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# Do Venture Capital-Driven Top Management Changes Enhance Corporate Innovation in Private Firms?

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## Abstract

The main study in my dissertation analyzes the effect of top management changes on corporate innovation in venture capital (VC)-backed private firms and the possible mechanism through which this occurs using a unique hand-collected dataset. I find that top management changes are associated with more and higher quality corporate innovation. Further, such management changes are primarily driven by VCs and the effect of management changes on innovation is stronger for firms where VCs have greater power. An instrumental variable analysis using an exogenous shock to the supply of outside managers available for hire implies that the above relationships are causal.

**Category:** Venture Capital; Finance; Innovation

**Keywords:** Venture Capital; Top Management Changes; Corporate Innovation; Inventor Mobility

## Main Takeaways:

- VCs enhance corporate innovation of their portfolio companies through inducing top management changes.
- Top management changes are more effective in enhancing corporate innovation in venture-backed private firms in which VCs have greater power.
- One channel through which top management changes enhance corporate innovation is by new management teams attracting a greater number of inventors, for a given investment size.

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The role of venture capital (VC) in creating value for the entrepreneurial firms has been a widely debated topic. Both practitioners and academics have suggested that venture capitalists take an active role in the portfolio companies that they finance beyond providing capital (see, e.g., Gorman and Sahlman (1989), Lerner (1995), and Hellmann and Puri (2002)). One channel through which VCs may add value to their portfolio companies is by improving their management team, either by adding new managers in areas where the firm is lacking in managerial expertise or by removing managers who underperform. Further, VC investments typically focus on high technology and high growth sectors of the economy, such as information technology, life sciences, and energy technology (Da Rin, Hellmann, and Puri (2013)), where innovation is a critical driver of their long-term growth and competitive advantage. This means that one measure by which one can judge the effectiveness of venture capitalists in recruiting new managers or removing underperforming managers is by studying the effect of such venture-driven top management changes on the innovativeness of their portfolio companies. However, to the best of my knowledge, there is little analysis of the relation between top management changes and corporate innovation in venture-backed private firms. In this paper, I use a unique hand-collected dataset to fill this gap in the literature by providing new evidence on how top management changes affect corporate innovation in venture-backed private firms and on the possible mechanisms through which this occurs.

I explore several interesting research questions regarding the effect of top management changes on corporate innovation. First, do top management changes lead to more and higher quality corporate innovation output? Second, is the probability of top management changes in venture-backed firms higher in firms where VCs have greater power (e.g., greater board membership)? Further, is the relation between top management changes and corporate innovation stronger in such firms? Third, as top management changes may include adding new managers as well as removing existing managers, how does each of these actions affect corporate innovation? Fourth, what type of top management background (in terms of educational and employment experience) is important in spurring innovation? In particular, are

managers with general managerial skills (having worked as a CEO in another company), or those with a prior technical background (having engaged in the research and development process themselves), or both, important in spurring innovation?<sup>1</sup> Fifth, what are the underlying mechanisms through which top management changes affect corporate innovation in venture-backed private firms? Finally, how do top management changes and enhanced innovativeness affect the probability of a successful exit (either through an IPO or an acquisition) of venture-backed private firms?

The empirical analysis of the relation between top management changes and corporate innovation in venture-backed private firms is hampered by two major challenges. First, the data (especially management team and board of directors data) on venture-backed private firms is very limited. Second, potential endogeneity may confound any empirical analysis on the relation between top management changes and corporate innovation. On the one hand, one may argue that the relationship between top management changes and corporate innovation may be largely driven by omitted variables such as the underlying quality (innovativeness) of the firm, i.e., both top management changes and corporate innovation may be positively related to firm quality, in which case the baseline (OLS) regression estimates linking top management changes and corporate innovation will be biased upwards. On the other hand, venture capitalists may be more likely to intervene in firms (i.e., induce management

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<sup>1</sup>Anecdotal evidence suggests that venture-backed entrepreneurial firms may add seasoned CEOs as well as top managers with a prior technical background to help firms succeed. For example, SpaceClaim Corporation, a provider of 3D Modeling Software based in Concord, Massachusetts, announced the addition of Michael McGuinness (a seasoned CEO and President with rich software industry experience) to its top management team right before it received the third round of VC financing. SpaceClaim commented that McGuinness brought to SpaceClaim “broad executive experience across several industries” and strategic vision in high technology, management, and business development. See more details at [http://www.spaceclaim.com/fr/company/news/pressreleases/07-03-20/SpaceClaim\\_Announces\\_Addition\\_of\\_Michael\\_McGuinness\\_as\\_Chief\\_Operating\\_Officer.aspx](http://www.spaceclaim.com/fr/company/news/pressreleases/07-03-20/SpaceClaim_Announces_Addition_of_Michael_McGuinness_as_Chief_Operating_Officer.aspx). An example of a venture-backed firm that added a top manager with a prior technical background is Acceleron Pharma, Inc., a biopharmaceutical company based in Cambridge, Massachusetts. Acceleron announced the appointment of Matthew L. Sherman, M.D. (who was responsible for clinical research and clinical operations in another pharmaceutical company prior to joining Acceleron and published a number of research papers) as Senior Vice President and Chief Medical Officer when it received VC financing in 2006. The company claimed that the addition of Sherman brought to Acceleron “broad scientific and clinical research knowledge along with his experience and proven record of building clinical development organizations.” See more details at <http://investor.acceleronpharma.com/releasedetail.cfm?ReleaseID=785744>.

changes) when they are performing poorly in order to help them improve their performance, in which case the baseline regression estimates will be biased downwards.

