequality. To this end, in accordance with existing works (e.g. Connelly et al., 2013), we start by collecting data on the various items of executive compensation packages, such as base salary, cash bonuses, restricted stock granted, the Black-Scholes value of stock options granted, and other long-term incentive payouts.

We then distinguish between fixed and variable pay items. As measure of fixed compensation we use the base fixed salary (Cohen, Dey, and Lys, 2012), which is usually specified in the employment contract and remains constant over a period of time. In order to quantify the variable amount of executive pay, we take the sum of cash bonuses (typically representing a variable compensation on an annual basis), restricted stock granted and Black-Scholes value of stock options granted (reflecting the long-run component of variable pay). Both of these measures are in line with the literature on CEO incentives (e.g. Bergstresser and Philippon, 2006; Cohen et al., 2012). One concern of including stock options in the variable pay is that, contrary to our theory, stock options might not necessarily relate to past effort and individual performance but could be intended instead as motivational tools to engage executives to perform well in the future, being driven by company results rather than individual-level performance. To avoid this potential concern, we conduct additional analyses where variable pay is only measured with cash-based bonuses, a pay component more directly linked to individual-level performance.

Next, we measure the inequality in fixed and variable pay. Extant empirical research is fragmented and no clear consensus exists on how to measure pay inequality. We operationalize pay inequality by means of a ratio, which is consistent with prior works. For instance, Connelly et al. (2013), who adopt the ratio of TMT pay to average worker pay in their study of pay inequality and firm performance, suggest that ratios are useful to measure "multidimensional constructs in which variations in one variable are theoretically meaningful with reference to variations in the other" and that "pay dispersion is operationalized as theoretically prescribed ratio" (pg. 10-11).

Following these indications, we take the ratio between the compensation of the executive with the highest pay and the compensation of the executive with the lowest pay as reported in Execucomp.[2] In order to separate out the effect of inequality in fixed and variable pay components, we then compute three versions of this ratio, i.e. based on (1) total compensation (*total compensation gap*); (2) fixed compensation only (*fixed compensation gap*); and (3) variable compensation only (*variable compensation gap*). Given the presence of a few extreme values, possibly outliers due to e.g. temporary executive appointments, we trim observations in the bottom/top 0.5% of the distribution of each ratio.

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[2] We verify the robustness to the use of an alternative operationalization: rather than scaling the pay items of the highest-paid executive by the items of the lower-paid executive, we scale by the compensation in the bottom quartile of the pay distribution. Notice that we do not use the Gini index to avoid potential biases arising from the limited number of executives (Deltas, 2003).

Our measure has several appealing features. First, it accounts for the structure of the whole executive team (not just the CEO or CFO) thereby mirroring also the pay strategies applicable to R&D managers (Balkin et al., 2000). Second, data on the composition of pay packages allow us to directly and precisely account for the different structure of incentives in place. Third, our ratio draws on accurate and reliable data, it does not need any arbitrary algebraic transformation, and it has an intuitive interpretation: it takes value of 1 if the highest and the lowest executive pay are the same, whereas values above 1 indicate the degree to which the compensation of the most paid executive exceeds the one of the executive with lowest pay. Fourth, our measure is constructed using information on the pay of key decision-makers with crucial influence on the business (and thus on innovation policies). To be more precise on this point, we fine-tune the computation of the ratio exploiting the information on the job title of each executive. To this end, we conduct a textual analysis of each reported job title and for each firm identify the executive manager explicitly and formally responsible for innovation activities. Specifically, we identify executives explicitly involved in innovation activities by searching within each job title the following words: *Technology*, *Technological*, *R&D*, *Research*, *Innovation*, *Innovative*, *Product*, *Knowledge*, *Science*, *Scientist*, *Scientific*, and *Laboratory*. Then, in an additional test we employ the ratio between the pay of the highest paid executive and the pay of the executive in charge of innovation activities. This is to ensure that we capture unambiguously the effect of pay dispersion on firm innovation. Moreover, this ratio explicitly incorporates the effort of the executive responsible for innovation activities, which we argue to be shaped by pay dispersion configurations.

After dropping observations with missing data in the key dependent and explanatory variables, we obtain a sample of 1,137 unique firms for 6,176 firm-year observations.

Summary statistics are presented in Table 2, which reports the inequality ratio in terms of total pay, as well as separately for fixed and variable items.

[[INSERT Table 2 about Here]]

The bottom part of the table presents the correlations between the three ratios, showing a positive correlation between the total compensation gap and its specific components, but also a positive correlation between fixed and variable compensation gaps. However, the correlation is relatively low and does not raise concerns of multicollinearity.

