



ADB Working Paper Series

**PUBLIC EQUITY MARKETS
AND INNOVATION**

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No. 772
August 2017

Asian Development Bank Institute

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Suggested citation:

Bernstein, S. 2017. Public Equity Markets and Innovation. ADBI Working Paper 772 Tokyo: Asian Development Bank Institute. Available: <https://www.adb.org/publications/public-equity-markets-and-innovation>

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Abstract

This paper reviews the literature on the role of public equity markets in the innovation ecosystem. The review highlights the importance of public equity markets in funding the research and development activities of young and high growth firms. It also illustrates the dependence of venture capital firms, which provide an important source of capital to early-stage start-ups, on the performance of public equity markets and the initial public offering market in particular. Finally, the paper discusses the potential shortcomings of public equity markets that may hinder innovation, and highlights various mechanisms that may alleviate such concerns.

Keywords: public equity markets, finance, innovation, entrepreneurship, agency problems, venture capital

JEL Classification: G21, G24, L26, M13, O31, O32

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1. INTRODUCTION

One of the key challenges of policy makers today is fostering an environment that promotes innovation and entrepreneurship to create robust economic growth. A growing literature argues that public equity markets play an important role in innovation and entrepreneurial ecosystems (Brown, Fazzari, and Petersen 2009; Comin and Nanda 2014; Hsu, Tian and Xu 2014). Indeed, since 1980, more than 40% of the firms that went public and transitioned to public equity markets in the United States were technology firms, raising more than \$250 billion in gross proceeds according to Jay R. Ritter. This paper discusses the central role public equity markets play in the innovation process of firms and in the entrepreneurial ecosystem more broadly. Specifically, it explores how public equity markets affect the funding and process of innovation of high growth young firms after the initial public offering (IPO), as well as in early-stage financing before the IPO. The paper reviews the potential costs associated with the transition to public equity that may hinder the pursuit of innovative projects, and explores various mechanisms that can alleviate such costs.

Public equity markets affect the innovation process through various dimensions. Maybe the most important role is in the provision of capital to fast-growing companies. While alleviating financing constraints through public equity markets might be important for all young firms, this might be particularly true in the case of technology firms. As is discussed in Section 2, young publicly traded firms in US high-tech industries heavily rely on public equity markets to finance their R&D investments. 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 and the lack of tangible assets in innovative projects.

Selling shares on public equity markets in the IPO (and in subsequent secondary offerings) also provides an important source of liquidity for early-stage investors such as venture capital (VC) firms. The availability of such exit opportunities affects the willingness of VC firms to fund early-stage tech companies in the first place. Typically, the performance of VCs highly correlates with the performance of public equity markets. In periods in which the IPO market is active and valuation of public equity markets is high, venture capital returns are high too, and there are large inflows of funds into the venture capital industry. Such inflows subsequently trigger additional investments in entrepreneurial companies. Hence, there is a direct link between the health of the IPO market and the public equity markets and the financing of early-stage technology start-ups, as discussed in Section 3.

However, the transition to public equity markets does not come without a cost. Innovation in firms typically takes 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 earnings reports, analyst expectations, and stock price fluctuations, managers may be tempted to reduce such investments toward efforts that materialize more quickly—that is, sacrificing long-term growth for short-term profits. Such agency costs are discussed in Section 4, where the evidence that the transition to public equity markets may lead managers to focus on a more incremental type of innovation is considered. The rise of such agency costs may hinder and limit the innovation pursued by publicly traded firms.

In response to concerns about agency costs, a growing literature illustrates that firm innovation in public equity markets may benefit from insulating managers from such stock market pressures, and mitigate the agency costs between managers and shareholders. Various papers discuss how institutional investors, concentrated ownership, and even anti-takeover laws may provide managers of publicly listed firms an environment that is more tolerant of failures, and encourage managers to take riskier projects and more ambitious innovation.

2. PUBLIC EQUITY MARKETS AND THE FINANCING OF R&D

2.1 The Difficulty in Financing Innovation

It is a widely held view that innovative activities and research and development (R&D) are inherently difficult to finance due to their unique characteristics. Firstly, innovation activities may not be fully protected. In contrast to investments such as the building of a factory or machinery, innovation by one firm may not preclude its use by another. This risk of imitation increases the uncertainty regarding such projects, which increases the risks for capital providers.

