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Innovator's Dilemma: *IPO or No?*

WHAT'S NEXT?

One of the greatest moments in the life of a company is its initial public offering, or IPO, as it is commonly known. This moment is reserved for only a handful of companies in America and marks the time when a company goes from being privately held to publicly traded and listed on a public exchange. And in the U.S., we measure the success of the innovation economy, in part, by the number of IPOs that occur in a given year.

But if IPOs are a measure of success in the innovation economy, are IPOs actually good for innovation? In a provocative new paper for our NEXT series, Stanford's Shai Bernstein asks an important question and conducts a fascinating experiment. Do firms become more or less innovative after they go public? Mindful of inherent biases in defining innovation and also whether going public may just simply occur at the height of a firm's innovation, the author compared firms going public with firms that were about to go public but held back because of market volatility. And he measured innovation not just by counting patents, but by measuring new patent quality to see how widely used new innovations became.

The results of the experiment were striking: going public means a 40% decline in quality innovations for those firms in the five years immediately following listing. Meanwhile, the firms that flirted with an IPO but stayed private innovated at an accelerated rate. Why? Bernstein found that once a firm is public, early innovators within the company often cash out their stock and move to new start-ups. This may not be a bad thing for the economy because innovation is still occurring, just at a different firm. However, the authors found that inventors who stayed at the newly public company saw a 48% decline in quality innovation. They concluded that going public changed the calculation for top managers who felt it may be difficult to justify far-flung research to shareholders. The pay-off for this innovation would not be near-term; in fact, it might not occur at all, he surmised.

This phenomenon of succumbing to shareholder pressure is the reason Mark Zuckerberg in 2010 said "being private is better for us now because some of the big risks we want to take in developing new products ... it would be even more difficult if we had a public stock price bounding around." The ramifications of this study are far reaching. We want firms to go public for many reasons, but we don't want innovation to be held back for short-term shareholder interests.

As the author puts it: “IPO markets play an important role in the entrepreneurial ecosystem and have influenced the evolution and financing of the leading technology firms in the U.S. market. Nevertheless, this study reveals that the transition to public equity markets leads to a decline in innovation quality, and pursuing innovation is more challenging due to the stock market pressures and the difficulty of retaining key inventors.”

This study is sure to add fuel to the fire about concerns that the pressures of modern day capital markets may be favoring short-term gains over long-term growth. “The IPO event is far from being a simple fundraising process. Rather, it is an event that affects almost all of the daily operations of the firm,” Bernstein says. As policymakers look to further reforms of capital markets and the taxation of capital gains, addressing the innovation issue should be part of the discussion.

Innovator’s Dilemma: IPO or No? is the latest in a series of ahead-of-the-curve, groundbreaking pieces published through Third Way’s NEXT initiative. NEXT is made up of in-depth, commissioned academic research papers that look at trends that will shape policy over the coming decades.

In this series, we seek to answer the central domestic policy challenge of the 21st century: how to ensure American middle class prosperity and individual success in an era of ever-intensifying globalization and technological upheaval. It’s the defining question of our time, and one that, as a country, we’re far from answering.

Each paper dives into one aspect of middle class prosperity—such as education, retirement, achievement, or the safety net. Our aim is to challenge, and ultimately change, some of the prevailing assumptions that routinely define, and often constrain, Democratic and progressive economic and social policy debates. And by doing that, we’ll be able to help push the conversation toward a new, more modern understanding of America’s middle class challenges—and spur fresh ideas for a new era.

Jonathan Cowan
President, Third Way

INNOVATOR'S DILEMMA:

IPO OR NO?

by Shai Bernstein

The central challenge facing policymakers today is the creation of robust economic growth, and that means creating the best possible climate for innovation—the major engine of growth in the U.S. economy. This paper looks at one important aspect of innovation: how the transition to public equity markets affects firms’ innovation strategy.

The Initial Public Offering (IPO) is the process through which a firm sells its shares to the general public on a securities exchange for the first time and transitions to the public equity markets, where its stock is traded. Historically, the IPO market has played a central role in the evolution of technology firms. Since 1980, almost 40% of the firms that have gone public have been technology firms, raising more than \$250 billion in gross proceeds.¹

But since the beginning of the 2000s, there has been a decline in IPO volume, raising concerns by corporate managers and policymakers that the dearth of IPOs may mark a breakdown in the engine of innovation and growth.² The concern was strong enough that on April 5, 2012, President Obama signed a bill known as the Jumpstart Our Business Startups—or JOBS—Act. This bill aimed to alleviate such concerns about the decline in IPOs by easing the process of fundraising through the IPO market for young, fast-growing companies.