3.4. Control Variables

We construct a number of variables that will be included as controls in the regression models. Consistent with the literature on patents (e.g. Galasso and Simcoe, 2011), we start with taking the logarithm of firm revenues (*Ln Sales*), and the logarithm of the capital to labor ratio (*Capital to labor*), computed as property, plants and equipment divided by employees. We also construct the logarithm of firm age (*Ln Firm age*), proxied by the number of years a firm has been in Compustat, to control for differences in the stage of development across firms.

As written above, Execucomp covers the 5 highest-paid executives, but a few firms report compensation for a few more executives. We are aware that the number of executives for which the company reports compensation data can affect the values of the inequality ratio. For instance, the ratio could take a lower value for a firm that reports compensation only for the CEO and the CFO (usually the executives with the highest pay), as compared to a firm that reports compensation for several more executives (thus including the low-end of the pay distribution). In the empirical analysis, we explicitly account for this potential problem by controlling for the number of executives used to compute the inequality ratios (*Ln number* *executives*). Finally, we construct two variables at the CEO level that may correlate with both compensation structures and innovation, and thus confound our results. These are the logarithm of CEO age (*Ln CEO age)* and the logarithm of the years the CEO has worked in the firm (*Ln CEO experience*). Summary statistics are presented in the bottom part of Table 1.

3.5. Empirical Model

Our goal is to estimate the effect of executive compensation inequality on a firm's innovation activities. To this end, we follow the literature (e.g. Hausman et al., 1984) and assume that the expected number of patents is an exponential function of the explanatory variables $\mathbf{X}_{it}$. More specifically, we estimate a Poisson model with conditional mean:

$$E[Y_{it}|\mathbf{X}_{it}] = \exp(\delta + \beta \text{Compensation gap}_{it} + \gamma'\mathbf{Z}_{it} + \alpha_i + \alpha_t)$$

in which the dependent variable is, alternatively, the raw patent count or the count of truncation-adjusted patent cites for a firm *i* at times *t*. Consistent with existing works that have documented a relatively short lag between innovative investments and patenting (e.g. Hall, Griliches, and Hausman, 1986), we use current values (i.e. dated at time *t*) of both dependent and explanatory variables. However, we will show that our results hold using lagged rather than current explanatory variables.

The key explanatory variables included in the $\mathbf{X}_{it}$ vector are the compensation gaps of firm *i* at times *t*.[3] The vector $\mathbf{X}_{it}$ further includes a host of controls to mitigate the concern of omitted factor bias, as well as α_i and α_t that represent, respectively, firm fixed effects, used to

[3] Notice that here we include the fixed and variable compensation gaps in the same model. In robustness checks, we verify that our findings hold if the two variables are separately included.

absorb firm-specific and time-invariant heterogeneity, and year dummies, which absorb overall trends in innovation.

Following existing works based on innovation counts (e.g. Amore, Schneider, and Zaldokas, 2013; Czarnitzki, Hussinger, and Schneider, 2011; Simcoe, Graham, and Feldman, 2009), we estimate the model using the Quasi-Maximum-Likelihood (QMLE) method, which has the advantage of providing consistent estimates as long as the conditional mean is correctly specified even if the true underlying distribution is not Poisson. Standard errors are clustered at the firm level, which is deemed appropriate since it accounts for heteroskedasticity and serial autocorrelation (common with panel data); yet, in untabulated checks we have validated our results using industry or state-level clustering, as well as estimating the model with a negative binomial regression.

4. Findings

In this section, we empirically test our first hypotheses on the relationship between executive pay inequality and patent outcomes. We then conduct a number of checks to accommodate various empirical concerns. Finally, we test our hypothesis on the interaction between fixed and variable pay inequalities, and on the importance of the innovative context.

4.1. Main Results

Table 3 presents the results using the total compensation gap as main explanatory variable[4], together with firm- and CEO-level characteristics. As shown, the coefficient related to total compensation inequality is only marginally significant in Column 1 (0.025; $p<0.1$), and it does not display any statistical significance in Column 2 (0.025; $p>0.1$).

[[INSERT Table 3 about Here]]

Consistent with our theory, we argue that the inequality measured by using total compensation masks the two opposite effects coming from its variable and fixed components, ultimately resulting in this lack of significance. We tease out the two opposite effects in Table 4, Columns 1 and 2, which include the fixed and variable pay inequality ratios as separate explanatory variables. As expected, the two coefficients in Column (1) are statistically significant at the 5% and 1% level and display opposite signs: a greater inequality in fixed compensation has a negative effect on patent counts (-0.043; $p<0.05$), whereas a greater inequality in variable compensation has a positive effect (0.0003; $p<0.01$). These findings hold true even considering patent cites instead of patent counts as dependent variable (Column 2). Hypotheses 1a and 1b are thus fully confirmed.