Even absent of imitation risk, financing innovation is quite challenging given the unique characteristics of innovative projects relative to other forms of investment. For example, most of the spending is on wages and salaries of scientists and engineers, who create intangible assets in the form of knowledge and insights. Hence, such investments do not result in tangible assets or products that can be used as collateral when funding the investment. In fact, to the extent that this knowledge is hard to codify, it is embedded in the firm's human capital, and the firm risks losing the innovation output in the case of employee departure.

Two additional features characterize investments in innovation and R&D. Innovative projects are typically long-term projects, and are associated with a significant degree of uncertainty. These two aspects make it particularly difficult for the financier to evaluate the project, its probability of success, and its net worth in the case of success.

Altogether, innovation differs from regular investment by multiple margins that may expose such activities to higher financing friction. Moreover, given these characteristics, it might not be surprising that young and publicly traded firms in high-tech industries are less likely to fund their innovative activities using debt. Debt often relies on collateral, and typically includes provisions that ensure down side protection. However, innovation value mostly comes from its option value given the uncertainty it involves, and therefore equity securities might be better suited to share the potential upside with financiers.

2.2 Public Equity Markets and the Financing of Innovation

How important are equity issuances in the funding of R&D investments? The earlier literature focused mostly on the largest and most important manufacturing firms in the economy. Hall (1992), for example, found a positive and strong correlation between R&D and firm cash flow, which suggests that these firms are financially constrained, and at the same time rely very little on debt as a form of capital that attempts to alleviate such constraints. Himmelberg and Petersen (1994) reach a similar conclusion when focusing on a sample of small US firms in high-tech industries.

More recent evidence highlights the importance of equity issuances in the funding of R&D and innovation activities. Brown, Fazzari and Petersen (2009) illustrate that both cash flow and the issuance of public equity are particularly important for the financing of R&D for young publicly traded firms. Interestingly, they find that mature firms are much less sensitive to the availability of such resources. Importantly, they argue that shifts in the supply of equity finance during the 1990s to a large degree alleviated financing constraints for young and innovative firms, which in turn enabled the R&D boom in the 1990s. In a separate paper, Brown and Petersen (2009) also find that since the 1970s there has been an increase in the dependency of R&D investments on public equity issuance in the United States, while this dependency has largely disappeared for physical investments.

Consistent with this evidence, Acharya and Xu (2013) further illustrate the importance of public equity markets in the financing of innovation. They find that in industries that are more dependent on external finance, public firms spend more on R&D and generate a better patent portfolio when compared to private firms. However, this is no longer the case in industries that do not rely as heavily on external financing.

Overall, the evidence suggests that public equity markets have become an increasingly important source of capital for young firms to fund their R&D and innovative activities. Such companies are typically highly innovative, may still not be profitable, but nevertheless entail significantly high growth opportunities.

3. PUBLIC EQUITY MARKETS AND THE FUNDING OF EARLY-STAGE FIRMS

3.1 What do VC Firms do?

The availability of thick and well developed public equity markets may play an even greater role in the entrepreneurial ecosystem, beyond the provision of capital to high-growth innovative companies. Public equity markets also provide the opportunity for early-stage investors, such as venture capital firms, to sell their investments through the IPO markets (and subsequent equity issuances) and exit their investments. Without vibrant IPO markets, early-stage investors may be hesitant in investing in the first place, which could limit the funding channel to early-stage technology firms.

Venture capital is an important source of capital in the earlier stages of the funding process in the entrepreneurial ecosystem. Typically, in its earliest stages, a start-up firm may rely on seed financing, mostly from individual investors such as friends, family, and wealthy individuals. As the firm grows, its funding requirements increase, and the start-up will attempt to attract capital from VC firms. As discussed below, VC firms typically engage in screening, monitoring, and financing of start-up companies through multiple funding stages. These investments in highly risky and uncertain early-stage firms rely heavily on the availability of liquid markets that will allow the VC to sell its investments and exit. Historically, the returns of VC firms arise from their ability to sell their portfolio companies through their IPO markets (Gompers and Lerner 1999), and their returns appear to be highly correlated with the returns of the stock market as a whole (Cochrane 2005; Kaplan and Schoar 2005; Ljungqvist and Richardson 2003). Hence, public equity markets—and the IPO market in particular—can have a direct effect not only on publicly listed firms, but also on the supply of capital to early-stage entrepreneurial and innovative firms in the economy.

