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Non-executive employee stock options and corporate innovation ☆

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ABSTRACT

We provide empirical evidence on the positive effect of non-executive employee stock options on corporate innovation. The positive effect is more pronounced when employees are more important for innovation, when free-riding among employees is weaker, when options are granted broadly to most employees, when the average expiration period of options is longer, and when employee stock ownership is lower. Further analysis reveals that employee stock options foster innovation mainly through the risk-taking incentive, rather than the performance-based incentive created by stock options.

Most great ideas for enhancing corporate growth and profits aren't discovered in the lab late at night, or in the isolation of the executive suite. They come from the people who daily fight the company's battles, who serve the customers, explore new markets and fend off the competition. In other words, the employees.

The Wall Street Journal (*August 23, 2010*) – *"Who Has Innovative Ideas? Employees."*

1. Introduction

Innovation has become an increasingly important corporate strategy that boosts the long-term growth and enhances the competitiveness of a firm. Innovation is about people. Innovation arises when active, motivated, and engaged people generate ideas and convert them into new products, services, or business models. In recent years, most companies have changed the innovation process by replacing centralized corporate research and development (R&D) laboratories with divisional laboratories (Lerner and Wulf, 2007), making rank-and-file employees increasingly important innovators in corporations.[1] What can motivate non-executive employees to be

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[1] Anecdotal evidence in Harden, Kruse, and Blasi (2008, p. 4) supports the view that non-executive employees are highly important

more innovative? In this paper, we examine the role of stock options, a key component of employee compensation, in engaging rank-and-file employees in innovative activities. We document a positive incentive effect of non-executive employee stock options on corporate innovation.[2]

Holmstrom (1989) points out that corporate innovation, unlike conventional investments in tangible assets, involves a high probability of failure due to its dependence on various unpredictable conditions. As a result, the standard incentive schemes based on the pay-for-performance principle are insufficient in encouraging innovations. Instead, the model of Manso (2011) and the experimental study of Ederer and Manso (2013) show that incentive schemes that tolerate early failure and reward long-term success lead to better innovation performance.

Building on prior literature, we expect non-executive employee stock options to have a positive effect on corporate innovation for four reasons. First, innovation requires risk-taking (Holmstrom, 1989). Non-executive employee stock options positively relate employee wealth to stock return volatility, incentivizing employees to take more risk in the innovation process. Second, rewards for long-term success and tolerance for early failure are crucial for innovation success (Manso, 2011). The asymmetric payoff structure of stock options not only rewards employees with unlimited upside potential when innovation succeeds and stock prices increase, but also protects them with limited downside loss when innovation fails and stock prices fall. Third, innovation projects are long-term, multi-stage, and labor-intensive (Holmstrom, 1989). Employee stock options normally have a long vesting period and a long average time to expiration.[3] To exercise their options, employees have to stay with their firms until options become exercisable (Core and Guay, 2001). Therefore, the deferral feature of employee stock options can effectively direct employees' attention to the firm's long-term success and encourage employees' long-term human capital investment in innovation (Rajan and Zingales, 2000). Finally, innovation takes teamwork.[4] The laboratory experiment of Ederer (2009) reveals that innovation success and performance are greatest when innovators receive a *group* incentive scheme that rewards long-term *joint* success. Non-executive employee stock options, as a group incentive scheme with value determined by employees' joint effort, can enhance cooperation between employees, induce mutual monitoring among co-workers (Baker, Jensen, and Murphy, 1988; Hochberg and Lindsey, 2010), and encourage information sharing and social learning between innovators, leading to greater innovation success.[5]

Using a large panel of US firms covered by the National Bureau of Economic Research (NBER) Patent and Citation Database, we document that non-executive employee stock options foster corporate innovation. Specifically, we follow Hochberg and Lindsey (2010) and define non-executive employees as all employees except the top five executives in a firm. We estimate the Black-Scholes value of non-executive employee stock options using data retrieved from the Investors Responsibility Research Center (IRRC) Dilution Database and ExecuComp. Our main results are that the value of non-executive stock options per employee is positively associated with the quantity and quality of innovation output, measured by the number of patents and the number of patent citations, respectively. The association is both economically and statistically significant. We then perform a variety of checks to ensure that our main results are robust to alternative model specifications and variable definitions. Furthermore, we use a number of tests to address the problem of omitted variables that are potentially related to firms' financial constraints, corporate governance, and industry geographic clustering, all of which could drive both innovation and employee stock options.

The findings that non-executive employee stock options and innovation are positively correlated, however, by themselves, do not establish a causal influence of employee stock options on innovation output. It is plausible that causation runs from innovation to employee stock options for at least two reasons. First, innovative firms may use stock options to sort and retain certain types of employees (e.g., Core and Guay, 2001). Second, successful innovative firms may be able to treat non-executive employees well by granting them more options without angering shareholders (e.g., Ittner, Lambert, and Larcker, 2003; Kroumova and Sesil, 2006).[6] Hence, the causal relation between non-executive employee stock options and innovation can be bidirectional, and the two directions of causality are not necessarily mutually exclusive.

To alleviate the concern about reverse causality, we control for several variables that capture innovative firms' incentive to use stock options to sort or retain employees.

(*footnote continued*)
innovators in a firm: "*Whirlpool credits their successful product innovations not to a couple of departments, such as engineering or marketing. Instead, they contribute their success to the 61,000 employees who have the ability to contribute and develop product, service, or processes innovations.*"

[2] Companies widely recognize the positive effect of employee stock options on corporate innovation. For instance, Cisco Systems, Inc., the world leader in communication and information technology, stated in its high-tech policy guide (January 2005) that "*Employee stock options fuel innovation and the entrepreneurial spirit.*" *Google*, one of the most innovative companies according to *Business Week*'s annual survey in 2010, describes its innovation policy as "*Our commitment to innovation depends on everyone being comfortable sharing ideas and opinions. Every employee is a hands-on contributor, and everyone wears several hats.*" In the meantime, according to the *New York Times* (November 12, 2007), *Google*'s current and former employees collectively held vested stock options that were worth roughly $2.1 billion as of November 2007.

[3] The vesting period of stock options refers to the amount of time it takes for options to become fully exercisable. The survey of National Center for Employee Ownership (2001) reveals that vesting periods of employee stock options generally range between one and seven years. Four years is the most common.

[4] Dougherty (1992) and Van de Ven (1986) show that team-based work increases the quantity and quality of innovation.

[5] Henderson and Cockburn (1994) show that the sharing of information and experiences among R&D workers positively affects firms' innovation performance.

[6] We thank the referee for pointing out this reverse causality. For example, General Electric grants options to lower-level employees with above-average performance evaluations, but only when the entire firm has performed well (Core and Guay, 2001).