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Executive Summary

# Does Going Public Affect Innovation?

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Abstract:

This paper investigates the effects of going public on innovation by comparing the long-run innovation of firms that completed their IPO filing and went public with that of firms that withdrew their filing and remained private. I use NASDAQ fluctuations during the book-building phase as an instrument for IPO completion and find that following the IPO the quality of internal innovation declines. This decline is driven by both an exodus of inventors and a decline in productivity among remaining inventors. However, public firms mitigate this effect by acquiring external technologies through mergers and acquisitions.

Does the transition to public equity markets affect innovation? This question is particularly relevant given the reliance of young and entrepreneurial firms on public equity issuances to fund their R&D investments,<sup>2</sup> and the critical role of innovation in promoting economic growth (Solow 1957). This paper studies the effects of going public on three important dimensions of firms' innovative activity: internally generated innovation, productivity and mobility of individual inventors, and acquisition of external innovation.

Theoretically, in frictionless financial markets, selling equities publicly should have no bearing on subsequent innovative activity. However, two broad views suggest that going public should in fact matter.

The "financing" view suggests that going public may enhance innovation by overcoming financing frictions and easing access to capital. As argued by Arrow (1962) and demonstrated empirically,<sup>3</sup> R&D is likely to be more sensitive to financing constraints than other forms of investments. For instance, debt financing of R&D may be limited due to associated information problems, skewed and uncertain returns, and the potentially scant collateral value of intangible assets. Equity financing, on the other hand, allows investors to share upside returns and can ease the financing of R&D investments by transferring idiosyncratic innovation risk to diversified investors through public equity markets. Therefore, the financing view suggests that going public may enhance internally generated innovation and may even facilitate technology acquisitions.

Alternatively, the "incentives" view suggests that ownership dilution and changes in governance may lead to a decline in the quality of innovation. Following the IPO, inventors may face weaker incentives to pursue novel projects as their claims on subsequent innovations become smaller. Increases in wealth and the ability to cash out may weaken inventors' incentives even further. In addition, if equity markets may fail to correctly evaluate innovation even when outcomes are predictable and persistent (Cohen, Diether, and Malloy, 2011), career concerns and takeover threats may pressure managers to select less novel projects that are more easily communicated to stock market investors<sup>4</sup> (Stein, 1989; Ferreira, Manso, and Silva, 2010). Interestingly, the benefits of accessing public markets can be tied to its costs. Managers may prefer to exploit improved access to capital to acquire ready-made technologies

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<sup>2</sup> See Brown, Fazzari and Petersen (2009). In fact, Brown and Petersen (2009) demonstrate that young firms' dependence on public equity markets to finance R&D expenditure has even increased over past decades.

<sup>3</sup> See, for example, Brown, Fazzari and Petersen (2009), Himmelberg and Petersen (1994), and Mulkay, Hall, and Mairesse (2001). For detailed surveys of the literature see Bond and Van Reenen (2007) and Hall and Lerner (2009).

<sup>4</sup> Minton and Kaplan (2008) demonstrate that turnover rates in publicly traded firms are high and significantly related to a firm's stock performance. Additionally, Edmans, Goldstein, and Jiang (2011) find that low stock prices strongly affect the likelihood of takeover threats.

rather than innovating internally, as this strategy is more transparent to the stock market and potentially less prone to failure.

To shed light on these two views, I use standard patent-based metrics to study the effects of going public on innovation. Consistent with the incentives view, the main finding of the paper illustrates that going public changes firms' strategies in pursuing innovation. Following the IPO there is a substantial decline in the novelty of internally generated innovation which is partially mitigated by the increased reliance on the acquisition of external technologies.

The key challenge in estimating the effects of going public on innovation arise from the inherent selection bias associated with the decision to go public. A standard approach in the literature uses within-firm variation to study the dynamics of firm outcomes around the IPO.<sup>5</sup> But, as noted by Jain and Kini (1994), this approach is likely to reveal biased IPO effects due to the selection of firms to go public at a specific stage in their life cycle. For instance, firms may choose to go public following an innovative breakthrough, as hypothesized by Pastor, Taylor, and Veronesi (2009).<sup>6</sup> In that case, the post-IPO performance may be affected by reversion to the mean, reflecting life cycle effects in addition to the IPO effects.