I overcome the first challenge by constructing a unique hand-collected dataset of top management team and board information of venture-backed private firms, using which I can identify the top managers as well as board of directors for each firm across different financing rounds. I begin with all the venture-backed deals covered in VentureXpert over the period of 2002-2010 and hand-collect top management team and board information for these venture-backed private firms in each financing round from their “Form D” filings on the SEC EDGAR website. Many venture-backed firms use exemptions under Regulation D, which allow them to sell equity to accredited investors (such as venture capitalists) without having to register with the SEC and become a public company. When relying on Regulation D, firms are required to file a Form D, which is a brief notice that contains important information about the firm and the offering, including the names and addresses of the firm’s executive officers (such as CEO, president, Chief Technology Officer) and directors, the amount of investment made by investors, and the date of sale.

I overcome the second challenge related to endogeneity using an instrumental variable analysis. I instrument for top management changes using a plausibly exogenous shock to the supply of outside managers that are able to move across firms and are available for hire by venture-backed private firms. Specifically, the instrument that I use is the number of acquisitions made by established firms in the same industry and in the same state as the venture-backed private firm multiplied by an index measuring the enforceability of non-compete clauses in that state. This instrument is motivated by the following facts. First, incoming managers to startups often come from established firms, and these firms are dominant players in the acquisition market. In other words, there is a strong correlation between the movement of executives across firms and the number of acquisitions made by established firms in the industry. Second, the enforceability of non-compete clauses, which are commonly used in employment contracts for top management to prohibit them from joining or founding

a rival company, affects the mobility of managers across firms. In each stage of my IV regressions, I include industry-by-year and state-by-year fixed effects to absorb any industry-wide technology shock and any local economic shock that may affect innovation. Therefore, my instrument is unlikely to affect innovation through channels other than through its effect on the ease of recruiting top management, thus satisfying the exclusion restriction.

My empirical results can be summarized as follows. First, I find that top management changes are associated with significantly more and higher quality corporate innovation subsequent to top management changes (as measured by patent counts and patent citations) in venture-backed private firms. For example, the number of patents in the next two years and the number of citations received by these patents increase by 14% and 11.7%, respectively, following top management changes. Second, I show that the probability of management changes is increasing with the power of venture capitalists in the firm (as measured by the number of outside board members), suggesting that management changes in my venture-backed sample are primarily driven by venture capitalists.<sup>2</sup> Further, I find that the effect of management changes on corporate innovation is stronger for firms where venture capitalists have greater power, consistent with the conjecture that venture capitalists add value to their portfolio companies through inducing management changes. My instrumental variable analysis (making use of a plausibly exogenous shock to the supply of outside managers as described above) shows that the positive relationship that I documented earlier between management changes and corporate innovation is causal. Third, I find that adding new managers has a positive and significant effect on the quantity and quality of subsequent innovation, while removing existing managers does not. Fourth, I find that adding seasoned CEOs has a positive and significant effect on innovation, while adding senior managers with

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<sup>2</sup>I follow the existing literature (see, e.g., Ewens and Marx (2014)) in making use of the number of outside board members as a measure for the power of VCs in the firm. Typically, outside board members in venture-backed private firms are composed of investors (e.g., VCs) and independent observers (see Kaplan and Strömberg (2003) and Ewens and Marx (2014) for details). The existing literature has documented that other outside board members are likely to vote along with VCs (especially when the venture-backed firm performs poorly), thus justifying the use of the number of outside board members as a proxy for the power of VCs in the firm.

a prior technical background does not.

I then investigate the possible underlying mechanisms through which top management changes may foster greater innovation activities. I hypothesize that the new management teams may select and allocate resources to higher quality innovation projects, manage innovative assets more efficiently, and provide a better environment for inventors (i.e., scientists and engineers) to succeed in the firm (for example, by creating a more failure-tolerant environment for inventors, in the sense of Manso (2011)). Thus, one way that top management changes may enhance corporate innovation is by the new management teams being able to hire more inventors to work for the firm (for a given amount of resources available). My result is consistent with this conjecture: I find that top management changes are associated with a significantly greater net inflow (inflow minus outflow) of inventors in the two or three years following top management changes. Further, the positive relation between top management changes and the net inflow of inventors is stronger for firms where VCs have greater power.

