

## Chapter 9

# A Life Cycle Model for the Creation of National Venture Capital Industries: Comparing the U.S. and Israeli Experiences

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Since its inception, the venture capital industry has experienced cycles. During the growth phase of each venture capital (VC) business cycle, local and national governments in various countries initiate policies aimed at establishing VC industries as part of an economic development strategy. Invariably, there is a proliferation of ill-advised policies similar to the ones tried during the previous phase. Not surprisingly, in a large number of cases, the 'new' policies to foster VC meet with minimal success or fail outright. While the causes of failure are undoubtedly multiple, there is ample room for believing that often the policies were based on an incomplete understanding of the roots and dynamics that have led to the development of self-sustaining national VC industries. This paper uses historically informed case studies of Israel and the U.S. to develop an appreciative model of how the VC industries in these two nations came into being.' This perspective can provide scholars and policy-makers with a grounded understanding of the emergence and development of the VC industries. This paper synthesizes detailed discussions of the evolution of the VC industry in the US and of Israel into a common theoretical perspective that could serve as a template for examining the emergence of VC in other nations. The identification of where in the evolution of its VC industry a nation is could lead to policy prescriptions better matched to the state of the industry.

### Previous Research

Nearly all the research on VC has focused upon the firm, and not on the evolution of VC as an industry. In the management literature, there is voluminous research output on the criteria VCs employ to evaluate possible investments, the types of assistance VCs provide to portfolio firms, and various other aspects of the investment process (Barney *et al.*, 1996; Bruno and Tyebjee, 1986; Hall and Hofer, 1993; MacMillan *et al.*, 1985). The dominant paradigm for conceptualizing the

relationship between VC firms and their portfolio firms has been agency theory (Gompers and Lerner, 1999; Gupta and Sapienza, 1992; Kaplan and Stromberg 2001; Sahlman 1990). This literature focuses the contract mechanisms creating incentives for the entrepreneur that overcome adverse selection, entrepreneurial shirking, incomplete information (Akerlof, 1970; Myers and Majluf, 1984; Stiglitz and Weiss, 1981), and other problems associated with the financing of start-ups (SUs) (Gompers and Lerner, 1999 and 2001).<sup>2</sup>

Beyond the agency research, there have been comparisons between VC financed firms and non-VC-financed firms. Florida and Smith (1994) found the VC-backed SUs are more global than non-VC backed SUs. Other studies show that the presence of a venture capitalist on the board of an issuing firm serves to lower the total cost of issuing stock by reducing IPO underpricing and underwriting costs (Stein and Bygrave, 1990). Finkle (1998) found that firms with a top 20 venture capitalist on their board of directors had larger IPOs. Others have found that receiving VC lowers bank interest rates on loans, and enables firms to go public sooner (Gompers and Lerner, 1999). VC-backed IPOs have better post-IPO performances, both in terms of stock price and growth rates (Jain and Kini, 2000; Megginson and Weiss, 1991). They also have higher growth rates in terms of total assets and revenues, and invest a larger fraction of total expenditures in R&D (Al-Suwailem, 1995). This suggests that a venture capitalist investment improves a fledgling firm's performance.

There is also evidence that VC spurs technological innovation in terms of the number of patents per dollar invested (Kortum and Lerner, 2000). Research shows that Israeli VC backed firms perform better than non-VC backed firms in terms of a higher rate of successful exits, younger age at IPO, higher IPO valuation, and more rapid sales growth (Avnimelech, 2004; Bar, 2002). The myriad failures of policy initiatives aimed at creating VC industries during the 1980s and most of the 1990s convinced many of the impossibility of deliberately creating environments within which VC could play an important role in supporting high-technology growth. These conclusions were justified when the policy focus is restricted to VC alone. However, we suggest that the difficulties encountered in implementing policies for encouraging VC are due to their promulgation without an understanding of systemic and evolutionary nature of the industry (Avnimelech and Teubal, 2003 and 2004b). Such a perspective would simultaneously consider how to create large numbers of high quality SUs, deal with organizational issues, and attract suitable professionals into the industry.

### **A History-Friendly, Life-Cycle Model**

The comparative approach makes it possible to inductively extract the elements or variables by uncovering commonalities and differences. Our approach differs from quantitative studies comparing national VCs systems such as Jeng and Wells (2000) in that we adopt an explicitly historical perspective that pays particular attention to institutions and the environment prior to the emergence of a measurable industry.

Life cycle models are attractive because they draw attention to the changes in an industry's dynamics. These models typically argue that industries evolve from a phase during which the innovations are radical to one in which innovation becomes more incremental or evolutionary (Abernathy and Utterback, 1978; Klepper, 1996). Periodization is always difficult and, at the margins, open to debate. Because conventional product life cycle models rarely consider the period prior to the actual emergence of the first entrants (for an exception see Helfat and Lieberman, 2002), we introduce three modifications. The first modification is that typical industry life-cycle models focus on single industries. In the case of VC, it is necessary to explicitly consider how it coevolves with the industries it funds. Second, for VC a set of conditions that develop in the pre-emergence phase are critical for the creation of a successful industry, because they provide the resources necessary for the emergence to be successful. Finally, though we accept the notion of a consolidation phase, our interpretation of consolidation is slightly different, because this is where the organizational and institutional forms that will become dominant are validated or, as is possible, the national VC industry fails and the resources are dispersed. The caveat is that a successful consolidation does not prevent new entrants in the next growth phase of the VC cycle.' Thus far, the VC industry has not exhibited the typical oligopolized dominant design phase. The model we develop has modest goals, it is meant to assist in understanding the establishment of a sustainable VC industry and its environment, and is not claimed to be generalizable to other industries.

We argue that there are five phases of the development of a VC industry. The first phase (background conditions phase) is where the conditions for developing a VC industry are evolving. This is not a teleological argument; it is quite possible and even likely that the conditions are not being consciously (or unconsciously) developed with the aim of creating a VC industry. When viewed in retrospect, it is possible to identify the beginnings of a high technology industry that includes SUs. In the case of both Israel and the U.S., the military had a powerful early role through funding research and buying the products of the electronics and information processing (EIP) industries, which have been the most successful fields for VC funding.