Given these concerns about the IPO market, it is important to understand how going public affects the process of innovation. There are several dimensions of a firm’s innovation strategy—internally generated innovation, individual inventors’ mobility and productivity, and reliance on acquisitions to acquire external innovation—all of which I will explore in this paper. But first, why are the IPO markets so important for the tech sector and the entrepreneurial ecosystem?

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ADVANTAGES OF THE IPO MARKET

IPO markets provide liquidity for early stage investors such as Venture Capital (VC) firms. This liquidity provides the rewards for venture capitalists' risk and motivates the investments in early stage tech companies in the first place. Typically, VCs generate the lion's share of their returns through the IPO market, and, not surprisingly, periods in which the IPO market is active and vibrant are associated with high venture capital returns and large inflows of funds into the venture capital industry. Hence, there is a direct link between the health of the IPO market and the financing of early stage technology startups.

But maybe more importantly, the IPO market allows fast-growing companies to raise much-needed capital to fund their operations, innovation, and expansion. While this might be true for all firms, this is particularly the case for technology firms. In the U.S., young publicly traded firms in the high-tech industries finance their R&D investment almost entirely with either their own generated cash flow or through public share issues. Other forms of financing, such as debt, may be typically limited for technology firms due to the high degree of uncertainty associated with R&D investments. Moreover, the key assets of technology firms are typically intangible. The firm's knowledge, from which profits in future years will be generated, are typically embedded in the firm's employees. Therefore, the most important assets of technology firms cannot be used as collateral, which is typically required with debt financing.³

Therefore, funds raised through an IPO and subsequent equity issuances can significantly alleviate financing constraints and allow technology firms to further enhance their innovative capabilities. Following an IPO, firms can upgrade their lab equipment, attract new talent by offering stock options, and even acquire existing companies using the stock as a currency for acquisitions. One would expect, therefore, that technology firms would be able to enhance their innovative capabilities following the IPO and the transition to public equity markets.

DISADVANTAGES OF THE IPO MARKET

However, the IPO process does not come without a cost. Innovation in firms typically take a long time and involves significant risk and uncertainty. While the cost of innovation takes place today through R&D expenses, its benefits may or may not accrue in the long run. With quarterly earning reports, analyst expectations, and stock price fluctuations, it may be tempting to reduce such investments toward efforts that are materializing more quickly, that is, sacrificing long-term growth for short-term profits. Therefore, after the transition to public equity markets, managers may choose to focus on more incremental types of innovation.

This concern about stock market pressures were apparent, for example, back in 2010 when Facebook was deliberating whether or not to go public. Mark Zuckerberg expressed openly that “Being private is better for us right now because of some of the big risks we want to take in developing new products ... it would be even more difficult if we had a public stock price bouncing around.”⁴ Hence, stock market pressures may dissuade managers from taking much risk and pursuing more incremental innovation.

Another difficulty after the IPO may arise with the retention of key employees. Going public provides a significant liquidity event for early employees. Following the IPO, firms may struggle to retain these workers, arguably, the same workers who were responsible for the most important innovations of the firm in its early days. This concern was expressed, for example, by Google at the time of their IPO back in 2004, as one of the risk factors in their prospectus said that “the initial option grants to many of our senior management and key employees are fully vested. Therefore, these employees may not have sufficient financial incentives to stay with us.” This difficulty in retaining key employees may affect the ability of firms to innovate following the IPO.

Markets also generate economic forces to reduce differences in pay or performance.

MEASURING THE CONSEQUENCES OF IPOs ON INNOVATION

In light of the above discussion, is it possible to measure the effect of IPOs on firm innovation?

To explore how going public affects firm innovation, we need to discuss first how to measure innovation. To do so, in this paper I focus on innovation measured in the form of patents granted by the firm in the three years before the IPO filing and five years after. While patent measures are publicly available and quantifiable, one needs to be careful about drawing conclusions that firms with more patents are necessarily more innovative, as patent counts cannot distinguish between breakthrough innovation and incremental discoveries.