How important are VC firms for the entrepreneurial eco-system? Many of the most innovative firms in the US economy have been funded initially by VC firms. Since 1970, roughly 40% of firms going public have been backed by venture capital. This number is even higher, reaching more than 60%, when focusing on technology firms. VC firms therefore play a significant role in identifying potential companies, sometimes after screening hundreds if not thousands of potential investments. Following the investment, the VCs, through their active role on the start-up board, may be actively involved in monitoring and advising these companies, with the hope that as the company matures it will ultimately be bought or go public.

Before discussing how public equity markets may affect VC firms' behavior, it is useful to discuss in greater detail what it is exactly that VC firms do. The earliest paper to document the potential involvement of venture capital firms in early-stage investments is that by Hellmann and Puri (2000). They examined a sample of both venture-backed and non-venture firms and conducted in-depth surveys to find that venture capital firms not only provide an important source of equity financing for these start-ups, but also enhance product market strategies and contribute to the success of their portfolio companies.

These results suggest that venture capital investors may play an important role in stirring early-stage ventures to success, and thus may play an important role in innovative companies. These findings are consistent with other papers that illustrate that VC firms are active investors and typically advise companies on their business and financial strategy, take board seats, help to establish governance structures, and assist in raising additional funds (see, for example, Baker and Gompers 2003; Hochberg 2012; Lerner 1995). However, these results rely on small samples, and there are still concerns about causal interpretation of the results. It might be the case that more innovative start-ups choose to be funded by venture capital, rather than the reverse, in which venture capital contributes to the creation of these innovative and successful firms.

Bernstein, Giroud and Townsend (forthcoming) find evidence that is consistent with the causal contribution of VC firms to their portfolio companies. They rule out selection effects by exploiting an exogenous source of variation in VC involvement through the introduction of new airline routes that reduce VCs' travel times to their existing portfolio companies. The authors conduct a large scale survey of VCs to confirm that direct flights indeed increase VCs' interaction with their portfolio companies' management and help them better understand companies' activities. They then find that following the introduction of the direct airline, the VCs' on-site involvement with the portfolio companies leads to an increase in innovation and the likelihood of a successful exit. Hence, VCs seem to play an important role in causally improving the innovativeness and ultimate success of their portfolio companies.

The contribution of venture capital to the entrepreneurial ecosystem and innovation is also apparent at a more aggregate level. Kortum and Lerner (2000) explore the impact of VC firms at the industry level. They address concerns about causality by exploiting the passage of the Employee Retirement Income Security Act (ERISA) in the late 1970s, which allowed pensions to invest in venture capital. This policy shift led to a sharp increase in the funds committed to venture capital and the availability of VC to some industries. This shock of increased flow of venture capital funding led to a strong and positive impact on industry-level innovation. The authors calculate that, on average, a dollar of venture capital appears to be three or four times more significant in stimulating patenting than a dollar of traditional corporate R&D. Moreover, Samila and Sorenson (2011) show that increases in the supply of venture capital in the

metropolitan area positively affect firm births, employment, and aggregate income in the region.

Given the importance of VC firms to the funding and creation process of entrepreneurial firms, it is important to understand how VC firms' behavior is affected by public equity markets. This is discussed in the next section.

3.2 VC Firms and Public Equity Markets

As discussed earlier, VC firms rely on the ability to sell firm shares on public equity markets, mostly through the IPO markets. Increased volume of IPOs may affect both the demand and supply of venture capital funds. On the demand side, the availability of exit mechanisms provides a strong incentive for the entrepreneur to start a company in the first place; on the supply side, it enables investors to provide capital in the wake of exit opportunities.

In that regard, the rapid growth in US venture capital markets may be due to the existence of a robust IPO market, as argued by Black and Gilson (1998). They also argue that this could explain the small share of VC activity in more bank-central economies such as Japan and Germany, which lack such active IPO markets. Exploring the determinants of venture capital in a sample of 21 countries, Jeng and Wells (2000) find evidence consistent with Black and Gilson's argument. While exploring a host of alternative explanations for the rise of venture capital in different countries, they find that the strongest driver of venture capital activity in the economy is the IPO market. In contrast, GDP and market capitalization growth do not seem to be important factors in explaining VC activity in the economy. The sensitivity of venture capital to IPO markets is particularly apparent among later stage VC firms.

