

Government Incentives for Entrepreneurship

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In the dozen years since the Global Financial Crisis, there has been a surge of interest on the part of governments in promoting entrepreneurial activity, largely by providing financing. This essay explores these policies, focusing on financial incentives to entrepreneurs and the intermediaries who fund them. The motivation for these efforts is clear: the well-documented relationships between economic growth, innovation, entrepreneurship and venture capital. Yet despite good intentions, many of these public initiatives have ended in disappointment. I argue that these failures have not simply been a matter of bad luck. Instead, the unfortunate outcomes have reflected the fundamental structural issues that make it difficult for governments to launch sustained successful efforts to promote entrepreneurship over sustained periods. I highlight several critical challenges, and outline two principles that might render these efforts more effective.

¹ Harvard University and National Bureau of Economic Research. Parts of this essay were adapted from Lerner (2009), Lerner (2013) and Ivashina and Lerner (2019). I thank Ben Jones and Ralph Lerner for helpful comments, Susan Woodward of Sand Hill Econometrics for access to data, and Harvard Business School's Division of Research for financial support. I have received compensation from advising institutional investors in private capital funds, private capital groups, and governments designing policies relevant to private capital. All errors and omissions are my own.

Introduction

In the dozen years since the Global Financial Crisis, there has been a surge of interest on the part of governments in promoting entrepreneurial activity, largely by providing financing (Bai et al, 2020). This essay explores these policies, focusing on financial incentives to entrepreneurs and the intermediaries who fund them. (Other chapters in this volume discuss related policies to create a general business environment conducive for entrepreneurship and innovation, such as through the tax code, cluster development, and labor force reforms.)

The motivation for these efforts is clear: the well-documented relationships between economic growth, innovation, entrepreneurship and venture capital. Yet despite good intentions, many of these public initiatives have ended in disappointment. To cite a several examples over the past decade:

- The U.S. Department of Energy’s clean energy initiative was created in 2005, but remained unfunded until 2009 when it received financing as part of the American Recovery and Reinvestment (also known as the Stimulus) Act.² The program was to provide loan guarantees and direct grants to risky but potentially rewarding energy projects that may otherwise be too risky to attract private investment. More than \$34 billion was spent in less than four years, which was almost \$2 billion more than the total private VC investment in the field. The proposed investments were controversial at the time. As one organization protesting the program noted, “DOE has minimal experience administering a loan guarantee program, and its one test case ended with taxpayers paying a heavy price. In the late 1970s and early 1980s, DOE offered billions in loan guarantees for the development of synthetic fuels. Due in large part to poor administration and market changes, the federal government was forced to pay billions to cover the losses” (“Oppose,” 2010). These worries proved prescient. The enormous scale of the public investment appears to have crowded out and replaced most private spending in this area, as VCs waited on the sideline to see where the public funds would go. Moreover, in the wake of extensive industry lobbying, the investment decisions of government administrators have led to a number of embarrassing bankruptcies (e.g., Solyndra, A123 Systems, Beacon Power).³ Rather than being stimulated, cleantech has

² See, for instance, Gold (2009), Kao (2013), Kirsner (2009), Mullaney (2009), and Sposito (2009).

³ Evaluating the return from these start-up investments is very difficult. As far as I can tell, the numerous evaluations of these programs by government agencies and academics have not attempted to compute one. Much of the difficulty stems from the fact that payments were made under a variety of programs (e.g., the 1705 Loan Guarantee Program and the Advanced Technology Vehicle Manufacturing Loan Program) and payment to start-ups were funded were mingled alongside those to established entities like Goldman Sachs and NRG Energy, where the bankruptcy risk was presumably much lower (though the rationale for public funding may have been so as well (Lipton and Krauss, 2011)). But given that public funding went to some of the most spectacular start-up bankruptcies in the sector, and that even independent venture capital investments in this sector between the beginning of 2008 and the third quarter 2019 have yielded (according to Sand Hill Econometrics) an annualized loss of -2.6% (before accounting for fees),

fallen from 14.9% of venture investments in 2009 to 1.5% of capital deployed in the first nine months of 2019.⁴

- The Saudi government has spent many tens of billions of dollars seeking to promote venture capital activity in the Kingdom.⁵ These have included a wide variety of regulatory reforms (creating, for instance, a second-tier market for entrepreneurial listings and facilitating the business registration process), the establishment of venture funds and regional hubs (often in conjunction with new universities), and global venture capital investments. In the last regard, the most notable was a commitment of \$45 billion by the Saudi Public Investment Fund—a Saudi sovereign wealth funds whose stated mission is to be “the engine behind economic diversity in the KSA” (Kingdom, 2019)—to the SoftBank Vision Fund. Yet the level of venture capital in the KSA has remained very modest. According to the consulting firm MAGNiTT (2019), only \$50 million of venture capital was raised in 2018 by Saudi firms and 2019 is on a very similar pace. The 2018 value represented 0.006% of gross domestic product, a level one-sixtieth of that of Israel and akin to that of the lowest nations tracked on this measure by the Organisation for Economic Cooperation and Development (e.g., Italy, the Russian Federation, and Slovenia) (OECD, 201).
- The Chinese government, after a series of adept moves to promote venture capital over two decades, made a major commitment in the middle part of the 2010s to promoting venture capital.⁶ Under the Government Guidance Fund program, over \$231 billion was invested in government-sponsored venture funds in 2015 alone, largely by Chinese government bodies and state-owned enterprises. By way of context, this amount was more than five times the total amount committed to venture funds worldwide by all other investors in 2015. The government claimed it had raised \$1.8 trillion for these funds by the end of 2018.⁷ The result appears to have been a massive bubble, followed by a quick collapse and slow-down. Between the fourth quarter of 2016 and the fourth quarter of 2018, fundraising dropped by nearly 90%, a trend that has continued into 2019. As a result, Chinese companies has fallen from a peak of 45% of venture capital invested worldwide to 15% in the second quarter of 2019 (Rowley, 2019). The prediction at the time of Gary Rieschel of Qiming Venture Partners (Shen, 2016) is looking increasingly prescient: “They have a fantasy that if they give everyone money they’ll create entrepreneurs. What it will result in is catastrophic losses for the government.”

In this essay, I argue that these failures have not simply been a matter of bad luck: for instance, the choice by the Obama administration, to target its subsidies to entrepreneurial firms to A123 Systems and Solyndra, rather than the more viable cleantech firms that would have avoided

it is hard to be optimistic about the performance of the investments in entrepreneurial firms as part of this initiative.

⁴ Based on the author’s analysis of data from Sand Hill Econometrics.

⁵ This paragraph is based on Seoudi and Mahmoud (2016), Sindi (2015), and assorted press accounts.

⁶ This paragraph is based in part on Oster and Chen (2016), Feng (2018), and Yang (2019).

⁷ Based on the author’s compilation of Preqin data.

bankruptcy. Instead, the unfortunate outcomes have reflected the fundamental structural issues that make it difficult for governments to launch sustained successful efforts to promote entrepreneurship over sustained periods. I highlight several critical challenges, and outline two principles that might render these efforts more effective.

