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**EVOLUTIONARY VENTURE CAPITAL POLICIES:  
INSIGHTS FROM A PRODUCT LIFE CYCLE ANALYSIS OF  
ISRAEL'S VENTURE CAPITAL INDUSTRY**

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# **Evolutionary Venture Capital Policies: Insights from a Product Life Cycle Analysis of Israel's Venture Capital Industry**

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## **Evolutionary Venture Capital Policies: Insights from a Product Life Cycle Analysis of Israel's Venture Capital Industry**

### **Abstract**

The significance of VC as a component of the 'Silicon Valley' model of high tech has led many countries during the 80s and 90s to implement government policies aimed at stimulating this activity. This paper suggests that a major factor in the failure of many of these policies to create an early phase, high tech SU(Start Up) oriented VC industry was the simplistic attitude of policy makers who viewed VC as a 'pool of capital'. The alternative 'VC as an industry' view adopted in this paper explicitly considers issues of VC organization, capabilities, strategy and institutions. These are analyzed in the context of an Industry Life Cycle approach which focuses on the process of creation of the new industry ("VC Emergence") and on the subsequent crisis, restructuring and consolidation phases. The successful emergence of a VC industry in Israel during the 90s was not a 'pure' market-led process; rather it was triggered by a *targeted VC directed policy/program (Yozma)*, implemented during 1993-98. The incentives structure & timing of this program as well as other elements in its design stimulated entry both of high quality domestic managers/ entrepreneurs (many of them with prior high tech experience) and of reputable, capable and networked investors from abroad. Both groups provided significant added value to the emerging VC industry and hi-tech cluster. Due to these and other factors Yozma facilitated an extremely rapid and efficient process of VC emergence based on co-evolutionary and other cumulative processes. It also assured a pattern of investment which followed a strict definition of VC (dominance of early stage investments in pure high tech SU).

This paper suggests that an analysis of the impact of VC policy requires considering the *context & timing* of policy implementation; and the links between VC and VC policies on the one hand and high tech and high tech cluster policies on the other. Moreover success necessitates adoption of a systems/evolutionary perspective to Innovation & Technology Policies in general and to VC-directed policies in particular.

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#### **List of Acronyms**

VC-Venture Capital, Venture Capital companies; SU- high tech Start Up, high tech Start Up Company  
LP-Limited Partnership; IVA-Israel Venture Capital Association; NVCA-National Venture Capital Association (US); PLC-Product Life Cycles; PE-Private Equity; IB-Investment Banks; BG-Business Group; S&T-Science and Technology; A&T- Avnimelech, G. & M. Teubal; ATK-Avnimelech, Kenney, Teubal  
ITP-Innovation & Technology Policy; SI-System of Innovation; SF: System Failure;  
OCS-Office of the Chief Scientist, Ministry of Industry and Trade (Israel); BIRD-Binational Industrial Research and Development Program; TASE-Tel Aviv Stock Exchange; RBS: Restructuring of Business Sector;  
SBIC-Small Business Investment Companies; SBIR-Small Business Innovative Research

## **1. Introduction & Objectives**

This paper deals with policies promoting Venture Capital oriented to the financing and support of seed & early phase high tech SU companies (a ‘strict VC definition). In the context of an ‘Industry Life Cycle Model’ of VC *industry* evolution based on the classical Product Life Cycle model of the literature (Abernathy & Utterback 1978; Klepper 1996), it focuses, although not exclusively, on targeted programs directed to *VC Emergence*. The motivation originated from an analysis of the Yozma Program (‘*Yozma*’) which was successfully implemented during 1993-7 and which triggered the Emergence of Israel’s VC industry (A&T 2002a,b). In previous work we argue that the objective of this program was to promote a *domestic (infant) industry* rather than the generation of ‘*a pool of capital*’. This was reflected in the program’s design where both promotion of appropriate forms of VC organization- the LP form which prevailed in Silicon Valley- and promotion of learning figure prominently. Moreover the *Upside* incentives offered both stimulated entry of professional and highly skilled VC managers who would readily focus on *early phase investments* in SU; and value adding foreign investors. The incentives offered by Yozma contrast with the tax benefits to investors & risk sharing mechanisms which were common in other VC promotion programs at the time (OECD 1996, 2003a,b,c).