[[INSERT Table 4 about Here]]

We validate this result in two ways. First, we use an alternative operationalization of the key inequality variables, by computing the ratio of the highest executive pay to the pay of executive specifically involved in the innovation activities (see Section 3.3. for details on the

[4] This and the subsequent tables include fewer than the 6,176 observations mentioned in the data section because the fixed effects estimator excludes firms with only one observation in the sample period and firms that display all zeros in the dependent variable.

classification). This approach increases the consistency with our theoretical framework since it restricts the analysis to lower-paid executives that undertake activities directly related to the dependent variable of interest (i.e. patent counts and citation counts). Results, reported in Columns (3) and (4), show significant effects fully consistent with our previous arguments. Interestingly, the coefficients are economically larger, possibly owing to the fact that the restriction to innovation executives magnifies the effect of pay inequalities on innovation.

We proceed by showing results obtained excluding stock options from the computation of the variable inequality ratio, which may be contaminated by stock price fluctuations and thus only indirectly reflect individual effort provision. Results, reported in Columns (5) and (6) display again coefficients strongly in line with our main hypotheses.

In Appendix A, we further confirm our main result with an extensive set of robustness checks. For instance, we show that our results are largely unaffected by outliers, that they hold controlling for a broader set of explanatory variables, that they are not influenced by sample composition concerns, and that simultaneity concerns do not bias significantly our results.

4.3. Interaction Effects

We proceed by testing the interaction effect between inequality in fixed and variable pay components. Our hypothesis was that the negatives of social comparisons arising from high inequality in fixed compensation would offset the positives of high inequality in variable compensation arising from tournament incentives.

We test this hypothesis in Table 5, in which we augment the model of Table 4, with the interaction between fixed and variable inequality ratios (*Variable×Fixed gaps*). To ensure comparability in the coefficients, we *z*-score each ratio prior to computing the interaction term. Results indicate that the interaction coefficient is positive and statistically significant (0.008; $p<0.06$). Supporting hypothesis 2, this result indicates that the negative innovation effect of fixed executive pay inequality is mitigated by the inequality in variable pay.

[[INSERT Table 5 about Here]]

Due to difficulties in interpreting interaction effects in nonlinear models, we also conducted an analysis using subsamples. Specifically, we divided the sample around the median fixed compensation and estimated the effect of variable pay inequality for firms with high/low inequality in fixed pay. Again in line with our arguments, results (untabulated for brevity) suggests that variable compensation inequality has a positive and 10% significant effect on patent outcomes when fixed pay inequality is low, whereas the effect becomes statistically insignificant when fixed pay inequality is high.

4.4. Innovative vs. Non-Innovative Contexts

Next, we establish the importance of the innovative context for our result. Drawing on Balkin et al. (2000), we hypothesized a close relationship between executive pay variables and innovative outcomes primarily in intensive R&D activities, i.e. the context in which the motivating influence of compensation to engage in innovative activities is most pronounced. To this end, we exploit industry variations in R&D intensity (i.e. the year average ratio of R&D to sales for each 3-digit SIC code), and estimate our model separately for firms operating in high and low R&D-intensity industries.

Results in Table 6 confirm our hypothesis on the importance of the innovative context. The coefficients of the two inequality ratios are strongly statistically significant in the subsample of firms operating in R&D intensive industries, whereas they become marginally significant or insignificant in industries with low R&D intensity. This result is robust to identifying high-technology industries as in Lim (2015), i.e. by isolating those SIC codes referred to high-tech manufacturing, high-tech services (such as communication), and computer-related services.

[[INSERT Table 6 about Here]]

5. Discussion

Following recent calls for multi-industry studies to better understand the relationship between intra-firm pay inequality and corporate success (Trevor et al., 2012; Connelly et al., 2013; Ridge et al., 2015), we investigate the nexus between executive pay inequality and corporate innovation. We concentrate on a firm's technological innovativeness as outcome, given its high sensitivity to executives' coordination and effort provision, as well as given its importance for corporate success.

We contend that executive pay inequality acts as a double-edged sword for innovation activities: on the one hand, it can promote effort provision, coordination and good team dynamics among top executives involved in innovation activities (e.g. Kale et al., 2009); on the other hand, it can promote affective conflicts and make executives unwilling to exert effort, share knowledge and cooperate (e.g. Carpenter and Sanders, 2004; Fredrickson et al., 2010) thus harming innovation.