The Motivation

Public bodies have been motivated to undertake these efforts by the perceived relationship between entrepreneurial activity on the one hand and employment opportunities, innovation, and economic growth on the other. The reader by this point in the volume should be convinced of the importance of innovation to entrepreneurship growth. But the role that entrepreneurship in general and venture capital in particular play in promoting innovation have been much less thoroughly discussed so far.

Initially, economists generally overlooked the creative power of new firms: they suspected that the bulk of innovations would stem from large industrialized concerns. For instance, Joseph Schumpeter (1942), one of the pioneers of the serious study of entrepreneurship, posited that large firms had an inherent advantage in innovation relative to smaller enterprises.

These initial beliefs have not stood the test of time. Rather, today they look like the intellectual by-product of an era that saw large firms and their industrial laboratories (such as IBM and AT&T) replace the independent inventors who accounted for a large part of innovative activity in the late nineteenth and early twentieth centuries.

In today's world, Schumpeter's hypothesis of large-firm superiority does not accord with casual observation. In numerous industries, such as medical devices, communication technologies, semiconductors, and software, leadership is in the hands of relatively young firms whose growth was largely financed by venture capitalists and public equity markets. (Think, for example, of Boston Scientific, Cisco, Intel, and Microsoft.) Even in industries where established firms have retained dominant positions, such as finance, small firms have developed an increasing share of the new ideas, and then licensed or sold them to larger concerns. Large firms are if anything cutting back their investments in basic science. (See the evidence in Arora, Belenzon, and Pataconi, 2015.)

This pattern of new ventures playing a key role in stimulating innovation has been especially pronounced in the past two decades. The two arenas that have seen perhaps the most potentially revolutionary technological innovation—biotechnology and the Internet—were driven by smaller entrants. Neither established drug companies nor computer software manufacturers were pioneers in developing these technologies. Small firms did not invent the key genetic engineering techniques or Internet protocols. Rather, the enabling technologies were developed with government funds at academic institutions and research laboratories. It was the small entrants, however, who first seized upon the commercial opportunities. Even in areas where large firms have traditionally dominated, such as energy research, start-up firms appear to be playing an increasing role.

Not only do Schumpeter's arguments fail the test of experience, but systematic studies have generated little support for his belief in the innovative advantage of large firms. Over the years, economists have tried repeatedly to measure the relationship between firm size and innovation. While this literature is substantial, it is remarkably inconclusive. While I will not inflict upon the reader a detailed review of the hundreds, if not thousands, of papers on this subject, it is worth highlighting that they give very little support to the claim that large firms are more innovative.⁸ Much of this work has related measures of innovative discoveries—for example, R&D expenditures, patents, or inventions—to firm size. Initial studies were undertaken using the largest manufacturing firms; more recent works have employed larger samples and detailed data (e.g., studies employing data on firms' specific lines of business). Despite the improved methodology of recent studies, the results have remained inconclusive: the studies seem as likely to find a negative as a positive relationship, and even when a positive relationship between firms' size and innovation has been found, it has had little economic significance. For instance, one study concluded that a doubling of firm size increased the ratio of R&D to sales by only 0.2 percent (Cohen, Levin and Mowery, 1987).

Whatever may be the relationship between a firm's size and its innovations, one of the relatively few things that researchers can agree on is the critical role played by new firms, or entrants, in many industries. The role of start-ups in emerging industries has been highlighted not just in many case studies, but also in systematic research. For instance, a study by Acs and Audretsch (1988) examined which firms developed some of the most important innovations of the twentieth century.⁹ They documented the relative contribution of large and small firms. Small firms contributed almost half the innovations they examined. But they found that the contribution of small firms was not central in all industries. It was greatest in immature industries in which market power was relatively unconcentrated. These findings suggest that entrepreneurs and small firms play a key role in observing where new technologies can meet customers' needs and rapidly responding to the,. Whether owing to poor incentives, inefficient internal capital markets, or other causes, larger firms do not appear to fare well in this regard.

Recent studies have also pointed to the special advantage in innovation enjoyed by young entrepreneurs backed by venture capital firms. Considerable evidence shows that venture capitalists play an important role in encouraging innovation. The types of firms that they finance—whether young start-ups hungry for capital or growing firms that need to restructure—pose numerous risks and uncertainties that discourage other investors.

Where, then, does this advantage come from? The financing of young firms is a risky business. A lack of information makes it difficult to assess the potential of these firms, and permits opportunistic behavior by entrepreneurs after financing arrives. To address these information problems, venture investors employ a variety of mechanisms that seem to be critical in boosting innovation.

The first of these devices is the screening process that venture capitalists use to select investment opportunities. This process is typically far more efficient than that used by other funders of

⁸ The interested reader can turn to surveys by Azoulay and Lerner (2012) and Cohen (2010).

⁹ Similar studies include Aron and Lazear (1990) and Prusa and Schmitz Jr. (1994).

innovation, such as corporate research and development laboratories and government grant-makers. In addition to the careful interviews and financial analysis, venture capitalists usually make investments with other investors. One venture firm will originate the deal and look to bring in other venture capital firms. Involving other firms provides a second opinion on the opportunity. There is usually no clear-cut evidence that an investment will yield attractive returns. Having other investors approve the deal limits the likelihood of funding bad deals. The result of this detailed analysis is, of course, many rejections: only about 0.5 to 1 percent of business plans are funded (Kaplan and Stromberg, 2004). Inevitably, many good ideas are rejected as part of the assessment process.

When venture capitalists invest, they hold not common stock, but rather preferred stock (Kaplan and Stromberg, 2003). The significance of this distinction is that if the company is liquidated or otherwise returns money to the shareholders, preferred stock is paid before the common stock that entrepreneurs, as well as other, less privileged investors, hold. Moreover, venture capitalists add numerous restrictive covenants and provisions to the preferred stock. They may be able, for instance, to block future financings if they are dissatisfied with the valuation, to replace the entrepreneur, and to have a set number of representatives on (or even control of) the board of directors. In this way, if something unexpected happens (which is the rule rather than the exception with entrepreneurial firms), the venture investor can assert control. These terms vary with the financing round, with the most onerous terms reserved for the earliest financing rounds.

The staging of investments also improves the efficiency of venture capital funding (Gompers, 1995; Neher, 1999). In large corporations, research and development budgets are typically set at the beginning of a project, with few interim reviews planned. This pattern contrasts with the venture capital process: once they make a decision to invest, venture capitalists frequently disburse funds in stages. The refinancing of these firms, termed “rounds” of financing, is conditional on achieving certain technical or market milestones. Proceeding in this fashion allows the venture capitalist to gather more information before providing additional funding, thus helping investors separate investments that are likely to be successful from those that are likely to fail. Managers of venture-backed firms have to return repeatedly to their financiers for additional capital, which allows venture capitalists to monitor that their money is not being squandered on unprofitable projects. Thus, an innovative idea continues to be funded only if its promoters continue to execute well.