To overcome this selection bias, I construct a novel dataset of innovative firms that filed an initial registration statement with the SEC and either completed or withdrew their filing. This sample allows me to compare the innovative activity of firms that went public with private firms at a similar stage in their life cycle, namely, firms that intended to go public at the same time but withdrew their filing. But this does not completely eliminate the selection bias as the decision to withdraw may be related to a firm's R&D policy and innovative opportunities.

I use the two-month NASDAQ fluctuations following the IPO filing date as an instrument for IPO completion. The instrument relies on the sensitivity of filers to stock market movements during the book-building phase (Busaba, Beneveniste, and Guo, 2000; Benveniste et al., 2003; Dunbar, 1998; Dunbar and Foerster, 2008; Edelen and Kadlec, 2005). These fluctuations provide a plausibly exogenous source of variation that affects IPO completion and is unlikely to be related to innovation.

One concern regarding the instrument might be that the exclusion restriction does not hold; i.e., that two-month NASDAQ returns may relate to innovation measures through channels other than the IPO completion (see Section 2.C for a detailed discussion). There are several reasons this may not be the case.

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<sup>5</sup> See, e.g., Degeorge and Zeckhauser (1993), Jain and Kini (1994), Mikkelson, Partch, and Shah (1997), Pagano, Panetta, and Zingales (1998), Pastor, Taylor, and Veronesi (2009), and Chemmanur, He, and Nandy (2009).

<sup>6</sup> Chemmanur, He, and Nandy (2009) find that firms go public following productivity improvements, and experience a decline in productivity following the IPO.

First, the analysis compares firms that filed to go public in the same year. I find that the characteristics of filers that experienced a NASDAQ drop during the book-building phase do not differ significantly from other firms that filed to go public during the same year but did not experience such a decline.<sup>7</sup> Second, the analysis uses firm innovation measures that are in relative terms, scaled by the average innovation measures of all patents granted in the same year and in the same technology class.<sup>8</sup> Therefore, even if two-month NASDAQ returns contain information about aggregate changes in innovative opportunities, such a change should affect all firms conducting research in the same area, and is therefore unlikely to affect relative innovation measures.

Using this instrumental variables approach, I find that going public caused a substantial decline of approximately 50 percent in innovation novelty as measured by patent citations. At the same time, I find no change in the scale of innovation, as measured by the number of patents. These results suggest that the transition to public equity markets leads firms to reposition their R&D investments toward more conventional projects. Such findings cannot be explained by the financing view which suggests that improved access to capital may enhance innovative activities.

To uncover the channels driving the decline in innovative activity, I study the effects of going public on individual inventors' productivity and mobility over time. Consistent with the incentives view, I find that the quality of innovation produced by inventors who remained at the firm substantially declines following the IPO and key inventors are more likely to leave. These effects are partially mitigated by the ability of public firms to attract new inventors.

I also find a stark increase in the likelihood that newly public firms acquire companies in the years following an IPO, particularly privately held targets. To better understand whether these acquisitions are used for purchasing new technologies, I collect information on targets' patent portfolios. I find that public firms acquire a substantial number of patents through M&A: acquired patents constitute more than one-fifth of firms' patent portfolio in the five years following the IPO. The acquired patents are more likely to be in technologies that are only weakly related to a firm's previous patents and are of higher quality than the patents produced internally. These findings are broadly consistent with both the financing and the incentives view.

To further investigate the underlying causes, I propose two incentives-based explanations. The first explanation suggests that career concerns lead managers to select more incremental projects, while

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<sup>7</sup> These characteristics include: firm innovation in the three years before the IPO filing, firm financials at the time of the IPO filing, venture capital backing, age, underwriter ranking, and location within the IPO wave.

<sup>8</sup> Technology classes are defined by the United States Patent and Trademark Office (USPTO), and capture technological essence of an invention.

the second explanation suggests that after the IPO inventors are facing weaker incentives to pursue high-quality innovation.