While the literature has long argued that social comparison and tournaments can be important theories to explain CEO compensation levels (O'Reilly III, Main, and Crystal, 1988), strategy scholars have only recently begun to integrate these theories in attempting to explain the effect of pay inequality on firm outcomes (Shaw et al., 2002, Trevor et al., 2012, Ridge et al., 2015). Drawing on recent works on the importance of pay contingency (Pazy and Ganzach, 2009), we posit that whether the negatives or the positives of executive pay inequality on innovation prevail would depend on the form of executive compensation inequality, i.e. fixed or variable pay. In line with Trevor et al. (2012), we contend that inequality in variable pay – being designed to respond to individual effort (Shaw et al., 2002, Suchman, 1995) – is likely to be perceived as equitable and thus represent an effective means to spur work effort provision and organizational commitment, coordination and learning as lower-paid executives try to fill the pay gap with higher-paid peers; this, in turn, will result in higher innovative outcomes. By contrast, a pronounced inequality in fixed pay is more likely to foster the negative effects of social comparisons because increased effort will not directly affect fixed pay. Executives would be more likely to engage in affective conflicts, feel discouraged and suffer by social comparison when receiving a lower pay not tied to individual performance. Any attempt to exert higher effort would not result in higher compensation aimed directly at filling this gap, which would also imply unwillingness to coordinate and share knowledge with each other; in combination, this will harm a firm's innovative performance.

Consistent with the hypotheses we set forth, our empirical investigation of US firms' patenting activities confirms that executive pay inequality does lead to antithetic effects on firm innovation: high inequality in fixed compensation is associated with fewer patents and of lower quality (as measured by forward citations), whereas high inequality in variable compensation is associated with higher number of patents and of better quality.

Documenting these associations helps reconcile the opposite existing views on executive compensation inequality and business outcomes. Our study connects the two main research streams on pay inequality and documents their simultaneous validity in the context of corporate innovation. These two views have separately proposed that: i) social comparisons can demotivate executives and thus lead to worse firm performance, and ii) that executive compensation schemes are effective means to trigger the right managerial actions needed to foster shareholder value-increasing actions.

Empirically, this literature has analyzed the general inequality between executives and its effect on corporate performance (e.g. Shaw et al., 2002, Trevor et al., 2012 and Ridge et al., 2015). Our contribution to this literature is threefold. First, we study the effects of pay inequality on corporate innovation outcomes, which may represent an important channel behind the inequality-performance relationship documented in previous studies. Second, we operationalize the distinction between fixed and variable pay in connection with the inequalities for pay at the executive level, and show that interdependent innovation work does not necessarily suffer from high pay dispersion. Finally, we go beyond the analysis of executives generically considered and show that our results are magnified when the consistency between job titles and corporate outcomes is greater.

Digging deeper into the relationships between executive pay inequality and firm innovation, we hypothesize that the adverse innovation effect of fixed pay inequality should counteract the positive effect triggered by inequality in variable pay. In contrast, the negative innovation effect of inequality in fixed pay should be weaker if the inequality in variable compensation is large. Our empirical results are thus fully consistent with the notion that different pay inequalities interact in shaping a firm's innovativeness. Finally, studying the importance of the innovative context, we document that the innovation effect of executive pay inequalities is particularly important for firms operating in industries where R&D

expenditures are more intensive, i.e. where the incentive mechanisms to engage in innovation are more crucial for corporate success.

Our study has important implications for practitioners. To the extent that our findings are driven by a firm's optimal compensation choices, they suggest that large fixed executive pay inequalities can be applied in low-tech contexts, whereas large variable pay inequalities are best suited for innovative firms. Moreover, our results strongly suggest that executive compensation schemes and corporate outcomes should be examined by considering the importance of *relative* and not just *absolute* compensation levels (e.g. Carpenter and Sanders, 2002; 2004). Going beyond the analysis of pay for the CEO him/herself, we highlight the importance of relative pay across the entire structure of executive teams, and propose that relative pay effects are especially important given that innovation activities require cooperation and knowledge sharing between a firm's key decision makers, especially when they are directly involved in the innovation process. As such, our work expands recent works (Lim, 2015) that have focused on relative compensation levels from a temporal viewpoint (i.e. current CEO compensation compared to previous year values). Finally, our study suggest that it is crucial to pay special attention to the specific forms of remuneration, again not just in isolation but also in relative terms, towards the difficult task of motivating executives and spur corporate innovation activities.

Our study is not without limitations, which we acknowledge before concluding. The first has to do with the causal interpretation of our results. Although we have carried out a comprehensive host of robustness tests and produced evidence consistent with a causal interpretation from pay inequality to innovation, we cannot rule out that some unobserved factor could bias our results. The second limitation, which is also a promising avenue for future research, relates to the fact that we have not considered how executive pay inequality interacts with internal corporate governance mechanisms (e.g. board oversight) in shaping innovative outcomes. Future studies could introduce corporate governance moderators, as well as explore executive team dynamics with finer micro-level data. Finally, we acknowledge that our study adopts patent data, which have a number of well-known advantages over accounting-based items such as R&D expenses, but are certainly imperfect measures of innovation.

References

Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of management journal*, *39*(1), 123-148.

Amore, M.D., Schneider, C., and Zaldokas, A. 2013. Credit supply and corporate innovation. *Journal of Financial Economics*, 109: 835-855.

Balkin, D.B., Markman, G.D., and Gomez-Mejia, L. 2000. Is CEO pay in high-technology firms related to innovation? *Academy of Management Journal*, 43: 1118-1129.