No less important for the success of Yozma were the timing and context of its implementation. Israel’s VC industry did not arise in a vacuum; rather it evolved from a prior setting of high tech and R&D/innovation capabilities- yet another policy led process spanning the two decades which preceded emergence of the new industry. That experience suggests that a VC-directed incentives’ program should not represent the central thrust of Government policy directed to *create* a completely new high tech sector (Gelvan & Teubal 1997). Rather a VC industry may be socially desirable once high tech industry has developed and achieved a certain size and strength.

The special features and relative success<sup>1</sup> of VC policies in Israel and the problems encountered elsewhere in the development of an early phase VC industry<sup>2</sup> suggest that other countries may benefit from that country’s experience. Despite our

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<sup>1</sup> ‘Relative’ since Israel’s VC industry has not yet consolidated and passed the test of ‘sustainability’.

<sup>2</sup> Israel’s VC (broad definition including PE) investments during the 1998-2001 period as a share of GDP were the highest in OECD countries (1.3%) - higher than the UK, Sweden and the US. In the year 2000 a full 1% of GDP was invested by *domestic* VC companies only. Moreover, over 50% of these investments were in early stage firms (OECD 2003d), more than double or triple the share in other OECD countries. For most OECD countries, the GDP share of early stage investments in 1998 was less than 0.1% (OECD 2003, in progress).

belief that the Israeli experience is not replicable *in toto* elsewhere, *specific aspects* of the experience may be useful to other countries. Moreover, a number of *policy issues*, which arise from the Israeli experience & are analyzed in this paper could be quite valuable to researchers and policy makers elsewhere.

### **1.1 Research on Venture Capital Policy**

The extensive VC literature<sup>3</sup> is testimony that significant progress has been made in understanding the operation and impact of VC. This contrasts with research on *VC policy*, which has been much less extensive, more descriptive than analytical, and less successful in generating new knowledge. It is our belief that part of the problem resides in the policies implemented themselves- their simplistic underlying assumptions and their weak impact, both of which explain why no satisfactory conceptual framework has yet been developed for analyzing policy<sup>4</sup>. It also is the reason why an analysis of Israel's successful Yozma program could enhance our knowledge about the conditions for successful VC policies.

Public policy aimed at stimulating venture capital was significant in the early-mid 1980's when several OECD European countries implemented VC-directed policies. Most of these focused on the supply side- how to increase the pool of VC capital available through a combination of three sets of measures: 1) Direct Government investments (in private VCs or in SU); 2) Tax and other incentives to private sector investments in VC (capital gain taxes, government guarantees, etc); and 3) regulatory changes principally affecting Pension and Insurance funds. Most reviews of policy, divert little attention to the stimulation of "demand" (quantity & quality of SU companies); or to issues of VC organization, strategy or capabilities. Neither did they link the development of VC with the development of high tech clusters. One exception to the supply side bias was Poterba (1989) who examined how and whether capital gain taxation influenced the growth of VC in the US. He examines both the supply side - pool of capital to VC funds; and the demand side - the motivation of individuals to become entrepreneurs and to join startup firms. Proof that VC was not considered an 'industry' by most researchers in the field is given by the fact that no serious attention was given to measures to attract professional high

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<sup>3</sup> This paper will not review this literature e.g. see Gompers and Lerner 1999, 2001.

<sup>4</sup> A second reason is that, with few exceptions, 'policy' has not in general been considered an area of knowledge in itself but a simplistic application of 'positive' knowledge (see Teubal 2002).

quality VC managers/ firms into the VC industry and valued adding investors, despite the strong supply inelasticity in their generation (Gompers & Lerner 1999, Ch. 1).