The second phase, which we term 'pre-emergence', begins with the earliest VC investments, and at its end VC has become an identifiable activity. This pre-emergence phase resembles the fluid phase of the product life cycle described by Abernathy and Utterback (1978). During this period, a number of SUs have successful public offerings demonstrating the viability and profitability of entrepreneurship. Business opportunities have also expanded apace. At the beginning of this period there are only a few VC organizations, and no accepted organizational form has yet emerged, but by the end of the period VC is recognizable as an institution different from other financial institutions. During this phase, there are often already a smattering of VC and angel investing. Some may be successful, but the institutions, existing industry and its links with markets; and even their technological capability are not sufficiently mature for rapid growth. During this ground preparation period, it often appears as though little is actually occurring in terms of formal VC activity. No less important, culturally there is

increasing acceptance of high-technology entrepreneurship as a viable career path. Also, frequently there are some successful investments that by the end of the phase will serve as a motivation for entrepreneurs and fledging VCs. During this period, the process is particularly vulnerable to exogenous shocks such as stock market downturns. Too severe a shock could easily truncate the development of the industry; however both the U.S. and Israeli industries survived this early stage.

In the emergence phase the industry takes a coherent form. Direct national government policies can play a significant role. There is also much experimentation and collective and interactive learning with respect to VC strategies, procedures, and organization. By the end of the period, the organizational forms and VC practice have been defined. Also, the SU economy had grown sufficiently to encourage the early development of specialized professional services such as law firms, accountants, and investment banks comfortable with high-technology offerings supporting SUs and VC (Kenney and Burg, 1999).

This optimistic rapid growth in the emergence phase, then gives way to a crisis phase. Here, we are not referring to the regular VC business cycle downturn or what Lerner (2002) has termed 'investment overshooting.' The crisis shakes the industry to its core. Industry survival is not necessarily guaranteed. To survive the industry must restructure and this restructuring is part of the crisis phase. By the end of this period, a dominant design is emerging to be validated during the consolidation period. Today, many of the leading U.S. VC firms are survivors of the 1970s downturn. The emergence of dominant design in the VC industry however does not mean that new entrants are excluded. The point is that after this consolidation VC has become an integral part of the national innovation system -it is effectively a part of the environment.

## **Case Studies**

### *The U.S.*

*The Background Conditions' Phase (1930-45)* The Great Depression signalled a period of profound change in the U.S. political economy, unleashing enormous social tension and creating pressure for new institutional frameworks and policies for the support of small businesses. The election of Franklin Roosevelt and the inauguration of the New Deal ushered in this transformation. In the late 1930s the concept of 'venture capital' began to be discussed among the East Coast financial and political elite. However, there was little clarity about how VC would operate, and who should furnish the capital.

For VC the most important aspect of World War Two was the emphasis on aerospace and electronics technologies such as radar, sonar, and computing. As a result of the role of technology in the victory, both the U.S. military and existing corporations became convinced of the importance of technology preparing the ground for massive government investment in graduate education and university-based research (Hart, 1998).

*The Pre-emergence Phase, 1945-1957* At the end of World War Two the first VC firms were established. There were two organizational forms created. The first form was VC firms established by wealthy individuals and families. The second organizational form was American Research and Development (ARD), which was established in Boston in 1946. Its founders included businesspersons and professors and administrators from MIT and Harvard. ARD raised funds from investment trusts and through a public stock offering, and thus was the first non-family VC fund. Through ARD's investments were scattered across industries, a significant portion of them were in technology, and a number of them were MIT-related (Liles, 1977; Etzkowitz, 1993; Hsu and Kenney, 2004). In the larger environment, the GI Bill, NSF, NIH, and the Department of Defense were creating the postwar research universities, massively expanding research output, and creating a large technically capable workforce.

Though the few existing firms were the only VCs operating at the time and no new firms had entered, a fledgling SU environment was maturing. The technology base grew significantly and there were an increasing number of high technology SUs. Semiconductors and computers were becoming important, though incumbent firms such as IBM, RCA, and Westinghouse largely controlled these businesses, some SUs achieved success and rapid growth. Further, there was evidence of the value of earlier SUs. For example, Hewlett Packard raised money by successfully listing in the 1950s proving that profitable exit was possible.

By the end of this pre-emergence phase, there was a growing number of EIP SUs and a few VC firms that had experienced some success. The groundwork in terms of the developing EIP trajectory, a dawning recognition on the part of existing VCs that EIP technologies offered unique opportunities for capital gains, and government recognition of the need to provide support for small, fast-growing business was evolving.

*The Emergence Phase (1958-72)* The emergence of the VC industry as economically significant began in 1958, and was intimately related with a number of other macro-social events. In 1958, the Russians launched Sputnik, and the U.S. response was to mobilize universities and corporations in a crash effort to develop a space program. As a result, R&D spending and government purchasing particularly in advanced aerospace fields experienced massive increases. Miniaturization and increased processing power were paramount.

These markets and the rapid technological evolution in EIP led to the formation of two important firms. First, in 1958 ARD invested \$70,000 in a MIT-related spinout, Digital Equipment Corporation (DEC), which would be the first significant minicomputer firm. DEC grew exponentially and by 1970 the initial investment of \$70,000 was worth more than \$400 million—a gain that proved to be a powerful attractant for investors and ambitious prospective VCs. The minicomputer industry spawned other Boston area spin-offs and they fuelled the Boston VC industry. Even as the minicomputer was born in Boston, in 1957 a group of eight Bay Area engineers left an earlier SU, Shockley Semiconductor, to launch Fairchild Semiconductor. Four years later, the first engineers and scientists began resigning from Fairchild and forming new semiconductor firms. This exodus

formed the basis of 'Silicon Valley,' and provided the fledgling VCs investment opportunities.

In Palo Alto, an important organizational innovation the limited partnership form was first used in 1958 by Draper, Gaither, and Anderson (DGA). Though it was closed in the mid 1960s, DGA's legacy was the limited partnership as an organizational form, which proved to be very congenial for VC investing. In 1961, the second limited partnership was created when Arthur Rock joined Thomas Davis to form Davis and Rock and received investment from the Fairchild entrepreneurs. The partnership was financially successful and knitted together the interests of key technologists and investors. By the end of the 1960s, the limited partnership had become the dominant organizational form for venture investing.