Bebchuk, L.A. and Fried, J.M., 2003. Executive compensation as an agency problem. *Journal of Economic Perspectives* 17, 71–92.

Bebchuk, L., Cremers, M., and Peyer, U. 2011. The CEO pay slice. *Journal of Financial Economics*: 102: 199-221.

Bergstresser, D. and Philippon, T. 2006. CEO incentives and earnings management. *Journal of Financial Economics*, 80: 511-529.

Bessen, J. (2009) NBER PDP project user documentation: Matching patent data to Compustat firms. Available at: http://www.nber.org/~jbessen/matchdoc.pdf

Bloom, M.D. 1999. The performance effects of pay dispersion on individuals and organizations. *Academy of Management Journal*, 42: 25-40.

Bloom, M.D. and Michel, J.G. 2002 The relationship among organizational context, pay dispersion, and managerial turnover. *Academy of Management Journal*, 45: 33-42.

Breugst, N., Pazelt, H., Rathgeber, P., 2014. How Should We Divide the Pie? Equity Distribution and its Impact on Entrepreneurial Teams. *Journal of Business Venturing*, 30: 66-94

Breza, Emily, Supreet Kaur, and Yogita Shamdasani. The Morale Effects of Pay Inequality. Working paper, 2015.

Carpenter, M.A. and Sanders, Wm. G. 2002. Top management team compensation: The missing link between CEO pay and firm performance? *Strategic Management Journal*, 23: 367-375.

Carpenter, M.A. and Sanders, Wm. G. 2004. The effects of top management team pay and firm internationalization on MNC performance. *Journal of Management*, 30: 509-528.

Cohen, W. and Levinthal D. 1990. A New Perspective On Learning and Innovation, *Administrative Science Quarterly*, 35: 128-152.

Cohen, D., Dey, A., and Lys, T. 2012. The Sarbanes Oxley Act of 2002: Implications for compensation structures and risk taking incentives of CEOs. Working Paper.

Cohn, A., Fehr, R., Herrmann, F., and Schneider, F. 2014. Social comparison and effort provision: Evidence from a field experiment. *Journal of the European Economic Association*, 12: 877-898.

Connelly, B.L., Haynes, K.T., Tihanyi, L., Gamache, D.L., and Devers, C.E. 2013. Minding the gap: Antecedents and consequences of top management-to-worker pay dispersion. *Journal of Management*, forthcoming.

Connelly, B.L., Tihanyi, L., Crook, T.R., and Gangloff, G.A. 2014. Tournament theory: Thirty years of contests and competitions. *Journal of Management,* 40: 16-47.

Conroy, S.A., Gupta, N., Shaw, J.D., and Park, T.Y. 2014. A multilevel approach to the effects of pay variations. *Research in Personnel and Human Resources Management,* 34: 1-14.

Czarnitzki, D., Hussinger, K., and Schneider, C. 2011. Commercializing academic research: The quality of faculty patenting. *Industrial and Corporate Change*, 20: 1403-1437.

Devers, C.E., Cannella, A.A. Jr., Reilly, G.P., and Yoder, M.E. 2007. Executive compensation: A multidisciplinary review of recent developments. *Journal of Management*, 33: 1016-1072.

Deltas, G. The small-sample bias of the Gini coefficient: Results and implications for empirical research. *Review of Economics and Statistics*, 85: 226-234

Ederer, F. and Manso, G. 2011. Incentives for innovation: Bankruptcy, corporate governance, and compensation systems. In: Handbook of Law, Innovation, and Growth. Edward Elgar Publishing.

Ederer, F. and Manso, G. 2013. Is pay for performance detrimental to innovation? *Management Science*, 59: 1496-1513.

Faleye, O., Reis, E., and Venkateswaran, A. 2013. The determinants and effects of CEO-employee pay ratios. *Journal of Banking and Finance*, 37: 3258-3272.

Festinger, L. 1954. A theory of social comparison processes. *Human Relations*, 7: 117-140.

Finkelstein, S. 1992. Power in top management teams: Dimensions, measurement, and validation. *Academy of Management Journal*, 35: 505-538.

Fredrickson, J.W., Davis-Blake, A., and Sanders, Wm. G. 2010. Sharing the wealth: Social comparisons and pay dispersion in the CEO's top team. *Strategic Management Journal*, 31: 1031-1053.

Galasso, A. and Simcoe, T. 2011. CEO overconfidence and innovation. *Management Science*, 57: 1469-1484.

Gomez-Mejia, L. and Wiseman, R.M. 1997. Reframing Executive Compensation: An Assessment and Outlook. *Journal of Management*, 23: 291–374.

Griliches, Z. 1990. Patent Statistics as Economics Indicators: A Survey. *Journal of Economics Literature*, 28: 1661-1707.