Finally, venture capitalists provide intensive oversight of the firms they invest in. Survey evidence (Gompers et al., 2020) suggests that over 25% of venture capitalists interact multiple times per week and an additional one-third interact once a week. These interactions can have profound impacts. One intriguing study by Bernstein, Giroux and Townsend (2016) supports these claims, showing that when an airline adds a direct flight between the city of a venture capitalist and one of his or her existing portfolio firms (which presumably facilitates face-to-face interactions), the firm is likely to experience a boost in innovative and financial performance.

With support from venture capitalists, start-ups can better invest in the research, market development, marketing, and strategizing they require to attain the scale necessary to go public. This importance of this backing can be illustrated in stylized facts, such as that of the ten most

valuable companies in the world in November 2019, fully seven (five U.S. based and two Chinese) were originally venture backed.

The positive impact of venture capitalist also corroborated in large-sample research. Especially relevant is the finding of Kortum and Lerner (2000) that even after addressing the concern that venture capital investments are highly targeted, venture funding does have a strong positive impact on innovation. The estimated coefficients vary according to the techniques employed, but on average a dollar of venture capital appears to be *three to four* times more potent in stimulating patenting than a dollar of traditional corporate R&D. While venture capital has historically been small relative to corporate research, it is responsible for a much greater share of U.S. commercial innovations.

The Challenges

Given the apparently strong relationship between entrepreneurship, innovation and growth, it is not surprising that governments world-wide have sought to promote new ventures. But as the examples in the introduction suggest, many public efforts have gone astray.

In particular, in this section, I highlight three aspects of the nature of entrepreneurial ventures that pose substantial challenges to government policymakers.

The Geographic Dilemma

The first challenge is the tight geographical focus of entrepreneurial businesses. Entrepreneurial businesses are often clustered geographically (Glaeser, Kerr, and Ponzetto, 2010); venture-backed businesses even more so (Chen, Gompers, Kovner, and Lerner, 2010). These patterns characterize such businesses around the world.

The highly skewed distribution of venture capital investment can be illustrated by a tabulation of Pitchbook data between 2015 and 2017 by Florida and Hathaway (2018). The authors concluded that the top ten urban areas for venture financing (six in the U.S., two in China, London, and Bangalore) accounted for 62% of venture disbursements worldwide; while the top 25 urban areas accounted for 75% of all disbursements.

This disbursement is not accidental, but rather reflects the nature of investment performance. The Sand Hill Econometrics index of gross (pre-fee) returns from venture capital investments between 1980 and 2019 highlights a substantial discrepancy between Silicon Valley and other U.S. regions. Northern California transactions reported an annualized return of 25.6%, substantially more than other regions such as New England (14.3%), mid-Atlantic (15.4%), and non-California Pacific states (13.5%).¹⁰ While accurate regional return data is not available worldwide, undoubtedly this pattern would repeat itself elsewhere.

¹⁰ Based on the author's compilation of Sand Hill Econometrics data.

Yet many efforts to boost high-potential entrepreneurship end up directing far too much funding to unpromising areas in an effort to “share the wealth.” Much of the impact is diluted as funds that could be very helpful in a core area end up where they are not useful.

The Small Business Innovation Research (SBIR) program, the largest public venture program in the United States, provides an illustration of this problem. The effect of a fairness policy was shown in my work (Lerner, 1999) comparing the performance of program recipients with that of matching firms: awardees grew considerably faster than companies in the same locations and industries that did not receive awards. In the ten years after receipt of SBIR funding, the workforce of the average award recipient in a high-tech region grew by forty-seven, a doubling in size. The workforces of other awardees—those located in regions *not* characterized by high-tech activity—grew by only thirteen employees. Though the recipients of SBIR awards grew considerably faster than a sample of matched firms, the superior performance, as measured by growth in employment (as well as sales and other measures), was confined to awardees in areas that already had private venture activity. Many other examples can be offered from the Americas, Asia, and Europe, where the pressure for fairness has led to the diversion of substantial funds for entrepreneurial investments with little chance of success.

These issues are particularly relevant for science-based entrepreneurship. Economic activity linked to disruptive new technologies seem to evolve in a very concentrated pattern (Bloom et al., 2020). Potential explanations for these patterns include the dependence on close ties with academia (many of these initial hubs are near academic centers), agglomeration effects that encourage firms to bunch together, and labor market dynamics. Whatever the causes, the effect has been to render government efforts to encourage science-based ventures in peripheral locations very difficult.

Thus, in the name of geographic “diversity,” the program funded firms with inferior prospects. Underneath these patterns lie some intense political pressures and conflicting interests. For one thing, congressmen and their staffers have pressured program managers to award funding to companies in their states. As a result, in almost every recent fiscal year, firms in all fifty states (and indeed every one of the 435 congressional districts) have received at least one SBIR award. These patterns are far from unique: pressures for “fair” distribution of subsidies (Weingast, Shepsle, and Johnsen, 1981) often lower the social and private returns from these government initiatives.

The Timing Dynamic

Another issue stems from the boom-bust cycles that frequently characterize entrepreneurial markets. The venture market is extraordinarily uneven, moving from cycles of feast to famine and back again. In some periods, far too many firms can get access to financing, while in others, worthy companies languish unfunded.

Funds operating in periods with little competition eventually experience very good returns, a pattern that may reflect the fact that the funds operating during these years can invest in the most promising firms at relatively modest valuations. Over time, however, these high returns attract the interest of institutional investors. What starts as a trickle of fund of funds ends as a torrent.

The competition for deals rises, as does the pricing of these transactions. Ultimately, the expansion proves to be unsustainable, and returns fall. Then the cycle repeats itself all over again.

These cycles have led to considerable drama in the venture industry. Each industry downturn produces melodramatic claims that the venture industry is fundamentally broken, with too many investors competing for a limited supply of deals. For instance, in the dark days after the NASDAQ crash of 2000-02, Steve Dow of the venerable firm Sevin Rosen indicated that his group was unlikely to raise a new fund. “The traditional venture model seems to us to be broken,” he noted. “Too much money had flooded the venture business and too many companies were being given financing in every conceivable sector” (Helft, 2006). (More typically, the conclusion of the complaining venture capitalist is that everyone should exit the market except for the market observer and his best friends.)

This song has been repeated almost verbatim in every market downturn. “Dramatic inflows of cash weaken the ‘fragile ecosystem’ of the venture capital industry by forcing some to ‘shovel’ money into deals... The answer is to discourage more money from coming in and to suppress what [gets invested],” preached the Venture Capital Journal in 1993 (Deger, 1993). The same periodical bemoaned in 1980 (“Special Report,” 1980), “The rate of disbursements from venture investors to developing businesses continues to be extraordinary... [A] major limiting factor in expansion will be the availability of qualified venture investment managers. Direct experience is so critical to venture investment disciplines.” (With the benefit of hindsight, the Journal was exactly wrong in both cases. The typical funds raised in the years of these two articles had a return of 26.1% and 21.6%, respectively, which remain among the two best vintage years for venture funds ever.)