Finally, I explore the relation between top management changes, corporate innovation, and successful exit outcomes (as measured by an IPO or an acquisition by another company) in venture-backed private firms. I find that both management changes and innovation output are significantly and positively related to the probability of successful exit outcomes. I also show that the effect of top management changes on the successful exit is at least partly mediated through enhanced innovation.

I conduct a number of robustness tests and find that the positive relation between top management changes and corporate innovation that I documented earlier is robust to these tests. First, I find that the positive relation between management changes and corporate innovation is robust to controlling for industry-by-state-by-year fixed effects. As my instrumental variable analysis makes use of variation at the industry-by-state-by-year level, this helps to alleviate the concern that that industry-by-state-by-year level omitted variables may drive both management changes and corporate innovation. Second, to alleviate the

concern that corporate innovation may be driven by a general trend of technological development, I conduct a placebo test using innovation output generated prior to management changes as the dependent variable. I find that the relation between management changes and prior innovation is insignificant, suggesting that the positive relation between management changes and subsequent innovation is unlikely to be due to a general trend of technological development. Third, I show that the positive relation that I documented earlier between top management changes and corporate innovation is robust to controlling for lead VC firm fixed effects. The results of this robustness test confirm that the positive relation between top management changes and innovation is not driven by any unobservable and time-invariant VC firm characteristics that may affect innovation (such as VC firms' project selection ability and preferences).

My paper is related to a number of studies and contributes to several strands in the literature. First, it improves our understanding on how venture capitalists add value to the entrepreneurial firms that they invest in through active intervention in recruiting top management. Several existing studies show that VCs play a role in recruiting managers (especially CEOs) and replacing founders. For example, Hellmann and Puri (2002) use a sample of 170 Silicon Valley startups and show that venture capitalists professionalize nascent firms by instituting human resource policies and bringing in professional CEOs to replace founders. They, however, do not study the effect of such management changes on any subsequent outcomes (including innovation). Wasserman (2003) shows that raising financing from outside investors (mainly VCs) leads to higher chances of founder-CEO being replaced by an outside CEO, using a sample of 202 Internet startups. Amornsiripanitch, Gompers, and Xuan (2016) show that successful VCs who have a good track record of past investment and a large network are likely to hire outside managers and outside board members for their portfolio companies. Ewens and Marx (2014) find that venture capitalists are more likely to replace senior managers in struggling startups to "correct the ship" and establish a causal relationship between management replacements and better exit outcomes. In summary, none

of the above papers study the relationship between top management changes and product market innovation in venture-backed private firms, which is the focus of this paper.

Second, my paper adds to the literature on how venture-backing improves innovation or efficiency, by establishing the link between a specific action by venture capitalists (i.e., top management changes) and corporate innovation. Several papers study how VC-backing affects innovation in venture-backed firms, relative to non-venture-backed firms, while other studies attempt to identify the relationship between VC characteristics (such as experience, industry expertise, syndication, staged capital infusion, and failure tolerance) and innovation in venture-backed firms. Recent studies include Chemmanur, Loutskina, and Tian (2014), Tian (2011), and Tian and Wang (2014), Bernstein, Giroud, and Townsend (2015), etc. Another literature is the one studying whether VC-backing improves efficiency in private firms and the mechanisms through which they do so (see, e.g., Chemmanur, Krishnan, and Nandy (2011)).<sup>3</sup>

Third, this study sheds significant light on the top management changes/turnover literature. Existing studies have shown that management changes are important corporate events. In particular, there is empirical evidence documenting improvements in accounting and stock performances following CEO turnover mainly for large public companies (Huson, Malatesta, and Parrino (2004); Denis and Denis (1995); Cornelli, Kominek, and Lungqvist (2013)). Bereskin and Hsu (2013) study the effect of CEO turnover on corporate innovation in large public companies. However, with a few exceptions (Gao, Harford, and Li (2015) and Cornelli and Karakaş (2015)), the literature above focuses on the publicly traded firms and provides few insights into management changes in private firms due to data limitations.<sup>4</sup> My paper adds to the literature by examining for the first time, the effect of top management changes on corporate innovation in venture-backed private firms.

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<sup>3</sup>See Da Rin, Hellmann, and Puri (2013), who provide an excellent survey of the broader venture capital literature.

<sup>4</sup>Gao, Harford, and Li (2015) find that public firms have higher CEO turnover rates and exhibit greater CEO turnover-performance sensitivities than large private firms, using a sample of US public firms and large private firms. Cornelli and Karakaş (2015) find that CEO turnover decreases and is less contingent on performance when a firm is taken private, using a sample of LBO firms in the UK.

Finally, this study proposes a channel through which top management changes may affect corporate innovation, suggesting that the new management team may enhance innovation by attracting a greater number of inventors. Thus my study contributes to a small but growing literature on labor mobility and innovator flows (e.g., Marx, Strumsky, and Fleming (2009) and Chemmanur, Kong, Krishnan, and Yu (2017)).

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