The state of the IPO markets also affects the flow of funds raised by VC firms. Gompers and Lerner (1998b) find that taking portfolio companies public has a dramatic effect on the ability of VC firms to raise a new fund, and on the size of the fund. Through the IPO, VC firms can signal their quality, and enhance their reputation, which translates into raising new funds and attracting new high-quality companies. Gompers (1996) argues that such reputational considerations may lead younger VCs to attempt to take companies public earlier, as a way of demonstrating their ability to the market, even at the cost of taking the firm too early.

Public equity markets also affect VC firms' decisions on whether and when to finance companies in another round of funding or to take the firm public. For example, Lerner (1994) illustrates that when market value is high, investors are more likely to take the firm public; in contrast, when valuation is low, they are more likely to provide private financing. Hence, venture capital firms attempt to time the market when deciding when to sell companies to public equity markets. In fact, Lerner finds that more experienced venture capitalists appear to be more successful at timing the IPO market. Hence, the evidence further illustrates the various ways in which public equity markets affect VCs' investments and behavior.

While IPO markets provide an important liquidity event for VC firms, VC firms do not necessarily sell their entire equity stake at the time of the IPO. Instead, they may hold their equity position at the firm and return the money to their limited partners in the form of a transfer of shares, as illustrated by Gompers and Lerner (1998a). Such transfers arise following a significant increase in stock prices prior to distribution. In fact, Iliev and Lowry (2016) find that VCs may even invest in the company after the IPO, instead of simply selling stocks over time. This evidence suggests that venture capital firms' involvement and influence goes even beyond their impact on the pre-IPO period.

Overall, the literature highlights the importance of public equity markets in affecting the fund-raising process, returns, and investment decisions of the VC industry. Consistent with this micro-level evidence, cross-country analysis suggests that healthy and viable public equity markets are a critical determinant explaining the availability of VC financing in the economy.

4. AGENCY COSTS AND INNOVATION IN PUBLIC EQUITY MARKETS

While public equity markets play an important role in the financing of R&D investments of young publicly traded firms, a growing body of work suggests that agency costs associated with the transition to public equity markets can adversely affect innovation. The combination of quarterly earnings reports, analysts' expectations, and fluctuations in stock prices may pressure managers to focus on short-term investments that materialize quickly rather than innovative projects that are highly uncertain and materialize in the long run.

To be more precise, the agency costs between shareholders and managers that are introduced when firms go public can be illustrated with a simple variation of Holmstrom's (1999) model, wherein managers have private benefit from retaining their job and simultaneously need to decide whether or not to innovate. Innovation is highly uncertain and risky, and shareholders' ownership is widely dispersed after the IPO; therefore they have weak incentives to carefully monitor the firm. Because of that, shareholders may mistakenly attribute project failure to the manager's ability, which may lead the manager to underinvest in innovation relative to the optimum. Such managerial myopia also arises in Stein (1988), who shows that managerial short-termism may arise when shareholders cannot properly evaluate investments in long-term innovative projects.

These arguments can be applied directly to the decisions of firms on whether to become listed on public equity markets or remain private. Ferreira, Manso and Silva (2014) argue that private ownership aligns the firm's incentives to invest in innovative projects, as insiders are more tolerant to failures. In contrast, public ownership structure and the quick reaction of prices to news provide insiders with incentives to choose more conventional projects: therefore public ownership is more suited to commercialization than to innovation.

Bernstein (2015) explores how the transition to public equity markets affects firm innovation by focusing on firm patenting behavior around the IPO event. He finds that the quality of innovation deteriorates in the years around the IPO. In fact, the decline starts two years before the IPO event and continues in the five years thereafter. However, there are two potential interpretations of these findings. Firstly, the decline in innovation quality after the IPO is driven by the transition to public equity markets. An alternative interpretation, however, suggests that firms simply choose to go public at the peak of their innovation output. Therefore, the post-IPO decline in innovation quality is not due to the transition to public equity markets, but instead due to the lifecycle of the firm and the decision of when to go public.

To distinguish between the two alternative interpretations, Bernstein compares two groups of firms: firms that went public and firms that filed the IPO registration statements with the SEC 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. Applying this approach, Bernstein finds that firms that went public experienced a decline in their innovation quality by an average of 40% in the five years following the IPO filing relative to those firms that remained private. Moreover, innovation becomes narrower, incremental, and relies on a smaller set of technologies after the IPO.