Even as the first limited partnerships were formed. In 1958 Congress authorized the Small Business Administration to license Small Business Investment Corporations (SBICs) (Bean, 1996). The SBICs were meant to provide capital for SUs or business expansions. Because the original legislation was a source of low-cost monies with few limitations in addition to the young VCs, it attracted licensees from a wide variety of industries including real estate, product distributors, and simply unscrupulous individuals. By the mid 1960s, the SBICs were plagued by self-dealing, fraud, mismanagement, and various other ills. In response, the SBA tightened regulations, instituted inspections, and became far more bureaucratic. By the early 1970s, the successful SBIC managers turned in their licenses, and either began managing their own personal monies or raised VC funds through limited partnerships. The SBIC program thus operated as an important bridge enabling part-time investors to professionalize their practices, build their reputations, track records and capabilities, and develop linkages with possible investors. The stock market downturn at the end of 1960s adversely affected SU economy and brought an end to this growth phase. And yet, as this period closed, VC had become a part of the U.S. economic landscape and a cadre of seasoned VCs had been created.

*Crisis (Early 1970s through Late 1970s)* The 1970s was a crisis decade. The difficulties were, in large measure, due to macroeconomic disruption including a stock market crisis, the lingering Vietnam War, the first oil crisis, the Nixon impeachment, and in 1979 yet another oil-crisis accompanied by stagflation. In terms of technological development the scene was more promising. In the 1970s, the rapid pace of integrated circuit development made possible the personal computer. The development of recombinant DNA techniques created the basis for a biotechnology industry that was VC financed (Kenney, 1986). Simultaneously, the SBIC program declined in significance as the limited partnership emerged as the dominant organizational form.

The greatest threat to the VC industry was government legislation prompted by the collapse of a large number of corporate and union pension funds, some of which had been looted by insiders. Public outrage prompted Congress to pass the Employee Retirement Investment Security Act (ERISA) in 1974, which extended the 'prudent man' rule to private pension funds and placed criminal liability upon pension fund managers for 'imprudent' behaviour. Legal interpretations of ERISA

indicated that fund managers investing in risky assets, such as VC might be personally liable should the investments fail. With the difficult economic environment and the threat of prosecution, institutional commitments to VC virtually ended. VCs became the unintended victims of a congressional effort to halt pension fund fraud.

By the end of the 1960s, VCs had become aware of their common interests. So, in 1973 the National Venture Capital Association was formed as a lobbying organization. The NVCA began by lobbying the Administration and Congress for a loosening of the ERISA legal requirements. By 1976 the NVCA lobbying effort gathered political support. Though ERISA was never repealed, under congressional pressure, the government agencies responsible for enforcing the law relaxed their regulations. By 1978, the loosening had progressed to the point at which pension funds, even public ones, again began investing in VC partnerships as limited partners. The importance of this relaxation is confirmed by Gompers and Lerner (1999) finding that ERISA loosening was more significant than lowering capital gains taxes in explaining VC industry growth.

The exit side also changed. In 1971, the National Association of Securities Dealers established the NASDAQ electronic quotation system that was meant to provide bid-and-offer prices for OTC securities. Soon, NASDAQ began to allow trades over its system. Partly because of its historical legacy in OTC securities and in an effort to attract listings, the NASDAQ had less stringent listing requirements than did the NYSE, and was more solicitous of small firms' needs. Intel's decision to list its stock on the NASDAQ in October 1971 inaugurated an enduring relationship between the NASDAQ and VC-financed firms. Young firms could use NASDAQ as a vehicle to mobilize capital, and liquefy the firm's owners' stakes.

The general U.S. economy experienced a crisis that began in the early 1970s and really struck VC with the passage of ERISA. Existing VCs made few investments, and those seeking to raise new funds found it extremely difficult. Luckily, even as the crisis was underway the technological trajectory in the EIP industries continued to create enormous new opportunities especially in regards to the development of the enabling technologies for desktop computing. The EIP technologies were joined by the birth of the biotechnology industry, which gave VCs an entirely new technical realm that had characteristics amenable to VC funding.

*Restructuring and Consolidation (Late 1970s and early 1980s)* The consolidation of the VC industry as a sustainable element in the U.S. national system innovation began in the late 1970s and accelerated in the early 1980s. With the establishment of the NVCA in Washington, DC, the industry had its own voice. One signal that VC had arrived on the political scene was a series of Congressional hearings from 1982 through 1984 that explicitly lauded the role of VC. From the political perspective, VCs were not only an interest group, but were 'sexy.'

Of particular significance for the VC industry were the very successful listings of Genentech and Apple Computer in 1980. The biotechnology, personal computer and peripherals, and then the computer networking industries generated multiple successful listings. The rise of these firms was important in another way; it

heralded the reorientation of U.S. high technology industry away from its dependence on government and military markets and toward civilian markets.

By the end of the 1970s, the U.S. VC industry was a part of the national innovation system. New 'funds of funds' emerged in the early 1980s pooling smaller institutional investors' monies to invest in a basket of funds, thereby turning monitoring over to specialized intermediaries. These intermediaries demanded more standardized performance measures and, statistical sources on VC investing improved. In geographical terms, the center of the industry had moved irrevocably to the San Francisco Bay Area where consistently more than 30 per cent of total investment took place, while Route 128 gathered another 9-10 per cent.

The new structure and features of the VC industry, its embeddedness in the wider U.S. innovation system, the new institutional and regulatory framework, and the links with policy makers meant that the U.S. VC industry was sustainable in even the most difficult markets. Though the industry remained cyclical, it was now a part of the U.S. national innovation system. The private VC system was now supported by both political parties, and increasingly was considered as a core component for U.S. competitiveness.

#### *Israel'*

The Israeli VC industry was established far more rapidly than it was in the U.S. And yet, the Israeli industry exhibits a similar set of phases, and the co-evolutionary processes also are similar. There are also significant differences. As a follower, Israel knew that it was possible to have a VC industry - something the U.S. pioneers had to discover. Further, Israel could draw upon the knowledge and connections of Israelis living in the U.S. and successful American Jewish VCs such as Fred Adler and Alan Patricof. These international connections would prove extremely valuable.