By the late 1980's and early 1990's the scant success of such programs in developing an early stage, high tech & SU oriented, VC industry led to a generalized disappointment with VC policies in general. Florida et al. (1990, 1994) argued that government programs aimed at developing national VC industries or VC in specific states of the U.S. failed. This failure was related to the fact that VC investments flow mainly to established-high-tech centers regardless of the geographical location of the VC industry-a fact which means that it has a weak impact in regions without established high tech clusters<sup>5</sup>.

Most Government policies still assumed that VC was a 'pool of money' and this led in the late 80s and early 90s to pessimistic policy conclusions or to simplistic prescriptions to promote exit mechanisms. For example, in an early 90s report to the EU showing that modern, effective VC exit mechanisms did not exist in Europe; no neither significant nor far reaching policy conclusion was arrived at (Coopers et al. 1995). With the exception of some reference to the need of developing intermediaries in Europe and to further develop angel networks, the underlying framework of analysis did not consider structural and organizational elements. While the focus on taxation issues, strengthening of networks & information flows and standardization of evaluation criteria, are important they did not go to the core of the problem of developing a sophisticated VC *industry* e.g. the widespread absence of large numbers of quality, high growth SU and high quality VC agents. The limited and pessimistic policy implications and the weak impact of policy caused most researchers during the 1990's to largely ignore policy<sup>6</sup>.

A conclusion from a review of the literature till the mid 90s and from a study of policy and VC emergence since is that "success" in VC policy requires a broader & better integrated set of programs and institutional changes, not all directed at all times to VC but also to the domestic high tech cluster (R&D, SU, capital markets) and even to other areas. Once Venture capital is considered an industry rather than just a pool of capital, its focus will shift to the identification of the *market & system failures*

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<sup>5</sup> Thus the impact of VC is context sensitive since it may have a significant high tech growth impact in established high tech regions.

<sup>6</sup> The 'pool of capital' view of VC is also reflected in the 2003 OECD report on Israel which states that 'Israel succeeded in leveraging public investments in VC' and increasing the amount of private VC flowing to the industry. There is only a limited discussion of the reasons for this success

blocking the creation of a capable and professional VC *industry* (and other issues pertaining to the creation, transformation or growth of high tech clusters) - rather than simply to market failures associated with the flow of *financial* capital to VC.

A gradual change in perception which follows these lines became evident after the enormous success of some high tech clusters and VC industries in a number of countries during the second half of the 90s. Thus recent work by the OECD emphasizes both the importance of the specific contexts of each country; and the need to somewhat increase the set of policies considered e.g. greater emphasis was given to building formal and promoting informal angel networks. This development was also triggered by a few successful VC policies like Israel's Yozma program. Moreover VC development came to be viewed in this period as a mechanism for countries to actively participate in the IT Revolutions. In line with this several authors attempted to identify factors which might contribute to the development of Venture Capital. Black and Gilson (1998) for example emphasized the interaction between the strength of the local IPO market and the development of the VC industry<sup>7</sup>; while Jeng & Wells (2000)<sup>8</sup> shows that "the initial public offering market does not seem to influence commitments to early stage funds as much as later stage ones" and that "the strength of the domestic high tech cluster is the main stimulator of early stage VC activity". In general this strand of research suggests that the strength of the local IPO market is mainly related to late stage VC investment while the supply of high quality startup firms is more significant to early stage VC investments<sup>9</sup>.

Despite the above and despite the fact that some recent policy-related research in the field takes into consideration both VC demand and VC supply, most of existing research on VC policies still ignores issues of VC organization & capabilities; how to attract professionals to the VC industry; how to stimulate cumulative learning; and the role of cluster dynamics.

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<sup>7</sup> In the mid 90's few countries tried to triggered the VC industry through the creation of Equity markets for innovative SU following NASDAQ example such as EASDAQ, JASDAQ and SASDAQ.