The change in innovation strategy of firms following the IPO is, in fact, broader. Public firms seem to take advantage of their liquid stock as a potential currency for acquisitions, and their improved access to capital, in order to acquire off-the-shelf technologies externally through M&A, in contrast to those firms that remained private. Hence, following the IPO, firms rely more strongly on external rather than internal innovation.

Another potential cost following the transition to public equity markets is the departure of key employees. The IPO event may provide a significant liquidity event for early employees, and as a consequence firms may struggle to retain such employees. Given that the innovation knowledge of the firm may be embedded in the employees, their departure may adversely affect the ability of firms to innovate. Indeed, Bernstein finds that public firms experience an exodus of inventors following the IPO, particularly of employees that seem to have been responsible for the key innovation in the years leading to the IPO. At the same time, new employees are hired by the firm following the IPO.

The compositional shift in the firm workforce, combined with the acquisition-centric approach to rely on external innovation, marks the shift of public firms toward innovation. These results are consistent with the short-termism interpretation, in which firms are finding it too costly to innovate internally due to market pressures and shift to rely on ready-made technologies through the acquisition of external innovation.

In a related paper, Gao, Hsu, and Li (2014) explore the question of how public equity markets affect firms' innovative strategies, using a propensity score matching to find comparable public and private firms. They find that relative to private firms, public firms' patents are less exploratory. The authors argue that this is due to managerial short-termism that arises because of stock market pressures. Interestingly, they argue that potential forces affecting the extent of the managerial short-termism might be the higher fraction of vested stock option grants, or the higher likelihood of a public firm to become a takeover target when valuations are low (since the shares are liquid), or due to institutional investors that may be particularly oriented toward short-term horizons.

However, the transition to public equity markets may also lead to entrepreneurial spawning, and to the formation of new firms. This is illustrated in Babina, Ouimet and Zarutskie (2016), who use matched employee-employer US Census data to explore the impact of IPOs on employee departures to start-ups. Using a similar approach to Bernstein (2015), they rely on NASDAQ fluctuations to mitigate concerns about the endogeneity of the decision to go public. They find that going public induces employees to leave and join start-up companies instead. Hence, these results suggest that IPO events unlock an important source of human capital for early-stage firms and, in that regard, highlight the importance of IPO activity in the new firm creation process.

5. MITIGATING AGENCY COSTS IN PUBLIC EQUITY MARKETS

The evidence outlined so far suggests that public equity markets may impose agency costs that could adversely affect innovation, despite the improved access to capital associated with the transition to public equity markets.

Various mechanisms discussed in the literature seem to alleviate agency costs in public ownership as they relate to R&D expenditure and innovation. The common theme of these mechanisms is typically the greater insulation of managers from such short-term pressures. This section discusses several such mechanisms that illustrate that insulating managers from short-term pressure seems to positively enhance firm innovation. Some such mechanisms include anti-takeover provisions, institutional investors, and concentrated ownership.

Consider first the case of anti-takeover amendments. Such changes arguably increase managerial security and alleviate career concerns that may arise when innovative projects may take longer to materialize. This will allow managers to take on risk while reducing potential immediate responses by the takeover markets.

One of the first papers to study the effects of anti-takeover provisions was that by Johnson and Rao (1997), who do not find evidence that such amendments are followed by R&D cuts. Pugh, Jahara and Oswald (1999) explore the effects of the adoption of an employee stock ownership plan (ESOP), which is a form of anti-takeover protection. They find that the passage of these ESOP plans lead to an increase in R&D expenditure. However, the results are quite ambiguous, also because of the endogenous nature of the adoption of such provisions.

A set of papers attempt to explore more carefully the causal impact of anti-takeover. Atanassov (2013) exploits the staggered state-level adoption of the business combination anti-takeover laws that exogenously decrease the threat of hostile takeovers. Arguably, this leads to a reduction in managerial pressure and increased tolerance of failures, which could increase innovation and creativity. However, Atanassov finds exactly the opposite result. He finds that the passage of the anti-takeover provisions leads to a significant decline in the quantity and quality of patenting behavior of firms. His finding is consistent with the notion that takeover threats eliminate moral hazard concerns and, in the absence of such takeover threats, managers will choose to shirk, and innovate less. Sapiro, Subramanian and Krishnamurthy (2014) exploit a similar state-level adoption of anti-takeover law and find a U-shaped relationship between innovation and external takeover pressure.