*The Background Conditions Phase (1970-89)* The development of VC in Israel is rooted in a pre-existing high technology sector that had amassed considerable innovative capabilities during the prior two decades. A few events herald the beginning of this phase including the Six Day War and the French embargo that led to a national strategic decision to develop a domestic military R&D capability. This led to sharp increases in military R&D spending and investment. Another decision was to leverage Israel's basic science capabilities into applied science capabilities, and led to the establishment of the Office of the Chief Scientist (OCS) at the Ministry of Industry and Trade in 1969. The OCS extended R&D grants to individual enterprises in a neutral, bottom-up fashion. These policies were a part of a consciously orchestrated collective learning process (Teubal, 1983 and 1993), that included the development of R&D and innovation in the business sector, and culminated in the establishment of a distinctive high-technology sector. Another significant event was the investment by multinationals in R&D laboratories in Israel, e.g. Motorola in 1964, IBM in 1972, Intel in 1974, and Hitachi in 1978; and investment by multinationals in semiconductor and electronics manufacturing



facilities in Israel, e.g. Vishay in 1965, National Semiconductor in 1979 and Intel in 1985.

The R&D capabilities accumulated during the 1970s stimulated the emergence of Israel's software industry in the early 1980s. It also indirectly contributed to the first round of independent SUs; some of which were financed by external investors and were not direct spin-offs. Furthering this growth was a special *ad hoc* limited partnership program that during 1980-86 channelled U.S. investors' resources to a total of 54 SUs. By complementing the OCS budget these additional resources (estimated at between \$40-\$80 million) made a significant contribution to the development of Israeli high technology.

In 1977, the Israel-U.S. Binational Industrial R&D Foundation was established and it made its first investment in 1981. This foundation was a critical mechanism for Israeli companies to establish partnerships with U.S. high-tech companies contribute to Israel's high tech firms' reputation in the U.S. and strengthen Israel and U.S. industrial links.

A major milestone in Israel's VC industry was the founding of Athena, the first formal Israeli VC firm in 1985. Further, from 1980 to 1985, a number of incumbent or established firms had IPOs on the NASDAQ (mostly OTC). These IPOs both reflected and reinforced a growing link with U.S. investment banks such as Lehman Brothers. To provide an understanding of the magnitude of this linkage, between 1984 and 1988, Israeli technology firms raised \$300 million on the NASDAQ. During the same period the total capital raised by all Israeli firms on the Tel Aviv stock exchange was only \$500 million.

On the policy side, the 1984 R&D law allowed consistent increases in OCS funding of business sector R&D, and it recognized software as an industry that could receive OCS R&D support. It also indirectly facilitated restructuring of the defense-dominated electronics industry in the second half of the 1980s. By funding spin-off companies that undertook civilian R&D, at the macroeconomic level, stabilization policies and capital market liberalization were implemented. By the end of the 1980s the business environment improved dramatically. To encourage investment inflows, foreign investors were allowed full convertibility enabling the unfettered repatriation of principal and dividends.

The situation on the international scene also improved. By the end of the 1980s, the regulations for non-North American firms listing on the NASDAQ had been eased. Thus, business links with U.S. firms and with U.S. capital markets deepened, as a number of Israeli entrepreneurs took their SUs public on the NASDAQ. This maturation of the Israeli technology scene led policy makers and businessmen to consider strategies for establishing a domestic VC industry.

*The Pre-Emergence Phase (1989-92)* At the end of the 1980s, the technical, social, and economic assets and knowledge were now available in Israel to be mobilized for a more organized effort to establish a VC industry. The restructuring of the military industries during the second half of the 1980s had sparked an expansion of civilian-oriented, high-tech activity. The software industry had grown from less than \$1 million in 1980 to \$350 million in 1990, of which 20 per cent were exports. The number of SUs being established had increased from several per

year to several tens per year. Fourteen high-tech SUs that had been established after 1980 went public in the U.S., mostly on the NASDAQ, including at least one that had not yet achieved profitability.

The labor market was also changing. In the early 1990s, there was an immigration of thousands of engineers from the former USSR. Contemporaneously, the defence industry laid-off hundreds of engineers. These events contributed to a wave of new firm formation; however 60 per cent of these firms subsequently failed. The government attributed this to an inability to raise additional capital for marketing, and suggested that there was a capital gap and an absence of sufficient marketing capabilities. The government also believed that there was a bias toward technology rather than marketability in the OCS R&D Grants approval process.

The earlier problems catalyzed a process of experimentation and learning by both business sector and government. Treasury and OCS officials believed that despite massive government support for R&D, both market failure and systemic failure was blocking the successful creation and maturation of SUs. Officials decided that this was the result not only of insufficient sources of follow-up financing, but also weak management capabilities and technological development that did not have a market focus. The response was to gradually shift policy objectives from R&D promotion to the enhancement of SU formation, survival, and growth. In the early 1990s, a large number of new government programs were launched including the moderately successful Technology Incubator Program in 1991 and the Magnet Program in 1992. Even while the Treasury was searching for ways of supporting SUs, Yigal Erlich, the head of OCS, was considering measures to make OCS support more effective. His diagnosis was that the weak links in the system were both financial and marketing management and concluded that the establishment of a VC industry could remedy this deficiency.

The first significant direct government effort to create a VC industry was the 1992 Inbal Program. Its central purpose was to stimulate the creation of publicly traded VC funds by using a newly formed government insurance company Inbal. Inbal would guarantee these VC funds that would trade on the Tel Aviv Stock Exchange (TASE) at up to 70 per cent of initial capital assets. In all four funds were established. However, neither the funds nor the Inbal program were successful, suffering from the same problem that had contributed to the demise of the publicly held SBICs in the U.S., namely onerous bureaucratic oversight procedures, the necessity of submitting time-consuming periodic reports, and the fact that holding companies often trade at a discount to the value of their securities. For these reasons, few competent VCs were attracted to the program. Today, the remaining funds in the program and all of the (former) Inbal Funds are managed by one holding company. The failure of the Inbal Program, convinced government policy makers that they needed to develop a new strategy.