<sup>8</sup> Other research such as that of Lerner (1999) and Gans & Stern (2003) focused on support of early stage R&D in SU in the context of their analysis of the successful SBIR program in the US. In addition, Lerner (1998, 2002) examined other issues related to government policy in the area of funding entrepreneurial activity. Rather than considering subsidies as another form of Government Venturing activity, we propose that direct subsidies to SU should be considered as complementary (or VC-relevant/related) actions to Government VC policies. For example, R&D grants to business firms in Israel, through a number of distinct dynamic processes, set the base for the subsequent emergence of a VC industry. Moreover, they were contemporaneous to and complemented the Yozma program.

<sup>9</sup> Israel's strong domestic early stage VC industry is linked to the US VC industry for mezzanine and late stage finance of Israeli SUs and therefore to the US IPO market. These links enabled Israel's VC industry to exist in the absence of a significant domestic IPO market.

## ***1.2 Recent Research on Israel's Venture Capital Industry***

In recent work (A&T 2003a,b) we analyzed the emergence and development of the Venture Capital Industry in Israel and its role in the recent successful growth of Israel's high tech cluster. Taking an Evolutionary perspective we trace the co-evolutionary and dynamic process involving the business sector, technology policies, venture capitalists, SU companies, and foreign linkages. We argue that the VC emergence is part & parcel of the reconfiguration (Teubal & Andersen 2000) of a pre-existing Electronics Industry one involving large amounts of SU and new powerful links with global *capital* & product markets. The main conclusions and policy lessons of these papers are that specific technology policies targeted to the Venture Capital sector can be effective in causing VC Emergence only to the extent that a) favorable background conditions exist or were created; b) a pre-emergence period existed with significant amount of *informal* VC & SU *related* activities; and c) the design and timing of such a policies are such that they lead to the early and rapid accumulation of reputation & capabilities.

In Israel the *Background Conditions* (1970-88) included a pre-existing high tech sector with considerable innovation capabilities induced by a coherent and important Horizontal Program supporting company R&D<sup>10</sup>; significant restructuring of the pre-existing Military-dominated Electronics industry during the second half of the 80s; domestic stabilization policies & capital market liberalization; the globalization of technology capital markets (NASDAQ); and the strengthening of business links with US industry & capital markets<sup>11</sup>. Moreover, during *the Pre-emergence Phase* (1989-92) a considerable amount of *business experiments* took place- both with respect to the structuring of a new type of 'born global' SU oriented both to product & capital markets (with some success stories e.g. Lannet, Lanoptics, Magic, etc.), and also in relation to VC-related activities (e.g. Star, Veritas, Evergreen, etc.). There was also

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<sup>10</sup> An Horizontal program supports particular functions like company R&D to all firms of the business sector whatever their sector affiliation, and the technology being used. It contrasts with 'targeted' programs directed to the particular industries or technologies. An unintended effect of Israel's Horizontal R&D support program was to generate awareness both of the weak links in the system and of potential areas of competitive advantage.

<sup>11</sup> Israel's high tech links with the US were established through academic links and through Israelis working in Silicon Valley. A program called BIRD, which promoted joint R&D between Israeli and US companies, reinforced the process. By the 90's Israeli returnees from the US established SU in Israel and local offices of MNE. A related development was the increasing relative importance of NASDAQ. During 1984-88 Israeli technology-companies raised \$300M in NASDAQ while only \$500M was raised by all Israeli companies in the Tel Aviv Stock Exchange. We might say that a path and link to NASDAQ-so important in the 90s-was blazed during the 80s.

important policy experimentation and learning from the launch of the relatively unsuccessful, pre-Yozma, Inbal program in 1992; and from the Technological Incubator's program. In conjunction with the high rate of SU creation and successful technological developments at the time (which generated a clear excess demand for VC services) together with large-scale failure in their market/financial success- these developments suggested the existence of a 'Systemic' failure in Israel's business sector. Policy makers eventually identified the means to overcome this deficiency—creation of an early phase, domestic ‘*adding value*’ VC industry with global linkages and a Limited Partnership (LP) form of organization.