However, the conclusions are more nuanced. Chemmanur and Tian (2012) explore the adoption of firm-level, rather than state-level, anti-takeover provisions and reach a different conclusion. Using a regression discontinuity around shareholder proposal votes, they find that anti-takeover provisions positively affect firm innovation, and this effect is more pronounced among firms that suffer from greater information asymmetry and are in more competitive product markets. Hence, they argue that such provisions help to nurture innovation by insulating managers from the outside short-term pressures of the public equity markets.

Other papers have explored the effects of institutional ownership on agency costs and managerial willingness to take on innovative projects in publicly traded firms. The argument in favor of the mitigating force of institutional investors is consistent with models of career concerns, as in Holmstrom (1999). Institutions such as mutual and pension funds often control somewhat larger blocks of shares, which raises the incentives of shareholders to monitor CEOs and therefore protect the managers from being fired in cases where innovative projects fail in a manner that does not capture managerial ability. Hence, it allows managers to take more risk by increasing their tolerance of failure.

Empirical evidence is broadly consistent with this argument. For example, Majumdar and Nagarajan (1997) find that high institutional investor ownership does not lead to short-term behavior on the part of the firm, as captured by R&D expenditure cuts. Francis and Smith (1995) find a positive correlation between ownership concentration and R&D expenditure, suggesting that monitoring alleviates agency costs and enables more risk-taking and investment in innovation. Moreover, Bushee (1998) finds that companies with greater institutional ownership are also less likely to cut R&D expenditure following poor earnings performance.

More recently, Aghion, Van Reenen and Zingales (2013) explored the effect of institutional ownership on innovation in publicly traded firms, as measured by the patenting behavior of the firm (rather than its R&D expenditure only). Consistent with the importance of agency costs, they find that greater institutional ownership leads to more innovation. Moreover, they find that CEOs are less likely to be fired in the face of profit downturns when institutional ownership is higher, consistent with the role of such investors in insulating managers and enhancing their tolerance of failure which, in turn, facilitates firm innovation.

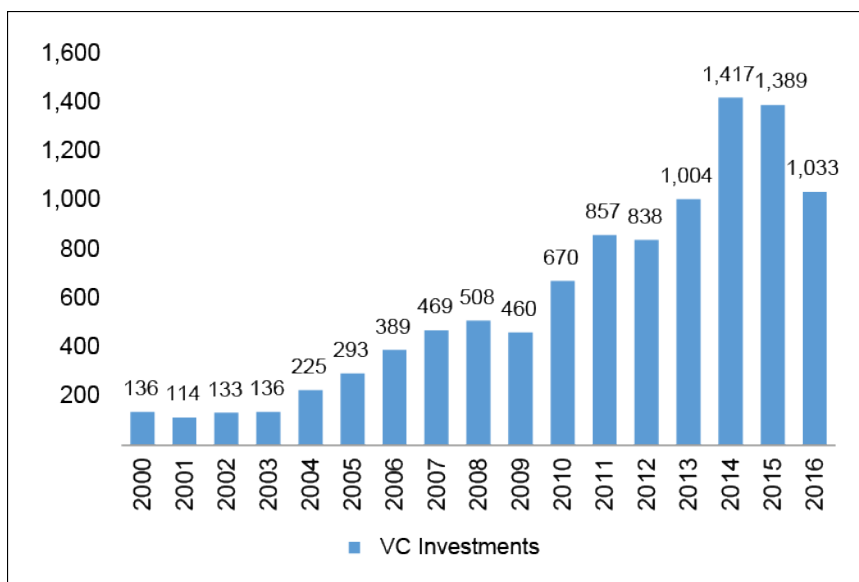
Another illustration of the benefit of concentrated ownership and its insulation from short-term pressures is evident in Lerner, Sorensen and Stromberg (2011). They show that the quality of patents by portfolio firms increases following a private equity acquisition and is more concentrated in the most important areas of companies' innovative portfolio. This finding is yet again consistent with the idea that private equity firms relieve managers from short-term pressures, which allows managers to pursue more ambitious and innovative projects.

Overall, this section provides ample evidence of the consequences of managerial agency costs and career concerns for firm innovation. The literature illustrates that insulating managers from such pressures through mechanisms such as concentrated ownership, institutional investors, or by mitigating takeover concerns enables managers of publicly traded firms to take on more ambitious and risky projects, translating into more innovation in their firms.