*The Emergence Phase (1993-2000)* The second significant government initiative to create a VC industry was the Yozma Program that began operations in 1993 (Avnimelech and Teubal, 2003b and 2004a). Rather than the inward-looking Inbal Program, Yozma meant to create a competitive industry with critical mass by

integrating and learning from foreign limited partners and integrating Israeli VCs into an international network. Yozma was a \$100 million government-owned VC fund with two functions: the first function was to operate as a fund of funds investing \$80 million in ten private VC funds, i.e., \$8 million in each fund. As a condition for receiving this \$8 million (40 per cent), it had to be matched with \$12 million in private funds. Further, the Israelis managing each of these ten funds would have to attract a reputable foreign VC fund or foreign financial institution to also invest. Finally, the government retained \$20 million to create the government-owned Yozma Venture Fund that invested directly in early stage SUs. The total government investment of \$100 million leveraged another \$150 million of foreign funds.

The Yozma program promoted the establishment of private Israeli limited partnership VC funds dedicated to investing in young Israeli SUs. Being paired with the foreign VCs provided the Israeli firms an opportunity to learn. The financial commitment by foreign VCs operated as a quality check on the Israelis applying for the government funds and assured continued monitoring. In this way, the Yozma program favoured entry of professional managers or of individuals with VC-related abilities. To provide a strong upside incentive, for five years the private funds had a call option on government shares at cost plus 5-7 per cent annual interest - a lucrative incentive for both the Israeli and foreign partner. The Yozma-spawned VC funds invested in over 200 SUs.

The most salient aspect of the Yozma program was its emphasis on learning. The first dimension of this learning occurred through the interaction with the foreign investors. The second dimension was through the participation of the Yozma Venture Fund managers in the board meetings of all Yozma funds. Not only did they learn through participation, but also there is evidence that they stimulated co-investment. Further, personal links assured informal interaction between the fund managers.

The Yozma program was very successful. VC investment increased from \$5 million in 1990 to \$3.3 billion in 2000. During the same period the number of foreign investment banks operating in Israel increased from one to 26 (Bar et al 2001). The accumulated number of SUs created was more than 2000; total capital raised by VCs was approximately \$10 billion, the total capital raised in capital markets reached about \$15 billion, and there was an additional \$20 billion in mergers and acquisitions.

One indicator of Yozma Funds' success in triggering industry growth is their expansion that took the form of much larger follow-on funds that received no support from the Yozma Program. This contrasts with Inbal funds that found it very difficult to raise additional funds. The follow-on funds managed by the Yozma-related VC firms were approximately \$5.5 billion in 2000 and accounted for approximately 55 per cent of the total VC pool under management. Moreover, during 2001-2003 (the crisis years) the Yozma descendants exhibited the highest rate of survival and were the most active VCs. The final measure of success of the program was the establishment of a number of non-Yozma funds drawn by the example of the large capital gains achieved by the Yozma funds.

In 1996, the Israeli Venture Capital Association was created. To further publicize the success of the Israeli VC industry, starting in 1996 three significant international conferences were held annually to introduce Israeli SUs to national and international investors. In the heated SU environment of the late 1990s, there was a proliferation of corporate VCs and angel networks. Also, professional service firms such as accountants and attorneys, and PR firms specializing in high-technology were formed.

The Yozma Program with its early successful exits catalyzed the Emergence phase through its role in generating critical mass and improving coordination between different agents in the cluster that accelerated VC and SU activity and learning. It also created a reputation effect that had global value. In interviews, many believed that the fact that, through Yozma, the Government of Israel was willing to invest directly and indirectly in SUs was an important profitability confidence signal to investors (Erlich, 1998 and 2000). The second and no less important reason concerns the preparatory process that was underway during the Pre-emergence Phase. It created the environment within which the Yozma could trigger the entry of VCs. There had been successful exits, Israeli entrepreneurs understood the SU process, and there were technological areas in which Israelis were global-class.

Yozma's design ensured that successes should be highly profitable, while failure would be subsidized only to the extent that the government investments were lost. This encouraged Israeli VCs to exert considerable effort in firms with great potential for success while presumably more quickly terminating less successful investments. With a number of significant successes, Israel developed a reputation for having highly profitable SUs, which attracted both international and domestic investors. This set in motion a path-dependent, positive feedback loop (Avnimelech, 2004). The linkage of Israeli VCs to reputable foreign partners brought linkages to the product markets in other nations, these were vital for the growth of the portfolio firms and provided linkages to foreign stock markets especially NASDAQ. The initial success leads to the development of a reputation that resulted in a sustainable competitive advantage. Early success the follow-up funds.

A central component of the cumulative process triggered by Yozma was VC-SU co-evolution (Avnimelech and Teubal, 2004b). The enhanced VC activity spurred additional SUs; and additional SUs spurred further VC activity. Underlying it there was a number of processes, some of which spurred by specific individuals. As was the case in the U.S., successful SU founders became VC partners. Often, the founders of portfolio companies participated in the funding decisions for new VC investments. These initiatives assisted in creating supply-demand interactions. This virtuous circle of enhanced capabilities and networking contributed to the further success of VCs and enhanced value-added services to SUs. By 2000, Israel had one of the most successful VC-funded start-up ecosystems in the world.

## **Reflections upon the Commonalities and Differences in the Two Cases**

### *Commonalities*

There are a number of commonalities between the two nations. In the Background Conditions Phase, the important commonalities are defence spending and general R&D investment by the government. In the U.S., World War Two developed linkages between universities and industry. In the case of Israel, U.S. high-technology enterprises began manufacturing there and linkages between Israeli and U.S. high technology firms were created. The most salient commonality was the role of the government in funding university R&D and in funding high technology procurement. Finally in both countries new financial mechanisms were created either to finance SMEs (U.S.) or which had the effect of supporting small, R&D performing companies (Israel).

For both nations, the pre-emergence phase was their take-off periods in electronics. There were also an increasing number of SUs, a few of which successfully listed on the stock markets, and a concomitant greater acceptance of entrepreneurship as a career path. Both nations had VC firms, but there was not yet an industry. In Israel this phase was quite short as the Israeli high-technology firms benefited from a quickened growth of high-technology industries around the world. The U.S. had a prolonged process of searching for the right industries in which to invest.