Hall, B.H., Griliches, Z., and Hausman, J.A. 1986. Patents and R and D: Is there a lag? *International Economic Review*, 27: 265-283.

Hall, B.H., Jaffe, A.B., and Trajtenberg, M. 2001. The NBER patent citation data file: Lessons, insights and methodological tools. Working Paper 8498. *National Bureau of Economic Research*.

Hall, B.H., Jaffe, A.B., and Trajtenberg, M. 2005. Market value and patent citations. *RAND Journal of Economics*, 36: 16-38.

He, Zhiguo, Si Li, Bin Wei, and Jianfeng Yu. "Uncertainty, risk, and incentives: theory and evidence." *Management Science* 60, no. 1 (2013): 206-226.

Henderson, Andrew D., and James W. Fredrickson. "Top management team coordination needs and the CEO pay gap: A competitive test of economic and behavioral views." *Academy of Management Journal* 44, no. 1 (2001): 96-117.

Jaffe, A., Fogarty, M., and Trajtenberg, M. 2000. Knowledge spillovers and patent citations: Evidence from a survey of inventors. *American Economic Review*, 90: 215-218.

Lazear, E.P. 1998. *Personnel Economics for Managers*. MIT Press: Cambridge, US.

Lim, E.N. 2015. The role of reference point in CEO restricted stock and its impact on R&D intensity in high-technology firms. *Strategic Management Journal* ,36: 872-889.

Manso, G. 2013. Motivating innovation. *Journal of Finance*, 66: 1823-1860.

Nickerson, J., and Zenger T. 2008. Envy, Comparison Costs, and the Economic Theory of the Firm, *Strategic Management Journal*, 29:1429-1449

O'Reilly, III C.A., Main, B.G., and Crystal, G.S. 1988. CEO compensation as tournament and social comparison: A tale of two theories. *Administrative Science Quarterly*, 33: 257-274.

Pfeffer, J. and Langton N. 1993. The effect of wage dispersion on satisfaction, productivity, and working collaboratively: Evidence from college and university faculty. *Administrative Science Quarterly*, 38: 382-407.

Kale, J.R., Reis, E., and Venkateswaran, A. 2009. Rank-order tournaments and incentive alignment: The effect on firm performance. *Journal of Finance,* 64: 1479-1512.

Kini, O. and Williams, R. 2012. Tournament incentives, firm risk, and corporate policies. *Journal of Financial Economics*, 103: 350-376.

Pazy, A. and Ganzach, Y. 2009. Pay contingency and the effects of perceived organizational and supervisor support on performance and commitment. *Journal of Management*, 35: 1007-1025.

Ridge, J.W., Hill, A., and Aime, F. 2014. Implications of multiple concurrent pay comparisons for top-team turnover. *Journal of Management,* forthcoming.

Ridge, J.W., Aime, F., and White, M.A. 2015. When much more of a difference makes a difference: Social comparison and tournaments in the CEO's top team. *Strategic Management Journal*, 36: 618-636.

Sharma, Z. 2011. Pay disparity and innovation: Evidence from firm level data. *International Journal of Banking, Accounting and Finance*, 3: 233-257.

Shaw, J., Gupta, N., and Delery, J.E. 2002. Pay dispersion and workforce performance: Moderating effects of incentives and interdependence. *Strategic Management Journal*, 23: 491-512.

Sheppard, J.A. 1993. Productivity loss in performance groups: A motivational analysis. *Psychological Bulletin*, 113: 67–81.

Siegel, P.A. and Hambrick, D.C. 2005. Pay disparities within organizations: Evidence of harmful effects on performance of high-technology firms. *Organization Science*, 16: 259-274.

Simcoe, T., Graham, S. and Feldman, M. 2009. Competing on standards? Entrepreneurship, intellectual property and platform technologies. *Journal of Economics and Management Strategy*, 18: 775-816.

Smith, W., Tushman, M. 2005. Managing Strategic Contradictions: A Top Management Model for Managing Innovation Streams, *Organization Science*, 16: 522-536.

Suchman, M.C. 1995. Managing legitimacy: Approaches. *Academy of Management Review*, 20: 571–610.

Trevor, C.O. and Wazeter, D.L. 2006. A contingent view of reactions to objective pay conditions: Interdependence among pay structure characteristics and pay relative to internal and external referents. *Journal of Applied Psychology*, 91: 1260-1275.

Trevor, C.O., Reilly, G., and Gerhart, B. 2012. Reconsidering pay dispersion's effect on the performance of interdependent work: Reconciling sorting and pay inequality. *Academy of Management Journal*, 55: 585-610.

West, Michael A., and Neil R. Anderson. "Innovation in top management teams." *Journal of Applied psychology* 81, no. 6 (1996): 680.