6. EVIDENCE FROM ASIA

Most of the academic literature on IPO markets, and in particular on innovation, has been focused on the US. Nevertheless, in recent years, there has been a surge of venture capital investments in East Asia, as illustrated in Figure 1 below. In the People's Republic of China (PRC) alone, venture capital investments was over \$31 billion as VC firms sought to invest in the growing number of innovative businesses in the country. This compares with \$26 billion in 2015 (according to KPMG Venture Pulse report).

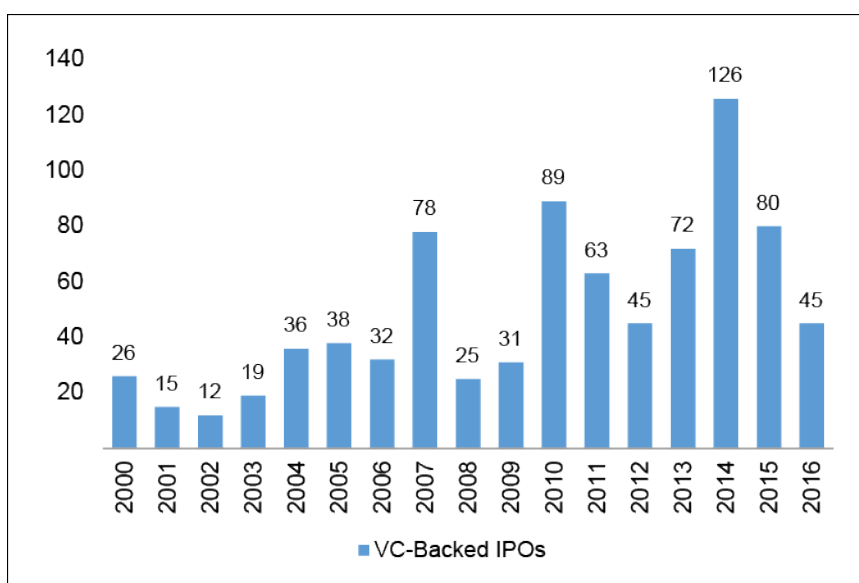
Figure 1: Number of VC Investments in East Asia



Source: Pitchbook. <https://pitchbook.com/> (accessed July 2017).

Similarly, the number of VC-backed IPOs has grown substantially in East Asia over the last few years, and this trend is expected to continue, given the current increase in venture capital investments in pre-IPO firms. This trend is illustrated in Figure 2 below. In fact, the increase in the number of IPOs is much more stark when considering the relative portion of Asia in global IPO markets. It turns out that 60% of all global IPOs (54% of total value) were centered in Asia and the Pacific, mostly due to Greater PRC. This is up from 42% of all IPOs globally back in 2013 (and up from 34% in total value).¹

Figure 2: Number of VC-backed IPOs in East Asia



Source: Pitchbook. <https://pitchbook.com/> (accessed July 2017).

¹ These statistics are based on the EY Global IPO Trends report, released in the first quarter of 2017.

In light of the significant growth in both venture capital investments and IPO markets in Asia, the question that remains is how IPO markets in Asia in particular affect innovation. As mentioned above, most of the research in this area was focused almost entirely in the US. The question of whether the role of IPO markets and their impact on innovation is similar in Asia is not irrelevant, given the many differences between the Asian and US markets in terms of institutions, sources of capital, and characteristics of local firms.

Consider, for example, the case of the PRC. Traditionally, its state-dominated banking sector was the main source of capital for PRC firms. Moreover, bank loans have often been disproportionately allocated to state-owned enterprises (Cong and Ponticelli 2016). However, the PRC is rapidly giving way to public and private equity finance, as illustrated by Allen et al. (2017).

There are stark differences between the IPO market in the PRC and in the US. The PRC IPOs and pricing seem to be much more volatile. For example, the average A-share IPO returns on the first day of trade are between 100% and 900% in studies surveyed by Yu and Tse (2006), compared with roughly 20% on average in the US according to Ritter and Welch (2002). Moreover, PRC firms face a long and often unpredictable lag between IPO offering and listing dates, given the more extensive regulatory approval process than in other countries. This could potentially contribute to the volatile nature of the IPO pricing (Chen, Firth and Kim 2004).