In the Emergence Phase, in both nations there was either directed government action to develop a VC industry or benefited from the unintended effects of other policies. The Yozma Program was successful, whereas the SBIC Program had a mixed record. Most important, both the SBIC and Yozma programs were structured to limit direct government involvement in the investment decision so as to ensure that private investors captured the capital gains. Finally, in both nations, the limited partnership became the dominant organizational form.

Both nations also experienced a Crisis Phase during which the industry experienced a severe shakeout. This is not a typical downturns that afflict all industries, but rather more resembles an existential crisis. The U.S. underwent this crisis from 1974 to approximately 1978. Israel is currently in the midst of such a crisis. In the case of the U.S., the general difficulties that the stock market experienced from 1969 through the Oil Crisis of 1973 were dramatically exacerbated when the U.S. Congress passed ERISA. The current Israeli crisis is different, and has to do with its insertion into the global high-technology economy. However, the outcome is similar. VC firms were unable to secure follow-on funds, and thus had to merge, liquidate, or dramatically downsize. This is testing the current Israeli model, which is overwhelming biased toward early-stage investments and foreign investors in Israeli VC firms.

The Consolidation Phase in the U.S. began in approximately the late 1970s. The limited partnership funded by pension funds and other institutions became the dominant organizational form. Contracts between entrepreneurs and VCs became increasingly standardized. Also, the center of the VC industry shifted to Silicon Valley (Kenney and Florida, 2000). In the case of Israel, the outcome is less sure. However, we believe that the Israeli industry's consolidation, if successful, will include Israeli partners becoming far more active in operating global VC firms.

They will, quite naturally, access Israeli deals, but they will no longer be so dependent on early stage deals in Israel alone.

### *Differences*

First and foremost, the Israeli industry was created rapidly. Of course, having already experienced at least four cycles, the U.S. industry is more mature. There are also other significant differences. The U.S. VC industry operates largely autarchically and, though it receives some foreign investment, it does not require foreign investment or involvement. In contrast, Israel is dependent upon global markets. A very significant difference between the U.S. and Israel relates to the role of government in the creation of the industries. The U.S. was market-led. The only direct role was the SBIC legislation. The U.S. government also reduced capital gains taxes and permitted all limited partnerships able to pass-through capital gains without taxation (Poterba, 1989). Finally, with the loosening of ERISA pension funds and other institutional investors were again comfortable investing in VC limited partnerships, thereby creating an enormous source of capital.

In contrast to the U.S. experience, VC emergence in Israel was 'policy-led.' The Yozma Program was critical. The Yozma program assured the onset of a cumulative process of growth. Significantly, it did this by an incentive program that increased the gains for successful VCs. However, the Yozma Program could never have been as successful were it not for the civilian-oriented innovation and technology policy that was implemented during the preconditions and pre-emergence phases. The R&D grants program begun in 1969 was central for the creation of the high technology sector during the 1980s. Also, the Israeli government introduced a program to stimulate innovation links between U.S. and Israeli firms. Israel learned from the U.S. experience.

The other major difference between Israel and the U.S. is the fact that the U.S. VC industry and high technology firms are the global leaders. The early phases in the U.S. were far longer than Israel's because pioneers are unable to learn from others, and thus must experience many more failures. Even in 2004 only the U.S. has a technology-driven VC industry that is fully consolidated. With the possible exception of mobile telephones, all of the major technology firms must have a presence in Silicon Valley and most of the significant VC firms in the world have some presence in Silicon Valley. The U.S. VC industry benefits from these links, however its survival does not depend on their existence. In contrast, Israel's VC industry depends upon its links to the U.S.

### **Discussion and Conclusion**

In both the US and Israel, the emergence of a VC industry was closely related to the evolution of the relevant high tech cluster. In the case of Silicon Valley, the emergence of the VC industry was intimately linked with the evolution of the region. But a caveat is necessary, successful entrepreneurial activity antedated the

emergence of formal VCs. Firms like HP and Varian were the result of bootstrapping, and they secured investments from *local informal investors* (at that time, the term 'angel' was not yet in use). Other early firms secured investment from industrial firms. However, in the early 1960s formal VC took root in the region. The emergence of VCs meant that entrepreneurs now had access to capital with which to more rapidly build their firms and also undertake larger projects thus lowering barriers to entrepreneurship and accelerating growth. The success of the entrepreneurial firms attracted more VC and encouraged further entrepreneurship. Also, the VCs learned how to nurture entrepreneurs and assist the fledgling firms in the growth process. Conversely, entrepreneurs learned what types of firms were attractive to VCs and how to pitch them. The result was the creation of a mutual interdependence and co-evolution characterized by powerful feedback loops.

In Israel VC-SU co-evolution was identified as a central axis in the cumulative process leading to VC emergence (Avnimelech and Teubal, 2003). Moreover given the importance of the new SU (and VC) component in the new high tech cluster (both are distinctive characteristics of the 'Silicon Valley Model') it is possible to state that VC emergence was also a *central axis* of the process leading to Israel's new high tech cluster of the 1990s. The interaction between the two types of agents was both direct and indirect. Direct interactions parallel supply-demand effects and user-producer links in young markets e.g. VC and SU *entry*; and interactive learning. Indirect links also occur through the wider cluster via one or more component sub-processes of cumulativeness.

To summarize whereas nearly all previous research has examined the 'practice' of venture investing; this paper changed the focus to VC as an institution and industry. Moreover in both the US and in Israel the emergence of this industry seemed to have been a central vector in the creation or re-configuration of their high tech clusters. The EIP technologies were critical to the development of VC. Our research suggests that any cross-national study that omits some measurement of R&D, especially in the EIP technologies and, to a lesser degree, biology will have difficulty explaining the development of VC internationally. In fact, a fruitful area for further research would be the role VC has had in affecting the way in which these technologies have been commercialized. Thus the early electronics technologies created a space within which VC could form, but the formation and maturation of VC reflexively created an environment for entrepreneurship and the further growth of VC.