Despite all the hype and drama, these boom-and-bust patterns are important and the interest that these cycles have attracted is justified. It is natural to wonder why pensions and others seem to put most of their money to work almost inevitably at exactly the wrong time. Why don’t venture groups pull back from investing in market peaks, rather than continuing to dance the dance? While much remains uncertain about these cycles of boom and bust, several drivers of these patterns have been documented.

At least some of the deterioration of performance stems from the phenomenon of “money chasing deals.” As more money flows into their funds from institutional and individual investors, venture capitalists’ willingness to pay more for deals increases: a doubling of inflows into venture funds led to between a 7% and 21% increase in valuation levels for otherwise identical deals. These results do not reflect improvements in the venture investment environment: when we look at the ultimate success of venture-backed firms, the success rates do not differ significantly between investments made during periods of relatively low inflows and valuations, and those of the boom years. But the findings, while suggesting how these cycles work, do not explain why they come about.

Part of the decline in venture activity stems from new funds. During hot venture markets, many inexperienced groups raise capital. In many cases, these funds are raised from inexperienced investors, who are attracted by the excitement surrounding venture funds or by funds-of-funds,

which target these investors. Often, they cannot get into top-tier funds, and instead reach out to less-experienced funds, not appreciating the differences across groups.

Part of the deterioration in performance around booms reflects the changes in the venture funds. Established groups often take advantage of these hot markets to increase their capital under management aggressively. (This decision is likely to be driven by the typical compensation that venture funds enjoy, which is largely driven by fees from capital under management.) As venture groups grow in size, they tend to increase the capital that each partner is responsible for and to broaden the range of industries in which they invest. These changes are often associated with deteriorating performance.

Whatever the precise mechanisms behind these cycles, their impact on innovation is most worrisome. Skeptical observers of the venture scene frequently argue that these cycles can lead to the neglect of promising companies. For instance, during the deep venture trough of the 1970s—in 1975, no venture capital funds at all were raised in the U.S.—many companies seeking to develop pioneering personal computing hardware and software languished unfunded. Ultimately, these technologies emerged with revolutionary impact in the 1980s, but their emergence may have been accelerated had the venture market not been in such a deep funk during the 1970s.

Townsend (2015), in an intriguing analysis of the technology market collapse of 2000-03, looks at the probability that firms failed to get refinanced through no fault of their own. He looks at how the probability that firms in sectors unrelated to information technology (IT) during the collapse period got another financing round, and how this varied with their lead venture firm's exposure to the Internet sector. He compared non-IT firms whose backers invested heavily in Internet companies during the years leading up to the peak of the bubble with those whose backers invested little in the Internet sector during that time. (Based on all observable characteristics, these firms are otherwise identical.) The unlucky ones with Internet-exposed backers were far less likely to raise another financing round. The analysis suggests that these unlucky firms—even though their technologies had nothing to do with the Internet, telecommunications, or software—experienced a 26% larger drop in the probability that they would raise additional funding than did those backed by funds without a heavy exposure to the Internet. If a potential entrepreneur realizes that even if he does everything right, his business may fail because he was unlucky in choosing a financier, his enthusiasm for the new venture may fade. He might well conclude that if he is going to be gambling, a trip to Vegas is a less costly and painful alternative.

It might be thought that this termination of new ventures is not a big deal. After all, the personal computing technology that may have languished unfunded during the 1970s ultimately saw the light of day in the next decade. But in addition to the delays inherent in this disruptive process, there is also the question of its impact on incentives.

Nor is the overfunding of firms during booms necessarily a good thing. While it can stimulate creativity (Ewens, Nanda, and Rhodes-Kropf, 2018), it can also lead to wasteful duplication, as multiple companies pursue the same opportunity, with each follower often being ever more marginal. Often, the initial market leader's staff is poached by the me-too followers, disrupting

the progress of the firm with the best chance of success. Moreover, once the overfunding subsides, the firms that still survive struggle to attract funding, as the sector often takes on a poisonous atmosphere that deters venture investors. Numerous examples of such crazed duplication can be offered: the recent plethora of social networking companies, the frenzy surrounding B2B and B2C Internet companies in the late 1990s, or the surge in funding disk-drive companies in the early 1980s. In each case, a surge of activity was followed by a reaction, when venture capitalists, suffering from poor returns, recoiled from the industry. As a result, these periods were incredibly disruptive to all firms within the affected industries.

In many cases, however, political leaders interpret these surges in activity as signals that it is appropriate to intervene with new subsidies, even as the marginal returns from public money declines. The public funds can have the effect of adding “fuel to the fire” of an overheated market. The decision of the Chinese government to “double down” on subsidizing venture activity after the boom in the first half of the 2010s is a dramatic example.

The Human Dimension

The final disengagement reflects the nature of people who often are associated with the greatest entrepreneurial success. Government officials may have many valuable talents and play incredibly important roles; but the skill sets associated with successfully identifying and funding entrepreneurial businesses are very different from those encountered in their typical daily work. The ambiguity, complexity, and specialization associated with these ventures makes these tasks quite challenging.

In many instance, officials may be manifestly inadequate to the task of selecting and managing entrepreneurial or innovative firms. Many examples can be offered of government leaders who did not think carefully about realistic market opportunities, the nature of the entrepreneurs and intermediaries being financed, and how the subsidies they offered would affect behavior. Whether they were rules that affects the ability of firms to accept outside financing, offshore routine coding work, or respond to shifts in customer demands, well-intentioned officials can make rules that prove to be very harmful to those they mean to help.

But beyond public incompetence, much of economists’ attention has been focused on a darker problem that affects these and similar programs: the theory of “regulatory capture.” This hypothesis suggests that entities, whether part of government or industry, will organize to capture the direct and indirect subsidies that the public sector hands out.¹¹ Yet public subsidies are often prone to political capture problems, where well-connected individuals end up with the bulk of the benefits, and those geared towards entrepreneurial firms are no exception (Akcigit, Baslandze, and Lotti, 2018). These issues are exacerbated by the fact that the most creative entrepreneurs are often outsiders: for instance, an extensive literature has documented the disproportionate representation of immigrants in U.S. entrepreneurship, both in general and among high-potential enterprises (Kerr and Kerr, 2017; see Fairlie and Lofstrom, 2015 for more general review).

¹¹ The articulation of this model in the economics literature is frequently attributed to Olson, 1965; its formal modeling to Peltzman (1976) and Becker (1983).

These capture problems are often exacerbated by opaque and poorly defined processes. While selecting the most promising new ventures is unlikely to ever be easy, making the process opaque is unlikely to help. For instance, the Department of Energy had little transparency about the criteria used to select the awards to cleantech firms discussed in the introduction. Reflecting this lack of clarity, firms responded by hiring lobbyists to seek awards. For instance, more than half the cleantech companies in the portfolio of New Enterprise Associates, a large U.S. venture firm, hired lobbyists to seek to influence the rewards. The emphasis on influence activities was exacerbated by the huge size of the individual awards: rather than scattering the funds over a variety of contenders, the Obama administration sought to pick winners. This is a classic situation where a public program targeted an area that was already interesting to private investors and actually ended up introducing counter-productive distortions.