Importantly for the IPO process in the PRC is the notion that, as a number of authors explain, the central government sets an annual quota for new issues and allocates it across provinces and industries according to regional developmental goals. This could lead to a politicization of the IPO selection process. For example, Piotroski and Zhang (2014) find that incumbent politicians are involved and can accelerate local IPOs, particularly of firms with connections to incumbents. This could lead to lower quality offerings. Similarly, Fan, Wong and Zhang (2007) show that three-year post-IPO stock returns for firms with politically connected CEOs underperform those without by 18%, and these firms also have poorer operating performance.

Given the differences highlighted above, the question remains as to whether the effect of IPO markets on innovation documented in the US (Bernstein 2015) is similar in Asian economies. A recent study by Cong, Howell and Zhang (2017) provides useful and important evidence on the effect on innovation of the transition to public equity markets in the Asian context. In particular, the study looks at the PRC IPO process and finds evidence to suggest that innovation declines following the IPO, similar to the findings of Bernstein (2015) in the context of the US IPO market. In particular, the authors explore the patenting activity of firms around the IPO in the PRC using various data sources such as the China Securities and Regulatory Commission (CSRC), China Securities Market and Accounting Research (CSMAR)/WIND, among others. They find a decline in successful patent applications around the IPO year.

This evidence illustrates comparable evidence in both the US and the PRC IPO markets. The transition of firms to public equity markets seems to be associated with a decline in innovative activity, potentially due to short-term pressures associated with the transition to the public equity market. Allen et al. (2017) argue that the selection criteria by which firms are allowed to go public may in their nature lead to short-termism, since firms must show at least three years' positive earnings before the IPO in order to gain approval to go public, and thus may sacrifice long-term innovation projects to reach this threshold.

The next and final section discusses various policy implications that arise from the literature that explore how public equity markets affect innovation.

7. POLICY RECOMMENDATIONS AND CONCLUSIONS

This section summarizes the evidence discussed in this paper on IPO markets and their relationship with innovation and the entrepreneurial ecosystem. It then discusses potential policy implications derived from the evidence highlighted above.

This paper starts by reviewing the literature that explores the role of public equity markets in innovation and entrepreneurship. There is clear evidence that highlights the importance of public equity markets in providing capital to young and high-growth firms which, in turn, allows them to finance their R&D expenditure and innovative activities.

The paper also highlights the somewhat less direct influence of public equity markets on the financing of early-stage firms in the pre-IPO stages. This link arises because of the important liquidity event associated with the IPO for venture capital investors and other early-stage investors in start-ups. The literature demonstrates that the state of public equity markets, and IPO markets in particular, correlates strongly with the performance of venture capitalists and the flow of funds into the venture capital industry, and thus their subsequent investment in start-ups and entrepreneurial companies.

Ample evidence highlights the fundamental dual role of the IPO markets in the entrepreneurial ecosystem. Firstly, they provide an important source of capital for high-growth and innovative firms; secondly, they provide an important source of liquidity to early-stage investors. Hence, it is clear that vibrant IPO markets and public equity markets are important in the economy to enhance innovative activity. Therefore, various policies that attempt to ease the access of private firms to IPO markets are important. Such policies can include more relaxed regulatory requirements for the listing of small and young firms or, alternatively, policies that reduce the uncertainty associated with the IPO selection and approval process. For example, several authors raise concerns about the potentially politicized nature of the IPO selection process in the PRC, which may lead to both adverse selection and crowding out of high-quality firms. Allen et al. (2017) even argue that such bias may lead to potentially serious consequences for growth, as it not only affects the composition of firms going public but may also hinder the development of the market for private equity, where IPOs are a key exit strategy.

While this paper highlights the positive implications of IPO markets for innovation and entrepreneurship, there are also potential drawbacks associated with the transition to public equity markets. The empirical evidence suggests that, in both the US and the PRC, transition to public equity markets may lead to a decline in innovation, possibly due to short-term pressures and an increase in the tendency of managers to focus on projects that materialize quickly rather than on long-term innovative projects.

The paper also reviewed several potentially important mechanisms that can help mitigate such short-term pressures and possibly reduce the decline in innovation following the IPO. The empirical evidence suggests that mechanisms such as anti-takeover provisions, greater holdings of institutional investors, and concentrated ownership can be effective in insulating the managers from such short-term pressures, consequently allowing managers to take more risks in the form of long-term projects and thus enhance and increase the innovation within the firm, even as a publicly traded firm.

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