Yanadori, Y. and Cui, V. 2013. Creating incentives for innovation? The relationship between pay dispersion in R&D groups and firm innovation performance. *Strategic Management Journal*, 34: 1502-1511.

Yanadori, Y. and Marler, J.H. 2006. Compensation strategy: Does business strategy influence compensation in high-technology firms? *Strategic Management Journal*, 27: 559-570.

TABLE 1
Summary Statistics: Firm Characteristics

	Average	s.d.	Median
Patent counts	35.523	174.165	1
Citation counts	592.181	3568.829	0
Ln (Sale)	7.278	1.729	7.276
Capital to labor	3.922	1.150	3.723
Ln (Firm age)	3.081	0.736	3.178
Ln (CEO age)	4.007	0.132	4.025
Ln (CEO experience)	2.531	0.922	2.708
Ln (number executives)	1.647	0.162	1.609

TABLE 2
Summary Statistics: Executive Compensation Gap

Panel A. Summary statistics

	Average	s.d.	Median
Total compensation gap	5.785	6.874	3.975
Fixed compensation gap	2.929	1.870	2.544
Variable compensation gap	20.479	94.622	5.197

Panel B. Correlations

	1.	2.	3.
1. Total compensation gap	1.000		
2. Fixed compensation gap	0.351	1.000	
3. Variable compensation gap	0.410	0.169	1.000

TABLE 3
Innovation and Total Compensation Gap

Dependent variable:	Patent counts	Citation counts
	(1)	(2)
Total compensation gap	0.0025*	0.0025
	(0.0013)	(0.0022)
Ln (Sales)	0.4923***	0.4924***
	(0.0938)	(0.0938)
Capital to labor	-0.0029	0.0520
	(0.0941)	(0.1087)
Ln (Firm age)	0.5729**	0.4675*
	(0.2904)	(0.2916)
Ln (CEO age)	0.0737*	0.0962**
	(0.0431)	(0.0449)
Ln (CEO tenure)	0.5279	0.2740
	(0.4582)	(0.5086)
Ln (executives number)	-0.3410**	-0.3869**
	(0.1490)	(0.1556)
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Observations	4,566	4,215

Standard errors (in parentheses) are clustered by firm. *, **, and *** denote (respectively) significance at the 10%, 5%, and 1% level.

TABLE 4
Innovation, Fixed and Variable Compensation Gaps

Dependent variable:	Patent counts	Citation counts	Patent counts	Citation counts	Patent counts	Citation counts
	Baseline analysis		Innovation executives sample		Variable compensation gap as cash bonus	
	(1)	(2)	(3)	(4)	(5)	(6)
Variable compensation gap	0.0003***	0.0005***	0.0648***	0.1008***	0.0099***	0.0101***
	(0.0001)	(0.0002)	(0.0249)	(0.0262)	(0.0028)	(0.0024)
Fixed compensation gap	-0.0432**	-0.0728***	-0.3215**	-0.2651*	-0.0400*	-0.0560**
	(0.0172)	(0.0267)	(0.1454)	(0.1569)	(0.0223)	(0.0264)
Ln (Sales)	0.5095***	0.5308***	-0.2726*	-0.1328	0.5284***	0.6147***
	(0.0972)	(0.0848)	(0.1491)	(0.2046)	(0.1048)	(0.0914)
Capital to labor	0.0368	0.1279	-0.1700	0.0221	0.0319	0.1265
	(0.0919)	(0.0915)	(0.2211)	(0.2095)	(0.1018)	(0.0980)
Ln (Firm age)	0.6393**	0.4683*	0.7029	-1.7304*	0.5342*	0.3863
	(0.3008)	(0.2634)	(0.9529)	(0.9714)	(0.3034)	(0.2643)
Ln (CEO age)	0.0691	0.0857*	0.6447***	1.9802**	0.0942	0.1190**
	(0.0429)	(0.0443)	(0.2240)	(0.7769)	(0.0582)	(0.0517)
Ln (CEO tenure)	0.6282	0.4674	-2.6600***	-5.3048*	0.5956	0.4017
	(0.4433)	(0.4907)	(0.7165)	(2.7371)	(0.4682)	(0.4418)
Ln (executives number)	-0.2794**	-0.3136**	-0.0835	0.0142	-0.4391**	-0.4549***
	(0.1384)	(0.1462)	(0.6656)	(0.6386)	(0.1705)	(0.1689)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4502	4162	356	299	3251	3023

Standard errors (in parentheses) are clustered by firm. *, **, and *** denote (respectively) significance at the 10%, 5%, and 1% level.

TABLE 5
Innovation and Interaction between Compensation Gaps

Dependent variable: Patent counts		
	(1)	(2)
Variable compensation gap	0.0327***	0.0319***
	(0.0115)	(0.0113)
Fixed compensation gap	-0.0708***	-0.0751***
	(0.0263)	(0.0270)
Variable×Fixed compensation gaps		0.0830*
		(0.0045)
Table-4 controls	Yes	Yes
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Observations	4,502	4,502

Standard errors (in parentheses) are clustered by firm. *, **, and *** denote (respectively) significance at the 10%, 5%, and 1% level.