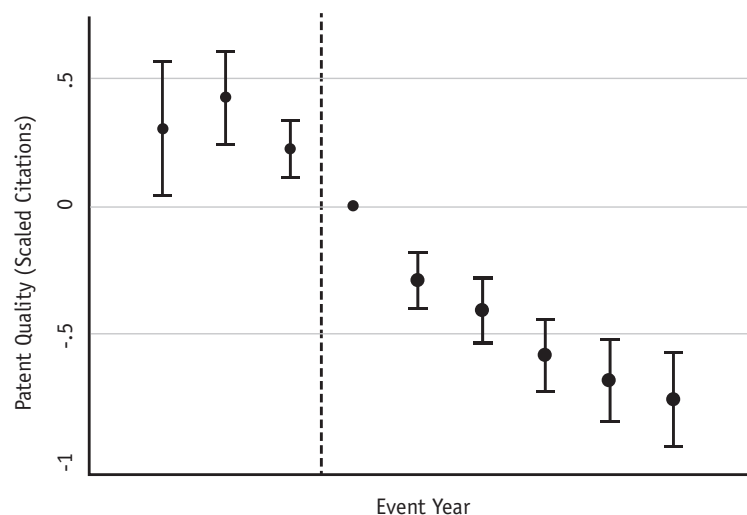
To get around this problem, I attempt to measure the quality of innovation, which I measure through the number of future technologies that build on existing innovation. More precisely, I measure the quality of an existing patent through the number of future patents that cite it, and thus, a highly cited patent is a patent that saw its technology and key ideas widely used by numerous inventors, illustrating the importance and quality of its technological contribution. Patents that are cited more often are likely to represent more fundamental breakthroughs and become economically important to the firm, as this measure correlates with a firm's stock market value. In fact, it turns out that stock markets seem to react more positively and strongly to patents that ultimately are more cited in the future.⁵ I refer to patent citations as a measure of the "quality" of innovation produced by the firm.

In the analysis, I collect financial and patent information on close to 2,000 technology firms that submitted their IPO filing. These firms produced approximately 45,000 patents in the time period of three years before the IPO filing until five years after.

The figure below illustrates the changes in innovation quality, measured by patent citations, in the years around the IPO, when year zero is the year in which the firm went public. The results are quite striking—firms experience a monotonic decline in innovation quality after the IPO. In fact, the decline starts two years before the IPO event, and it continues in the five years thereafter.

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Figure 1. Quality of Innovation around the IPO event.



There are two potential interpretations of the figure above. One interpretation is that the post-IPO decline in innovation quality is driven by the transition to public equity markets. An important alternative interpretation, however, is that firms decide to go public at the peak of the innovation output. In this case, the decline in innovation quality is not due to the transition to public equity markets, but instead is due to the life cycle of the firm and the decision of when to go public.

To distinguish between these two interpretations, we would like to conduct the following ideal experiment, similar to clinical trials of new drugs: We would like to randomly provide the drug to one set of patients, while giving the placebo to others. In our context, we would like to randomly allocate some firms to go public, while remaining firms will stay private. Then we could compare the innovative strategies of those firms that went public with those that remained private.

Clearly, randomly allocating firms to go public for research purposes is unthinkable, to say the least. In the study, therefore, I take an alternative approach. I compare two groups of firms—firms that went public and firms that filed the IPO registration with the Securities and Exchange Commission but later withdrew them for reasons *unrelated* to their innovation strategy and remained private. More precisely, the latter group withdrew its IPO filing because of unexpected fluctuations in the stock market. As it turns out, if the tech-heavy NASDAQ went into a swoon just after a company filed to go public, the company was much more likely to call off its plans.

Overall, this approach allows us to compare two firms that attempted to go public, and thus are likely to be in the same stage of their life cycle and innovative cycle. One firm ultimately withdrew its IPO filing due to unexpected stock market movement, but other than that, the withdrawing firm looked similar to the remaining firm on other dimensions. Using this empirical methodology allows us to explore the causal consequences of the IPO markets on various aspects of innovation strategy.

HOW DOES THE IPO CHANGE INNOVATION STRATEGY?

First, I explore how the quality of innovation produced by firms, measured by patent citations, changes after they go public. Comparing firms that went public relative to those that remained private reveals that the average quality of innovation declined by about 40% in the long run five years after the IPO event. By contrast, companies that remained private stayed on the same track as before. I also explore the “originality” of innovation produced by firms, which measures the number of different technologies being used by inventors. It turns out that innovations after the IPO rely on significantly fewer types of technologies. Hence, it seems that innovation simply become narrower, more focused, and more incremental after the IPO.