This study of the VC industry in the two nations has identified two distinct patterns of VC evolution and of successful VC emergence. The US's pattern of evolution is that of the *innovator* country; and emergence of the industry during the 1960s was to a large extent a *market led process* despite the important and even crucial direct and indirect effects of policy. Israel's pattern is that of a *successful imitator*, and its VC emergence process was *policy led*. Not all of the background conditions required for VC emergence in the US had to be developed autonomously. What was crucial for Israel were links with the US that country being the locus of global product and capital markets for technology companies. Links to access the knowledge required for the successful operation of a VC industry; and this was one of the main objectives of Yozma Program. The Israeli

case shows that globalization can accelerate the development of VC industries in peripheral economies, although materializing this potential poses unexpected challenges to policy makers (Avnimelech and Teubal, 2004a and 2004b).

For policy-makers our results indicate that a VC industry *focused on funding and commercializing new technologies through startups* should have great difficulty developing a local investment market in nations without the requisite background conditions (an important aspect of which was the willingness of the U.S. and Israeli governments to invest in human capital formation at universities and research institutions). Whereas researchers with a background in finance and policymakers have suggested that the creation of exit opportunities is the critical feature. Our study suggests that it is not so easy, technical capabilities in the EIP technologies will have to be created. These creations need not be entirely autarchic. Consistent with the role of ethnic networks in the growth of Taiwanese and Indian high tech, the case of Israel demonstrates the importance of Americans and Jewish descent in assisting in the access both technologies and of the tacit knowledge of how things were done in the U.S. Finally, in the case of Israel the government established the Yozma Program that attracted foreign investors, not merely for their capital, but also for their knowledge. The Program was deliberately organized to transfer learning from abroad and train Israeli VCs. Yozma's success and the SBIC's early assistance to fledgling U.S. VCs indicate that government's can have a positive impact on the development of a VC industry.

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### **Notes**

- 1 On appreciative theorizing, see Nelson and Winter (1982) and Malerba *et al.* (2001).
- 2 The difficulty of smoothly applying the principal-agent theoretical apparatus to the VC industry has encouraged some scholars to suggest alternatives. Operating within the principal-agent paradigm, Smith (1998) reverses the standard argument by postulating that the agent is the entrepreneur who accepts the venture capitalist's investment and is concerned that the venture capitalist might shirk or be opportunistic (Smith, 1998). Cable and Shane (1997) suggest that game theory provides a superior explanation for the structuring of VC-entrepreneur relationships. This fits with recent work contending that the central problem for the venture capitalist is uncertainty about the technology, the competence of the management team, the product, and the market. Therefore, principal-agent issues are second-order problems (Dubocage and Rivaud-Danset, 2001). More recently, scholars have proposed that procedural justice theory can explain the relationship between the venture capitalist and the entrepreneur as one in which trust and commitment are critical for reducing the need for costly formal mechanisms for managing the relationship (Sapienza and Korsgaard, 1996; Wright and Robbie, 1998).



- 3 Here, we borrow the title of the Gompers and Lerner (1999) book. However, the cycle they were referring to was the cycle in which venture capitalists raise money, invest in firms, and then reap the capital gains.
- 4 For lack of space we have eliminated our discussion of the Crisis and Consolidation phases. For additional information see Avnimelech and Teubal, 2004, a, b, and Avnimelech (2004).

## References

- Abernathy, W.J. and Utterback, J.M. (1978), 'Patterns of Industrial Innovation', *Technology Review* (June-July), pp. 40-47.
- Akerloff, G.A. (1970), 'The Market for Lemons: Qualitative Uncertainty and the Market Mechanism', *Quarterly Journal of Economics*, (84), pp. 488-500.
- Al-Suwailem, S. (1995), 'Does Venture Capital Financing Make a Difference?', Unpublished doctoral dissertation, Washington University, St. Louis.
- Avnimelech, G. (2004), 'An Industry Life Cycle Model of Venture Capital Industries', MA thesis, School of Business, The Hebrew University, Jerusalem.
- Avnimelech, G. and Teubal, M. (2003), 'Israel's Venture Capital Industry: Emergence, Operation and Impact', in D. Cetindamar (ed.), *The Growth of Venture Capital: A Cross Cultural Comparison*, CT Greenwood Publishing Group Inc., Westport, pp. 207-240.
- Avnimelech, G. and Teubal, M. (2004a), 'Venture Capital Policy in Israel: A Comparative Analysis and Lessons for Other Countries', in S. Mani and A. Bartzokas (ed.), *Financial Systems, Corporate Investment in Innovation and Venture Capital*, Edward Elgar, Cheltenham, pp. 85-116.
- Avnimelech, G. and Teubal, M. (2004b), 'Strength of Market Forces and the Successful Emergence of Israel's Venture Capital Industry: Insights from a Policy-led process of Structural Change', *Revue Economique*, Special Issue, 55(6), November, pp. 1265-1300.
- Barney, J.B., Busenitz, L.W., Fiet, J.O. and Moesel, D.D. (1996), 'New Venture Teams' Assessment of Learning Assistance from Venture Capital Firms', *Journal of Business Venturing*, 11, pp. 257-272.
- Bean, J.J. (1996), *Beyond the Broker State*, University of North Carolina Press, Chapel Hill.
- Bar, H.R. (2002), *Is Venture Capital Special?: Empirical Evidence from a Government Initiated Venture Capital Market*, Samuel Neaman Institute, Israel.
- Bar, H.R. Lukomet and Nachmani, E. (2001), 'Globalization and Entry of Foreign Investment Banks to Israel', typescript, Bank of Israel, Research Department.
- Bruno, A. and Tyebjee, T. (1986) 'The Destinies of Rejected Venture Capital Deals', *Sloan Management Review* (Winter), pp. 43-52.
- Cable, D.M. and Shane, S. (1997), 'A prisoner's dilemma approach to entrepreneur-venture capitalist relationships', *Academy of Management Review*, 22(1), pp. 142-176.
- Dubocage, E. and Rivaud-Danset, D. (2001), 'The Organization of Exchange Issue: The Venture Capital Market', Unpublished manuscript, University of Reims.
- Erlich, Y. (1998), Personal interview conducted by Morris Teubal.
- Erlich, Y. (2000), Personal interview conducted by Gil Avnimelech and Morris Teubal.
- Etzkowitz, H. (1993), 'Enterprises from Science: The Origins of Science-based Regional Economic Development', *Minerva* 31, (3), pp. 326-360.