The Search for Solutions

How can these seeming disconnects be addressed? In the final part of this essay, I discuss two potential policy reforms -- independence and reliance on matching funds -- that could address these disconnects.

The Need for Independence

One way to address the incentive issues described above is for policymakers to emulate central bankers and to seek to insulate entrepreneurial policy-making from day-to-day political pressures. A long list of economists have extolled the need to separate monetary policy from political pressures, lest the temptation to “do the wrong thing” prior to an election be too strong. Establishing an organization to implement new venture policies where the leadership has the independence from day-to-day political pressures can similarly lead to longer-term decisions that can address some of the challenges delineated above. Such a step may also make it easier to terminate a program when it is no longer needed.

Similar independent governance have been successfully implemented in other investment arenas. For instance, consider the experience of the Canadian Pension Plan.¹² The Plan was established in 1966 as a layer of retirement savings sitting between the Old Age Security System (similar to Social Security in the U.S.) and individual savings. It collected mandated contributions from employers and workers, and offered benefits that were a set percentage of wages, paid by the contributions of previous years and the returns from the Plan’s investments.

For the first 30 years of the CPP’s existence, expenses rose as benefits like inflation-indexing were added. Funds were invested in non-negotiable Canadian government fixed income bonds and also loaned to the provinces at sub-market interest rates for projects such as building schools and roads. These projects may have benefited Canadian society, but not surprisingly did little for CPP’s bottom line. Furthermore, aging population was working against CPP. The government realized that CPP faced either drastic cuts in benefits or sharp increases in contribution rates.

¹² This vignette is drawn from Canadian Pension Plan Investment Board (various years), Hardymon, Leamon, and Lerner (2009), and Lerner, Rhodes-Kropf, and Burbank (2013).

Similar problems have been shown to beset many U.S. pensions, especially those with heavy political presentation on their board (Andonov, Hochberg, and Rauh, 2018). But unlike in the United States, where government have almost universally kicked pension problems “down the road,” between 1995 and 1997, the federal and provincial Canadian governments managed to craft a solution.

The CPP Investment Board was established in 1997 in response to these challenges. One crucial part of the reforms adopted by the Canadian government was a dramatic restructuring of the Plan’s governance. It adopted a structure that former CEO Mark Wiseman referred to as “turducken,” except instead of a series of stuffed poultry, it featured “a partnership model inside a Crown corporation inside a pension plan.” In order to limit political influence, the CPPIB governance was set up as a twelve-member board notionally appointed by the federal and provincial governments, with appointments based entirely on business acumen, not political connections. The board of directors in turn appointed the CEO, with no right of veto from any government. The organization’s mandate was set as to invest “solely for the benefit of CPP members” to achieve the best long-term risk-weighted returns for the plan’s beneficiaries, regardless of government policy objectives. To further insulate CPPIB from political influence, any changes to its charter required approval by an amending process more stringent than that of the Canadian constitution itself. Small experiments along these lines have been reasonably successful in the entrepreneurial promotion business, such as the New Zealand Venture Investment Funds program,¹³ and it is my hope that these can be expanded.

Another advantage of independent is more flexibility in setting pay. Setting competitive compensation is even harder for public institutions in Western democracies, where the media may be over-eager to engage in sensationalism. The architects of the modern CPPIB created a structure that allowed the public pension unique freedoms, including the ability to set salaries and bonuses completely outside the Canadian civil service scale. With multi-million dollar bonuses—as well as the ability to live in Toronto, work in a congenial setting, and contribute to the betterment of the nation—CPPIB attracted a high-caliber investment team, many of them Canadians, eager to move home after a stint on Wall Street.

But implementing this scheme has been challenging. The fund was bitterly criticized for proposing to pay bonuses totaling \$7 million to four top executives for the 2008-09, after the fund had lost almost 19% of its value during the financial crisis. CPPIB’s rationale that the pay packages were based on long-term performance fell on deaf ears, whether due to its complexity or the political feeding frenzy. The Board ultimately adjusted its compensation policy downward. Perhaps unsurprisingly, eventually much of CPPIB’s leadership team left for jobs elsewhere. Similar experience.

A similar cautionary tale emerges from the experience of In-Q-Tel, which was established in 1999 to give the U.S. Central Intelligence Agency greater access to cutting-edge technologies.¹⁴

¹³ For a detailed history and analysis of the program, see Lerner, Moore, and Shepherd (2005).

¹⁴ This account is based on Book et al. (2005), Business Executives (2001), and numerous press accounts.

The agency's scientific leaders also realized that the most sophisticated technologies were being developed not within government laboratories, but rather in Silicon Valley start-ups. In-Q-Tel was designed to address this problem by allowing the government to access some of the key innovations in these firms. Using a variety of venture-like tools, the organization invested modest stakes in emerging companies, often in conjunction with independent venture firms.

The CIA realized it needed a special kind of team to run In-Q-Tel: individuals who were at once conversant with the world of high-technology start-ups and with a ponderous, security-conscious government bureaucracy. To maximize the chance of getting the right people, the CIA set up In-Q-Tel as an independent, not-for-profit entity, which shielded it from civil service rules that might discourage many recruits. In order to attract these staff members—and to avoid a revolving door through which people left as soon as they had the requisite experience—the CIA designed a compensation scheme quite different from that in typical government jobs. The package included a flat salary, a bonus based on how well In-Q-Tel met government needs, and an employee investment program, which took a pre-specified portion of each employee's salary and invested alongside In-Q-Tel in the young firms in its portfolio.

After a few years of operations, however, the *New York Post* decided to turn its attention to In-Q-Tel.¹⁵ Describing it as “an astonishing tale of taxpayer-financed intrigue on capitalism's street of dreams,” journalists homed in on the compensation scheme: one article charged that In-Q-Tel employees were “speculat[ing] with taxpayer money for their own personal benefit.” Needless to say, there was no discussion of the challenges of recruiting investment staff conversant with Silicon Valley, or the likelihood that many In-Q-Tel professionals could make far more in the private sector. This arrangement, the Post intoned, was “almost identical to the so-called ‘Raptor’ partnerships through which top officials at Enron Corp were able to cash in personally on investment activities of the very company that employed them.” Whether it was the criticism of the compensation levels—which while attractive by government standards, were far below those of independent venture capitalists—the distractions associated with frequent congressional investigations, or the media scrutiny, In-Q-Tel has struggled to hold onto its investment staff, despite a creative attempt to create attractive incentives.

While independence does not necessarily guarantee effective policy-making, it can increase the likelihood that decisions avoid political fads, relying instead on rules-based approaches and experimental evidence. All too often, in the rush to boost entrepreneurship, policymakers make no provision for the evaluation of programs. In an ideal world, the future of initiatives should be determined by their success or failure in meeting their goals, rather than considerations such as the vehemence with which supporters argue for their continuation. Independent governance can facilitate better decisions.