What can explain the decline in innovation quality and originality? One potential explanation is the departure of key talent after the IPO. To explore whether this could be the case, I divide inventors into three categories: “Stayers” are those who stayed at the firm after the IPO. “Leavers” are those inventors who left the firm after the IPO, and “newcomers” are those new inventors who joined the firm after the transition to public equity markets.

I find that, relative to those firms that remained private, the IPO event leads to an increased likelihood of employee departure. Inventors were about 18% more likely to leave the firm after the company went public. These leavers are likely to be exactly those who were responsible for the key innovation at the firm in the IPO pre-period.

One potential explanation for this exodus of inventors is that the IPO event can be particularly lucrative for early employees. These employees may have little incentive to stay with the firm and would be inclined to pursue different ventures. Alternatively, it may be the case that early employees prefer to work in an entrepreneurial environment. Following the IPO, the firm may grow and become

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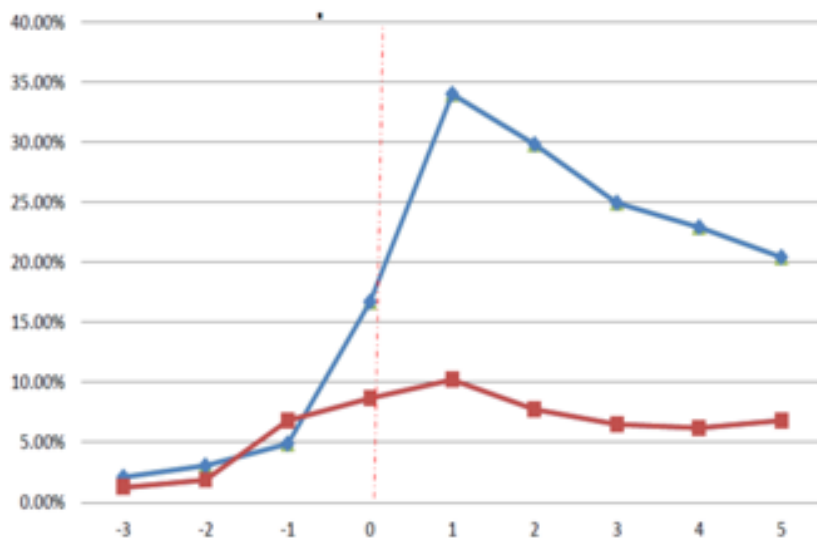
more bureaucratic and may be more focused on commercialization rather than innovation. This may lead early employees to leave the firm. Both these explanations are in fact consistent with my findings. Inventors who choose to leave the firm after the IPO are indeed likely to start new ventures after the IPO.

What happens to the productivity of inventors who remain with the firm after the IPO? It turns out that the stayers experienced a striking decline of 48% in the quality of their innovation. At the same time, the IPO firms recruit a large number of newcomers whose innovation quality is somewhat comparable to the stayers'. The fairly low quality of innovation produced by stayers and newcomers at the IPO firm could mark a shift in the innovation strategy of the firm. Alternatively, it could be the case that it is just more difficult to compensate inventors for breakthrough innovations at a publicly traded company. An IPO dilutes an inventor's stake in subsequent breakthroughs because those future profits will be spread among many more investors. Therefore, inventors may prefer to pursue breakthrough innovations outside the firm.

An alternative approach to internal innovation is simply to acquire off-the-shelf innovation externally. This is the next dimension I explore. Not surprisingly, I find that firms that went public exhibit a sharp increase in their M&A activity in the five years following the IPO, while there is hardly any effect for those companies that had to withdraw their IPO filing and remain private. This effect is illustrated in the figure below. The Y axis is the probability of acquiring a company in the years around the IPO filing, comparing firms that went public (blue line) and firms that remained private (red line). It is evident that from the year of the IPO filing, the transition to the public equity markets allows firms to increase their M&A activity.