While the two explanations are likely to co-exist, I find supportive evidence for the first explanation indicating that changing managerial incentives and public market pressures affect innovation at public firms. If managerial incentives are an important determinant of innovation, firms with more entrenched managers should be less sensitive to market pressures and therefore may invest in more novel projects. As a proxy for managerial entrenchment, I use cases in which the CEO also serves as the chairman of the board. I find that when managers are more entrenched, the negative effect of going public on innovation novelty is weaker and inventors are less likely to leave the firm.

The paper is related to several strands in the literature. First, the IPO literature documents a post-IPO decline in firm performance measures such as profitability and productivity.<sup>9</sup> This paper adds to the literature by demonstrating a post-IPO decline in innovation. Perhaps more importantly, the paper establishes that this decline is caused by the transition to public equity markets, rather than being a symptom of a particular stage of the firm life cycle. This paper is also related to a number of papers studying withdrawn IPOs.<sup>10</sup> By using patent data, this study is the first to investigate the performance consequences of the decision to withdraw an IPO.

The paper reveals a complex trade-off between public and private ownership. While private firms are able to generate higher quality innovation and retain skilled inventors, public firms can acquire technologies externally and attract new human capital. In that regard, the paper is also related to a growing literature that compares the behavior of public and private firms along various dimensions such as investment sensitivity, capital structure, and dividend payouts.<sup>11</sup> Additionally, this work contributes to the theoretical and empirical literature that explores the role of governance, capital structure, and ownership concentration on corporate innovation.<sup>12</sup>

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<sup>9</sup> Several papers report a post-IPO decline in profitability: DeGeorge and Zeckhauser (1993), Jain and Kini (1994), Mikkelson, Partch, and Shah (1997), Pagano, Panetta, and Zingales (1998), and Pastor, Taylor, and Veronesi (2009). Chemmanur, He, and Nandy (2009) reach similar findings regarding firm productivity.

<sup>10</sup> For example, Benveniste et al. (2003), Busaba, Benveniste, and Guo (2000), Busaba (2006), Dunbar (1998), Dunbar and Foerster (2008), Edelen and Kadlec (2005), and Hanley (1993).

<sup>11</sup> Several aspects of firm behavior are considered in that literature. Asker, Farre-Mensa, and Ljungqvist (2010), and Sheen (2009) focus on investment sensitivity, Saunders and Steffen (2009) and Brav (2009) study debt financing and borrowing costs, Michaely and Roberts (2007) explore dividend payouts, and Gao, Lemmon, and Li (2010) focus on CEO compensation.

<sup>12</sup> See Aghion, Van Reenen, and Zingales (2009), Atanassov, Nanda, and Seru (2007), Belenzon, Berkovitz, and Bolton (2009), Bhattacharya and Guriev (2006), Chemmanur and Jiao (2007), Fulgheieri and Sevilir (2009), Fang, Tian, and Tice (2010), Lerner, Sorensen, and Stromberg (2010), and Tian and Wang (2010).

This paper does not address the general equilibrium effects of the IPO market on innovation and its corresponding welfare consequences. Yet, the results suggest that there may be important complementarities between public and private ownership structures. While private ownership may allow firms to pursue more ambitious innovations, improved access to capital may allow public firms to acquire technologies, mostly from private firms. This suggests that ownership structure plays an important role in shaping the market for technologies.

Finally, corporate managers, bankers, and policy makers alike have expressed concerns that the recent dearth of IPOs marks a breakdown in the engine of innovation and growth (Weild and Kim, 2009). Some blame the Sarbanes-Oxley Act (SOX) for raising the costs of compliance for publicly traded firms.<sup>13</sup> Regardless of the role of SOX in explaining the recent IPO cycle, policy prescriptions of this sort raise the question of whether the transition to public equity markets affects innovation and if so how. This paper contributes to the debate by demonstrating that IPOs affect innovation, but that their effects may be indirect. While innovation novelty declines following the IPO, it allows public firms to acquire entrepreneurial firms, and thus, potentially facilitates innovation by increasing the demand for new technologies.

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<sup>13</sup> In the hope that IPO market stimulation will "jumpstart innovation and job creation," President Obama's Council on Jobs and Competitiveness has urged Congress to amend the Sarbanes-Oxley Act to allow small companies to tap public equity markets.