Turning again for the SBIR program, there are many examples where analysis could be enormously helpful. A striking study by Howell (2017) suggests while the initial Phase I awards made up only 20% of total of \$2.8 billion of awards in fiscal year 2017 (U.S. Small Business Administration, 2018)), essentially all the program's positive benefits resulted from those initial

¹⁵ These quotes are drawn from one of several pieces on In-Q-Tel done by the paper, Byron (2005).

grants. Similarly, both Howell's analysis and my own suggest the troublesome impact of the companies that have managed to capture a disproportionate number of awards. These "mills" commercialize far fewer projects than those firms that receive just one (or a handful) SBIR grant. These "SBIR mills" often have staffs in Washington that focus only on identifying opportunities for subsidy applications. These problems have proven difficult to eliminate, as "mill" staffers tend to be active, wily lobbyists.

An added benefit of such efforts has to do with time frames. Democracies worldwide are shaped by the ebb and flow of election cycles. This inevitably leads to a short-run orientation. And even leaders in office for life are often anxious to display progress and look for quick fixes. But building a venture capital industry is a long-run investment, which takes many years until tangible effects are realized. To cite one example, historians date the birth of the modern U.S. venture capital industry to 1978, a full twenty years after the enactment of the SBIC program. This is not a process that can be accomplished overnight.

As a result, an entrepreneurship or venture capital initiative requires a long-run commitment on the part of public officials. The one certainty is that there will be few immediate returns. If programs are abandoned after a few months or years, they are highly unlikely to bring any benefits. There has to be a commitment to be undaunted by initial failures—for example, the low rate of return that early publicly subsidized investments or funds garner—and instead to fine-tune programs in the face of early discouragements. An independent governance structure can limit these distorting effects.

At the same time, there may be times when a program has lived its useful life, and is no longer needed. One nomination might be the Small Business Investment Company (SBIC) program in the U.S. which subsidized the formation of venture funds. The U.S. industry is today many orders of magnitude bigger, and the need for the program much less compelling. And many of the firms receiving SBIC funding have been marginal ones who cannot attract private funds. Yet SBIC have vehemently argued for expanding the program, not terminating it.

Matching Funds

Far too often, decisions about fund allocation are distorted by a lack of understanding of how the market works or by political rather than economic considerations. By requiring that matching funds be raised from the private sector, the dangers of uninformed decisions and political interference can be greatly reduced.

We have already alluded to examples of well-intentioned but uninformed leaders making boneheaded decisions, as well as political capture leading to unfortunate decisions, such as to allocate much of the funding to regions where there is little chance of success. Yet another distortion is when policymakers make decisions based on "buzz," or incomplete information. One study determined that forty-nine of the fifty U.S. states started major programs to promote the biotechnology industry, in hopes of creating a cluster of activity (Feldman and Francis, 2003). In fact, only a handful of these states had the base of scientific resources and the supporting infrastructure (e.g., lawyers versed in biotechnology patent law and financing practice) to support a successful cluster, so the bulk of these funds were wasted. When these

programs did support a promising firm, in many cases it rapidly moved to a region more conducive to biotechnology entrepreneurship.¹⁶

The vast majority of efforts by the public sector to target particular industries seem to have been far less successful. If dozens of Ph.D.s poring for years over econometrics models with mountains of historical data have been unable to show how to target industries, how can the typical government leader identify good prospects in a compressed time period and with limited information?

But there is a way to address this problem at least partially. The most direct way is to insist on matching funds. If venture funds or entrepreneurial firms need to raise money from outside sources, organizations that will ultimately not be commercially viable will be kept off the playing field. In order to ensure that these matching funds send a powerful signal, the matching should involve a substantial amount of capital (ideally, one-half the funding or more should be from the private sector). These stipulations can limit the temptation to impose geographic diversity requirements that direct funds into non-viable areas.

The power of matching funds was clearly demonstrated in what has been considered the gold standard of public venture capital initiatives. In June 1992, the Israeli government established Yozma Venture Capital Ltd., a \$100 million fund wholly owned by the public sector (for more details, see Avnimelech, Kenney, and Teubal, 2004, OECD, 2003, Senor and Singer, 2009, and Trajtenberg, 2002). At the time, there was a single venture fund active in the nation, Athena Venture Partners. While there were certainly well trained engineers in the nation working on promising technologies, entrepreneurs (and would-be company founders) were suspicious of venture investors. This reluctance was based in part on their interactions with the pioneering venture capitalists in the nation, as well as their general skepticism about selling equity to unaffiliated parties. Instead, they preferred to rely on bank debt for financing. The only problem, of course, was that such financing was rarely available for young, risky ventures.

The key goal of Yozma was to bring foreign venture capitalists' investment expertise and network of contacts to Israel. The need for this assistance was highlighted by the failure of the nation's earlier efforts to promote high-technology entrepreneurship. One assessment concluded that fully 60 percent of the entrepreneurs in prior programs had been successful in meeting their technical goals but nonetheless failed because the entrepreneurs were unable to market their products or raise capital for further development. Foreign expertise was seen as key to overcoming this problem.

Accordingly, Yozma actively discouraged Israeli financiers from participating in its programs. Rather, the focus was on getting foreign venture investors to commit capital for Israeli entrepreneurs. The government provided matching funds to investors, typically \$8 million of a \$20 million fund. The venture fund was given the right to buy back the government stake within the first five years for the initial value plus a preset interest rate of roughly 5 to 7 percent. Thus, the design of Yozma meant that the government provided an added incentive to the venture fund

¹⁶ See, for instance, the saga of Cleveland's biotechnology initiative as related in Fogarty and Sinha (1999).

if the investments proved successful. Moreover, learning from the nation's misadventures during earlier programs to stimulate the venture industry—when cumbersome application procedures and burdensome reporting requirements discouraged participation—the administration of the program was deliberately made simple.

The Yozma program delivered beyond the wildest dreams of the founders. Ten groups took advantage of this offer, mostly from the United States, Western Europe, and Japan. Many of the original Yozma funds, including Gemini and Walden Ventures, earned spectacular returns and served as precursors to larger, follow-on funds. Moreover, many of the local partners recruited by the overseas venture capitalists were able to spin off and establish their own firms, which global venture capitalists were eager to fund because of their impressive track records. (A Yozma “alumni club” allows groups to learn from each other’s experiences while making these transitions.) One decade after the program’s inception, the ten original Yozma groups were managing Israeli funds totaling \$2.9 billion, and the Israeli venture market had expanded to include 60 groups managing approximately \$10 billion (Erich, 2007). The magnitude of this success is also suggested by the fact that the ratio of venture investment to GDP is consistently higher in Israel than in any other nation.

As powerful an idea as matching funds is, the devil is in the details. In the Government Guidance Fund initiative in China, the central government imposed matching fund requirements as well. In a number of the top cities, the government funds were matched with capital from legitimate investors. In many second- and third-tier cities (where many of the funds were set up), however, the requirements for matching funds were relaxed. Much of the capital came not from informed private sector actors, but rather from provincial and state governments eager to boost the local economy, or else from state-owned enterprises under these officials’ control. Thus, the informative quality of the matching funds was much reduced.