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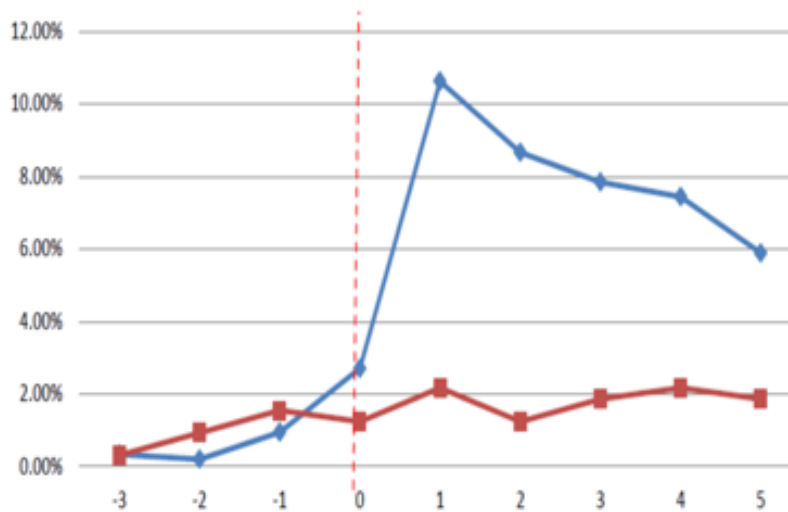
Figure 2. Acquisition likelihood around IPO event.



The increase in the M&A activity after the IPO should come as no surprise. The publicly listed firms not only have better access to capital, but can also use their stock as a currency for acquisitions. Acquisitions, however, are used for a variety of reasons. The question that remains is whether this strategy is used to acquire innovation externally and maybe even substitute for the decline in innovation quality that the firm is producing internally.

To explore this hypothesis, I collected information on the innovation of the target acquisitions through their patenting activity in the years leading to the acquisition. The figure below illustrates the increased reliance on external innovation after the IPO. The Y axis captures the probability of acquiring external patents in a given year around the IPO. The probability jumps significantly in the years after the IPO for the firms that went public (blue line), while remains fairly stable and close to zero for those firms that remained private (red line).

Figure 3. Acquisition likelihood of external patents around IPO event.



Interestingly, the quality of innovation acquired externally is higher than the internal innovation generated by the firm, as measured by patent citations.

Overall, in the five years after the IPO, roughly 30% of the patent portfolio of the firms that went public came from acquisitions (considering the patents generated by the targets before the acquisition). Interestingly, the quality of innovation acquired externally is higher than the internal innovation generated by the firm, as measured by patent citations.

So far, the study reveals important and significant changes in the innovation strategy of firms after the transition to public equity markets. First, firms experience a decline in innovation quality and originality in the five years after the IPO. Second, firms experience significant employee turnover. Key talent and early workers tend to leave, exactly those inventors who were likely to be responsible for the key innovation generated by the firm in the years before the IPO. The innovative productivity of remaining employees declines significantly in the years after the IPO. However, the increased access to capital allows firms to attract new inventors, as well as acquiring innovation externally through M&A. Overall, the results illustrate that the IPO event is far from being simply a fundraising activity. Instead, it marks a significant shift in the innovation strategy of firms, and an increased reliance on external innovation.

WHAT IS CAUSING THESE CHANGES?

What is causing the shift in innovative strategy following the transition to public equity markets? Why does internal innovation quality decline while reliance on external innovation increases? Below I discuss several potential explanations and assess whether the empirical evidence is consistent with these explanations.

Let start with maybe the most natural explanation of the findings—firms go public at the peak of their innovation activity (to maximize valuation), and therefore, no wonder we see a decline in innovation quality in the years after the IPO. However, this explanation can be easily rejected because of the empirical design of the paper. Essentially, we compare two firms that filed to go public, one completed the IPO and other withdrew the filing because of exogenous movements in the stock market and thus remained private. If the decline in innovation quality is simply due to the particular timing in which firms choose to go public, this should apply to both the firms that completed the IPO process and those that withdrew their IPO filing and remained private.

A second potential explanation is related to the cost of commercialization. It might be the case that commercializing the innovation is particularly costly such that only companies that transition to public equity markets, and thus have improved access to capital, can focus on commercializing their innovation. Indeed, commercialization can be particularly costly and require many resources to establish manufacturing facilities and distribution networks and to engage effectively with customers. If resources are limited in the organization, then the focus on commercialization could lead to a decline in innovation quality of the publicly traded companies. In contrast, those firms that remained private are forced to focus on innovation, since they do not have the resources to commercialize their innovation.