TABLE 6
Innovative Context

Dependent variable: patent counts	Low R&D intensity	High R&D intensity
	(1)	(2)
Variable compensation gap	0.0011*	0.0003**
	(0.0006)	(0.0001)
Fixed compensation gap	-0.0299	-0.0447**
	(0.0260)	(0.0206)
Table-4 controls	Yes	Yes
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Observations	1,836	1,876

Standard errors (in parentheses) are clustered by firm. *, **, and *** denote (respectively) significance at the 10%, 5%, and 1% level.

Appendix A.

In this section, we confirm our results using a variety of robustness checks. Results, which replicate the specification of Table 4, are reported in Table A1. As shown, all of our results remain economically relevant and statistically significant at the 1% to 10% level.

In Column 1, we augment our specification with the Herfindahl-Hirschman index, computed using the distribution of firm revenues at the 3-digit Standard Industrial Classification (SIC) level, and its squared term in order to take into account the effect of competition on innovation. While our specification absorbs overall trends in innovation by the inclusion of year dummies, it does not control for industry-specific trends in innovation. To control for this additional factor, in Column 2, we augment our specification with the average of the dependent variable computed at the year and 3-digit SIC level, after excluding the focal firm. In Column 3 we control for geographic trends including the average of the dependent variable computed by year and State of headquarter, and, in column (4), we include together industry and state trend variables.

Next, we deal with sample composition concerns. We start, in Column 5, by excluding the last sample years (i.e. 2005 and 2006), which can be problematic due to severe truncation problems in citations and patent applications. We move on by trimming, in Column 6, 1% of observations on the right tails of the patent count distribution to mitigate concerns of influential observations. Similarly, in Column 7 we trim a further 1% of observations (in addition to the 0.5% already trimmed in the variable construction) to the left and right tail of the inequality ratios. To further reduce the concern that of extreme values due to e.g. extremely short tenures, in untabulated regressions we check our results using firms in which the CEO has been present in the firm for at least one year. This test does not materially affect our main findings.

In Columns 8 and 9, we check that our results are not driven solely by the smallest firms, which can be exhibit intensive innovative activity post-IPO due to intense equity issuances, or by the largest firms, typically endowed with a large stock of innovative knowledge; to this end, we remove firms in the bottom or top 2.5% of the sales distribution. In Column 10, we limit our analysis primarily to the manufacturing sectors (SIC up to 4000).

In conclusion, we verify the robustness to controlling for additional firm-specific variables that may confound our baseline evidence. In Column 11 we control for R&D spending by including the logarithm of R&D expenditures. In Column 12 we control for the return on assets (ROA), computed as the ratio of earnings before interest, taxes, depreciation and amortization to total assets, in order to control for differences in profitability across firms. In Column 13, we augment the model with firms' market performance by including the market to book ratio, computed using the market value of equity divided by the book value of equity. In Column 14, we attempt to improve the causal interpretation of our results by using 1-year lagged inequality ratios rather than contemporaneous ones; lagged values help ruling out the concern that it is firm patenting that affects the compensation inequality rather than the other way around.

[[INSERT Table A1 about Here]]

TABLE A1
Robustness Checks

Dependent variable: Patent counts

	Controlling for competition	Controlling for SIC trends	Controlling for State trends	Controlling for State and SIC trends	Excluding late years	Excluding patent outliers	Excluding pay outliers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable compensation gap	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0003**	0.0018***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0004)
Fixed compensation gap	-0.0359**	-0.0435**	-0.0452***	-0.0453***	-0.0422**	-0.0361**	-0.0645***
	(0.0161)	(0.0173)	-0.0171	(0.0172)	(0.0175)	(0.0156)	(0.0240)
Table-4 controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,507	4,507	4,507	4,507	3,867	4,487	4,318
	Excluding smallest firms	Excluding largest firms	Only manuf-acturing firms	Controlling for R&D spending	Controlling for ROA	Controlling for market-book ratio	Lagged pay variables
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Variable compensation gap	0.0003***	0.0002**	0.0003**	0.0003***	0.0003***	0.0003***	0.0003*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Fixed compensation gap	-0.0466***	-0.0277**	-0.0330**	-0.0502***	-0.0501***	-0.0421**	-0.0287**
	(0.0170)	(0.0126)	(0.0157)	(0.0188)	(0.0182)	(0.0167)	(0.0143)
Table-4 controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,390	4,358	3,584	3,407	4,487	4,505	3,657

Standard errors (in parentheses) are clustered by firm. *, **, and *** denote (respectively) significance at the 10%, 5%, and 1% level.