One concern about a requirement of matching funds is that there are sectors and regions where private funding is very scarce. In these cases, a requirement that firms raise matching venture funding may lead to very little public funding at all. It may be possible to resolve this “chicken or the egg” problem by targeting earlier-stage, more informal investors such as individual angel investors. Some governments, for instance, have not only matched the funding provided by these investors, but subsidized these groups to hire an executive director to ensure that their activities run more smoothly. In other cases, however, it may make sense for government to back up even further, and focus on “table-setting” activities that create a conducive environment for entrepreneurs and their potential investors, rather than directly financing companies or investors.

Final Thoughts

Many of the same policies that have driven governments to promote innovation in general have led to a public policy focus on entrepreneurship. The bulk of these efforts have been well intentioned. But the substantial challenges associated with the promotion of entrepreneurial businesses have meant that the success rate is not as great as many policy makers hoped or expected.

At the same time, the numerous efforts around the globe suggest some guiding principles for maximizing the success of these funds. In particular, I highlight here two ideas. Rather than distributing the public funds willy-nilly, a requirement for matching funds can ensure market validation for the ideas. And placing the body under the aegis of an independent body can help buffet these long-run initiatives for the ebbs-and-flows of political fashion.

References

- Zoltan J. Acs and David B. Audretsch, "Innovation in Large and Small Firms: An Empirical Analysis," *American Economic Review* 78 (1988), 678–90.
- Ufuk Akcigit, Salomé Baslandze, Francesca Lotti, "Connecting to Power: Political Connections, Innovation, and Firm Dynamics," National Bureau of Economic Research Working Paper no. 25136, 2018.
- Aleksandar Andonov, Yael Hochberg and Joshua Rauh, "Political Representation and Governance: Evidence from the Investment Decisions of Public Pension Funds," *Journal of Finance*, 73 (2018), 2041-2086.
- Debra J. Aron and Edward P. Lazear, "The Introduction of New Products," *American Economic Review Papers and Proceedings* 80 (1990), 421–26
- Ashish Arora, Sharon Belenzon, and Andrea Pataconi, "Killing the Golden Goose? The Decline of Science in Corporate R&D, 1980-2007," National Bureau of Economic Research Working Paper no. 20902, 2015.
- Gil Avnimelech, Martin Kenney, and Morris Teubal, "Building Venture Capital Industries: Understanding the U.S. and Israeli Experiences," BRIE Working Paper no. 160, 2004.
- Pierre Azoulay and Josh Lerner, "Technological Innovation and Organizations," in *Handbook of Organizational Economics*, Robert Gibbons and John Roberts (editors), Princeton: Princeton University Press, 2012, chapter 14.
- Jessica Bai, Shai Bernstein, Abhishek Dev, and Josh Lerner. "Public Entrepreneurial Finance around the World," Unpublished working paper, 2020.
- Gary S. Becker, "A Theory of Competition among Pressure Groups for Political Influence," *Quarterly Journal of Economics* 98 (1983), 371–400.
- Shai Bernstein, Xavier Giroud, and Richard R. Townsend, "The Impact of Venture Capital Monitoring," *Journal of Finance* 71 (2016), 1591-1622.
- Nicholas Bloom, Tarek Hassan, Aakash Kalyani, Josh Lerner, and Ahmed Tahoun. "The Geography of New Technologies," <https://ssrn.com/abstract=3671016>, 2020.
- Kevin Book, Felda Hardyman, Ann Leamon, and Josh Lerner, "In-Q-Tel," Harvard Business School Case no. 9-804-146, 2005.
- Business Executives for National Security, *Accelerating the Acquisition and Implementation of New Technologies for Intelligence: The Report of the Independent Panel on the Central Intelligence Agency In-Q-Tel Venture*, Washington, D.C.: BNES, 2001.

Christopher Byron, “Penny Stock Spies,” *New York Post*, April 25, 2005.

Canadian Pension Plan Investment Board, *Annual Reports*, Toronto, CPPIB, various years.

Wesley M. Cohen, “Fifty Years of Empirical Studies of Innovative Activity and Performance,” in *Handbook of Economics of Innovation*, Bronwyn H. Hall and Nathan Rosenberg (editors), Amsterdam, North Holland Elsevier, 2010, volume 1, pp. 129-213.

Wesley M. Cohen, Richard C. Levin, and David C. Mowery, “Firm Size and R&D Intensity: A Re-examination,” *Journal of Industrial Economics* 35 (1987), 543–63.

Renee Deger, “Disbursements on the Rise: Sharp Gains Raise Yellow Flag to Some Venture Capitalists,” *Venture Capital Journal* 33 (December 1993), 29.

Yigdal Erlich, “The Yozma Group—Policy and Success Factors,” http://www.insme.org/documenti/Yozma_presentation.pdf, 2007.

Michael Ewens, Ramana Nanda, and Matthew Rhodes-Kropf, “Cost of Experimentation and the Evolution of Venture Capital,” *Journal of Financial Economics* 128 (2018), 422-442.

Robert W Fairlie and Magnus Lofstrom, “Immigration and Entrepreneurship,” in *Handbook of the Economics of International Migration*, Barry R. Chiswick and Paul W. Miller (editors), Amsterdam: North Holland, 2015, pp.877-911.

Maryann P. Feldman and Johanna L. Francis, “Fortune Favors the Prepared Region: The Case of Entrepreneurship and the Capitol Region Biotechnology Cluster,” *European Planning Studies* 11 (2003), 765–88.

Emily Feng, “China’s state-owned venture capital funds battle to make an impact”, *Financial Times*, December 23, 2018, <https://www.ft.com/content/4fa2caaa-f9f0-11e8-af46-2022a0b02a6c>.

Richard Florida and Ian Hathaway, *The Rise of the Startup City*, Washington, Center for American Entrepreneurship, 2018.

Michael Fogarty and Amit Sinha, “Why Older Industrial Regions Can’t Generalize from Route 128 and Silicon Valley: University-Industry Relationships and Regional Innovation Systems,” in *Industrializing Knowledge*, Lewis M. Branscomb, editor, Cambridge, MIT Press, 1999, pp. 473–509.

David M. Gold, “Cleantech Stimulus Not Very Stimulating,” *GreenGold Blog*, September 29, 2009, <http://www.greengoldblog.com/2009/09/cleantech-stimulus-not-very-stimulating.html>.

Paul Gompers, “Optimal Investment, Monitoring, and the Staging of Venture Capital.” *Journal of Finance*, 50 (1995), 1461-1490.

Paul Gompers, Will Gornall, Steven Kaplan and Ilya Strebulaev, “How Do Venture Capitalists Make Decisions?” *Journal of Financial Economics*, 135 (2020), 169-190.

Felda Hardyman, Ann Leamon, and Josh Lerner, “Canada Pension Plan Investment Board,” Harvard Business School Case no. 809-073, 2009

Miguel Helft, “A Kink in Venture Capital’s Gold Chain,” *New York Times*, October 7, 2006, <https://www.nytimes.com/2006/10/07/business/07venture.html>

Sabrina T. Howell, “Financing Innovation: Evidence from R&D Grants,” *American Economic Review* 107 (2017), 1136-64.