However, the empirical evidence is not consistent with this explanation. I find that the decline in innovation quality is concentrated also among the largest firms that went public, with the most resources and the least financially constrained. Moreover, the decline in innovation quality is apparent also among firms in the software industry, in which, arguably, the cost of commercialization is lower, say, than in the biotech and pharmaceutical industries. Finally, I also study firms that stated explicitly in their IPO prospectus that the

main motivation for the IPO is to finance their innovative activities. Even among this set of firms, I find a significant decline in innovation quality in the years after the IPO.

As a final explanation, I consider the potential possibility that the IPO may alter the management incentives, particularly when it comes to innovation strategy. Innovation is risky and takes a long time to materialize. Such projects are difficult to pursue in an environment in which stock price is fluctuating and they need to provide explanations on the profitability of the firm every quarter. It might be tempting to reduce investment in innovation to satisfy short-term analysts' expectations.

Another complexity that managers could experience in publicly traded firms is the need to explain the merits of innovation to a dispersed shareholder pool (unlike in the case of private firms, where shareholder holdings are much more concentrated). Due to the dispersed ownership, shareholders may have lower incentives to carefully monitor the firm and understand the potential benefits of innovation. Shareholders that lose patience can immediately sell the stock (again, in contrast to private firms) and trigger stock price declines.

To explore the validity of such explanation, I compare the consequences of going public on innovation for firms with two different management structures. In the first group, chief executives were also chairmen of the board and had more autonomy and job security to resist market pressures. The second group had separate chairmen and chief executives, which usually means the chief executive is less insulated from market pressure. It turns out that companies with separate board chairs and chief executives — those more likely to be sensitive to outside investors — saw a significantly bigger drop in innovation, and inventors were more likely to leave. The evidence is consistent with the notion that managers whose jobs are more secure and insulated from stock market pressures are willing to take more risks through innovation, in contrast to less-insulated managers.

Overall, while conclusively arguing which story explain these findings, the empirical evidence seem to be consistent with the idea that, as firms become publicly traded, the stock market pressure may affect the managerial incentives and lead them to pursue more incremental type of innovation on the one hand, while relying more heavily on acquisitions of safe and already proven off-the-shelf innovation.

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FINAL THOUGHTS

IPO markets play an important role in the entrepreneurial ecosystem and have influenced the evolution and financing of the leading technology firms in the U.S. market. Nevertheless, this study reveals that the transition to public equity markets leads to a decline in innovation quality, and pursuing innovation is more challenging due to the stock market pressures and the difficulty of retaining key inventors.

If this is the case, then, why do firms insist on going public? In fact, the decline in innovation quality and departure of key employees are not the only costs associated with the transition to public equity markets. The IPO process is expensive due to underwriters' commissions and expenses and legal and accounting fees. Moreover, management needs to devote significant time to ongoing reporting requirements to regulatory agencies rather than focusing on the company's operations, and sustaining control in the firm becomes more challenging.

These costs are balanced by the various benefits that lead firms to go public, such as improving access to capital, providing liquidity and diversification to investors and insiders, and enhancing a firm's reputation, among others. This paper illustrates that an important benefit of going public is the ability to acquire innovation externally and compensate for the decline in quality of internal innovation. Moreover, following the IPO, firms are capable of attracting new talent to the firm, even as it undergoes significant employee turnover. These are two important mitigating forces that alleviate the decline in internal innovation and the departure of existing employees.

The results in this paper illustrate that the IPO event is far from being a simple fundraising process. Rather, it is an event that affects almost all of the daily operations of the firm, including innovation project selection, employee turnover, and acquisitions. These changes cause firms to pursue a different approach to innovation after the IPO.

These findings also highlight the importance and contribution of private firms to innovation in the economy. Such companies are more able to pursue high-quality innovation in the absence of stock market pressures and inventor departure. And in many cases, the innovation of these private firms can be acquired by publicly traded firms that are more focused on commercializing these technologies and bringing them to the product market.

This paper illustrates that an important benefit of going public is the ability to acquire innovation externally and compensate for the decline in quality of internal innovation. Moreover, following the IPO, firms are capable of attracting new talent to the firm, even as it undergoes significant employee turnover.

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Shai's research expertise lie at the intersection of finance, entrepreneurship and innovation. In recent work he explores how the transition to public equity markets affect firm innovation, or whether venture capital firms add value to their portfolio companies. He also studies how do early stage investors choose in which start-ups to invest and how the major collapse in the housing market affected employees innovation. A common thread underlying his work is the attempt to understand the role of finance in shaping the entrepreneurial eco-system and innovation in the economy.