- Finkle, T.A. (1998), 'The Relationship between Boards of Directors and Initial Public Offerings in the Biotechnology Industry', *Entrepreneurship Theory and Practice*, 22(3), pp. 5-29.
- Florida, R. and Smith, D.F. (1994), 'Venture Capital and Industrial Competitiveness', report to the U.S. Department of Commerce, Economic Development Administration, May, Washington D.C.
- Gompers, P. and Lerner, J. (2001), 'The Venture Capital Revolution', *Journal of Economic Perspectives*, 15(2), pp. 145-168.
- Gompers, P. and Lerner, J. (1999), *The Venture Capital Cycle*, MIT Press, Cambridge.
- Gupta, A.K. and Sapienza, H. (1992), 'Determinants of Venture Capital Firms' Preferences Regarding the Industry Diversity and Geographic Scope of their Investments', *Journal of Business Venturing*, 7(5), pp. 347-362.
- Hall, J. and Hofer, C.W. (1993), 'Venture Capitalists' Decision Criteria in New Venture Evaluation', *Journal of Business Venturing*, 8, pp. 25-42.
- Hart, D. (1998), *Forged Consensus: Science, Technology, and the Economic Policy in the United States, 1921-1953*, Princeton University Press, Princeton.
- Helfat, C. and Lieberman, M. (2002), 'The Birth of Capabilities: Market Entry and the Importance of Pre-History', *Industrial and Corporation Change*, 11(4), pp. 725-760.
- Hsu, D. and Kenney, M. (2004), 'Organizing Venture Capital: The Rise and Demise of American Research & Development Corporation, 1946-1973', Berkeley Roundtable on the *International Economy Working Paper* 163.
- Jain, B.A. and Kini, O. (2000), 'Does the Presence of Venture Capitalists Improve the survival Profile of IPO Firms?', *Journal of Finance and Accounting*, 27(9/10), pp. 1139-1176.
- Jeng, L. and Wells, P. (2000), 'The Determinants of Venture Capital funding: Evidence across countries', *Journal of Corporate Finance*, 6, pp. 248-289.
- Kaplan, S.N. and Stromberg, P. (2001), 'Venture Capitalists as Principals: Contracting, Screening, and Monitoring', *American Economic Review*, 91 (May), pp. 426-430.
- Kenney, M. (1986), *Biotechnology: The University-Industry Complex*, Yale University Press, New Haven.
- Kenney, M. and von Burg, U. (1999), 'Technology and Path Dependence: The Divergence between Silicon Valley and Route 128', *Industrial and Corporate Change*, 8(1), pp. 67-103.
- Kenney, M. and Florida, R. (2000), 'Venture Capital in Silicon Valley: Fueling New Firm Formation', in M. Kenney (ed.), *Understanding Silicon Valley: Anatomy of an Entrepreneurial Region*, Stanford University Press, Stanford, pp. 98-123.
- Klepper, S. (1996), 'Entry, Exit, Growth and Innovation over the Product Life Cycle', *American Economic Review*, 86(3), pp. 562-583.
- Kortum, S. and Lerner, J. (2000), 'Assessing the Contribution of Venture Capital to Innovation', *RAND Journal of Economics*, 31(4), pp. 674-692.
- Lerner, J. (1999), 'The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program', *Journal of Business*, 72(3), pp. 285-318.
- Lerner, J. (2002), 'Boom and Bust in the Venture Capital Industry and the Impact on Innovation', *Federal Reserve Bank of Atlanta Economic Review*, Fourth Quarter, pp. 25-39.
- Liles, P. (1977), *Sustaining the Venture Capital Firm*, Management Analysis Center, Harvard University, Cambridge, MA.
- MacMillan, I., Zemann, L. and Narasimha, P. (1985), 'Criteria Used by Venture Capitalists to Evaluate New Venture Proposals', *Journal of Business Venturing*, 2, pp. 123-137.

- Malerba, F., Nelson, R., Orsenigo, L. and Winter, S. (2001), 'History-Friendly models: An Overview of the Case of the Computer Industry', *Journal of Artificial Societies and Social Simulation*, 4(3), pp. 1-26.
- Meggison, W. and Weiss, K.A. (1991), 'Venture Capitalist Certification in Initial Public Offerings', *Journal of Finance*, 46, pp. 879-893.
- Myers, S.C. and Majluf, N.S. (1984), 'Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have', *Journal of Financial Economics*, 13, pp. 187-22.
- Nelson, R. and Winter, S.G. (1982), *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge.
- Poterba, J.M. (1989), 'Venture Capital and Capital Gain Taxation', *NBER Working Paper* 2832.
- Sahlman, W. (1990), 'The Structure and Governance of Venture-Capital Organizations', *Journal of Financial Economics*, 27, pp. 473-521.
- Sapienza, H. and Korsgaard, M.A. (1996), 'Procedural Justice in Entrepreneur-investor Relations', *Academy of Management Journal*, 39 (3A), pp. 544-574.
- Smith, D.G. (1998), 'Venture Capital Contracting in the Information Age', *The Journal of Small and Emerging Business Law*, 2, pp. 133-145.
- Stein, M. and Bygrave, W.D. (1990), 'The Anatomy of High-tech IPOs: Do their Venture Capitalists, Underwriters, Accountants, and Lawyers Made a Difference?', in R. Brockhaus *et al.* (ed.), *Frontiers of Entrepreneurship Research*, Babson College, Wellesley, MA.
- Stiglitz, J.E. and Weiss, A. (1981), 'Credit Rationing in Markets with Incomplete Information', *American Economic Review*, 71, pp. 393-409.
- Teubal, M. (1983), 'Neutrality in Science Policy: The Promotion of Sophisticated Industrial Technology in Israel', *Minerva*, 21, pp. 172-179.
- Teubal, M. (1993), 'The Innovation System of Israel: Description, Performance and Outstanding Issues', in R. Nelson (ed.), *National Innovation Systems*, Oxford University Press, Oxford, pp. 476-502.
- Wright, M. and Robbie, K. (1998), 'Venture Capital and Private Equity: a Review and Synthesis', *Journal of Business Finance and Accounting*, (25), pp. 521-570.