Victoria Ivashina and Josh Lerner, *Patent Capital: The Challenges and Promises of Long-Term Investing*, Princeton, Princeton University Press, 2019

Hilary Kao, “Beyond Solyndra: Examining the Department of Energy’s Loan Guarantee Program,” *William and Mary Environmental Law and Policy Review* 37 (2013) 425-____.

Steven N. Kaplan and Per Stromberg, “Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts.” *Review of Economic Studies* 70 (2013), 281-315.

Steven N. Kaplan and Per Stromberg, “Characteristics, Contracts, and Actions: Evidence from Venture Capitalist Analyses,” *Journal of Finance* 109 (2004), 2173–2206.

Sari P. Kerr and William R. Kerr, “Immigrant Entrepreneurship,” in *Measuring Entrepreneurial Businesses: Current Knowledge and Challenges*, John Haltiwanger, Erik Hurst, Javier Miranda, and Antoinette Schoar (editors), Chicago, University of Chicago Press, 2017, pp. 187 – 249.

Kingdom of Saudi Arabia, “Vision 2030,” <https://vision2030.gov.sa/en/programs/PIF>, 2019.

Scott Kirsner, “Does Lobbying Always Pay?” *Innovation Economy Blog*, August 6, 2009, http://www.boston.com/business/technology/innoeco/2009/08/does_lobbying_always_pay.html.

Josh Lerner, 1999, “The Government as Venture Capitalist: The Long-Run Effects of the SBIR Program,” *Journal of Business* 72 (1999), 285-318.

Josh Lerner, *Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed—and What to Do About It*. Princeton: Princeton University Press, 2009.

Josh Lerner, *The Architecture of Innovation*, Boston and London: Harvard Business Press and Oxford University Press, 2012.

Josh Lerner, David Moore, and Stuart Shepherd, *A Study of New Zealand's Venture Capital Market and Implications for Public Policy: A Report to the Ministry of Research Science and Technology*, Auckland: LECG, 2005.

Josh Lerner, Matthew Rhodes-Kropf, and Nathaniel Burbank, "Canada Pension Plan Investment Board: October 2012," Harvard Business School Case no. 813-103, 2013.

Eric Lipton and Clifford Krauss, "A Gold Rush of Subsidies in Clean Energy Search," *New York Times*, November 12, 2011, http://www.nytimes.com/2011/11/12/business/energy-environment/a-cornucopia-of-help-for-renewable-energy.html?_r=1&nl=todaysheadlines&emc=tha2.

MAGNiTT, *Q3 2019 MENA Venture Investment Summary*, Dubai, MAGNiTT, 2019.

Tim Mullaney, "Lobbyists Are First Winners in Obama's Clean-Technology Push," *Bloomberg Business News*, March 25, 2009, <http://www.bloomberg.com/apps/news?pid=20601109&sid=aNH.vsK2D.lQ&refer=home>.

Darwin V. Neher, "Staged Financing: An Agency Perspective," *Review of Economic Studies* 66 (1999), 255–274.

Mancur Olson, *The Logic of Collective Action*, Cambridge, Harvard University Press, 1965.

"Oppose Wasteful \$10 Billion Increase for DOE Nuclear Loan Guarantee Program," *Letter from Taxpayers for Common Sense*, December 10, 2010, http://www.taxpayer.net/search_by_tag.php?action=view&proj_id=4063&tag=loan%20guarantees&type=Project.

Organisation for Economic Cooperation and Development, *Venture Capital Policy Review: Israel*, STI Working Paper no. 2003/3, Paris, OECD, 2003.

Organisation for Economic Cooperation and Development, *Financing SMEs and Entrepreneurs 2018: An OECD Scoreboard*, Paris, OECD, 2019.

Shai Oster and Lulu Yilun Chen, "Inside China's Historic \$338 Billion Tech Startup Experiment," *Bloomberg Business News*, March 8, 2016, <https://www.bloomberg.com/news/articles/2016-03-08/china-state-backed-venture-funds-tripled-to-338-billion-in-2015>;

Sam Peltzman, "Towards a More General Theory of Regulation," *Journal of Law and Economics* 19 (1976), 211–40.

Thomas J. Prusa and James A. Schmitz Jr., "Can Companies Maintain Their Initial Innovation Thrust? A Study of the PC Software Industry," *Review of Economics and Statistics* 76 (1994), 523–40.

Jason Rowley, “Chinese Startups Net Smallest Share of Global VC Investment in Years”, *Crunchbase News*, July 18, 2019, <https://news.crunchbase.com/news/chinese-startups-net-smallest-share-of-global-vc-investment-in-years/>.

Joseph Schumpeter, *Capitalism, Socialism, and Democracy*, New York, Harper & Brothers, 1942.

Iman Seoudi, and Salma Mahmoud, “Public Policy for Venture Capital: A Comparative Study of Emirates, Saudi Arabia and Egypt,” *Review of Business & Finance Studies* 7, (2016), 19-42.

Dan Senor and Saul Singer, *Start-up Nation: The Story of Israel's Economic Miracle*, New York, Twelve, 2009.

Lucinda Shen, “China is the Biggest Venture Capital Firm in the World,” *Fortune*, March 9, 2016, <https://fortune.com/2016/03/09/investors-venture-capital-china/>.

Hayat Sindi, “Building the Entrepreneurial Ecosystem in Saudi Arabia and the Middle East,” in *Social Entrepreneurship in the Middle East*, Dima Jamali and Alessandro Lanteri (editors), London, Palgrave Macmillan, 2015, volume 2, pp. 63-88.

Sean Sposito, “A123 Gets \$249m in Stimulus Funding,” *Boston Globe*, August 6, 2009, B5, http://archive.boston.com/business/articles/2009/08/06/a123systems_receives_249m_in_stimulus_funds/.

“Special Report—Capital Transfusion Renewal,” *Venture Capital Journal* 20 (July 1980), 6-8.

George Stigler, “The Economic Theory of Regulation,” *Bell Journal of Economics* 2 (1971), 3–21

Richard Townsend, “The Propagation of Financial Shocks: The Case of Venture Capital,” *Management Science* 61 (2015), 2782-2802

Manuel Trajtenberg, “Government Support for Commercial R&D: Lessons from the Israeli Experience,” *Innovation Policy and the Economy* 2 (2002), 79–134.

U.S. Small Business Administration, *FY 2017 SBIR/STTR Annual Report*, Washington, Small Business Administration, 2018.

Barry R. Weingast, Kenneth A. Shepsle, and Christopher Johnsen, “The Political Economy of Benefits and Costs: A Neoclassical Approach to Distributive Politics,” *Journal of Political Economy* 89 (1981), 642-664.

Jing Yang, “China's Venture Capital Boom Is Over, Leaving Investors High and Dry,” *Wall Street Journal*, November 15, 2019, <https://www.morningstar.com/news/dow-jones/201911144209/chinas-venture-capital-boom-is-over-leaving-investors-high-and-dry>.