The pre-emergence conditions specified above enabled an appropriate design of a Targeted VC policy program -Yozma, which triggered VC Emergence in Israel. The process involved rapid entry of professional managers (many of these with prior high tech experience) & companies and strong 'collective' learning. These and other factors such as VC-SU co-evolution, spurred a self-reinforcing, cumulative process of VC emergence & development<sup>12</sup>. Finally it must be said that the above processes influenced and were influenced by Israel's new high tech cluster which evolved in parallel to VC during the 90s.

### ***1.3 Objectives of Paper***

We showed that the emergence of Israel's Venture Capital industry could be visualized as a *path dependent* process involving a broad set of economic, societal and even geopolitical factors—some endogenous & some exogenous- spanning 2-3 decades. Previous work did not cover the post VC emergence period and some important issue of the VC emergence process and of post crisis restructuring & consolidation. Moreover, the narrative was not explicitly cast within an Industry Life Cycle framework, which seems to be the right framework for comparing the dynamics of VC industry formation and development across countries.

The specific research objectives & issues are:

*1. What are the key features of Israel's Yozma Program which assured its success in promoting VC emergence? And what are the main differences between the successful Yozma program and the failed Inbal program? (Section 2)*

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<sup>12</sup> One dynamic component would look as follows (see Avnimelech 2002): high quality SU → excess demand for VC → Yozma program → VC initial success & reputation → attracting value added investors & high quality deal flow → accumulation of additional capabilities and reputation. This is a 'Winner takes all' framework in which first mover advantage can lead to strong entry barriers.

2. *Propose an Industry Life Cycle framework for analyzing the evolution of a VC industry and adapt the Israeli case to this framework (section 3 &4)*
3. *Analysis of the co-evolutionary processes taking place in the VC emergence phase*
4. *Policy Implications including a typology of failures in VC policy (section 5).*

## **2. The Yozma Program (Policy Process, Design & Impact)**

### ***2.1. Background and Context***

New National Priorities emerged in Israel with the beginnings of the massive immigration from the former Soviet Union during the early 90s. The Government began searching for means to employ the thousands of engineers that came to this country. Simultaneously the Military Industries had laid-off hundreds of engineers; and many startup companies were created only to subsequently fail. In fact an official report (Jim report, 1987) mentions that 60% of the technologically successful OCS-approved projects failed to raise additional capital for marketing and had to close the business. This suggests both a capital gap and the absence of sufficient marketing capabilities<sup>13</sup>.

Officials in the treasury and the OCS realized that despite massive Government support for R&D there were clear 'market & *system* failures', which blocked the successful creation and development of Startup companies. This was related, not only to insufficient sources of R&D follow-up finance but also to weak management abilities, business know how and non market-directed developments.

It was clear that a shift in policy objectives gradually took place-from promotion of R&D to enhancement of SU formation, survival and growth. The head of OCS, Yigal Erlich, pondered about how to make OCS support more effective. He could not find even one real success "similar to those we see today" (interviews 1998, 2000). The basic problem was lack of capability to grow after the product development phase. He identified 'finance' *and* 'marketing/management' (skills & approach) as the weak links in the system; and eventually he believed that the way to overcome these deficiencies was to foster a domestic Venture Capital industry.

#### *A First Attempt: Inbal*

The Inbal Program was the first attempt at implementing a targeted ITP directed to the VC industry. It was launched by the treasury in 1992 one year before the

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<sup>13</sup> The weak reported impact of OCS's support was probably also due to a 'technology biases in the OCS R&D grants approval process.

implementation of Yozma. Its central idea was to stimulate *publicly traded* VC funds by guaranteeing the Downside of their investments. The mechanism used was a Government Insurance Company ("Inbal") that guaranteed VC funds traded in the Israeli stock market (TASE) up to 70% of initial capital assets. The program imposed certain restrictions on the investments of the VC companies covered by the program ('Inbal Funds'). Four 'Inbal' funds were established. They and the Inbal program as a whole were not a great success. Inbal funds valuations in the stock market were low, similar to Holding Companies' valuations; and the funds encountered bureaucratic problems. The funds did not succeed financially and did not raised additional capital. Eventually all four 'Inbal' funds quitted the program (today all of them are 'held' by one holding Company-Green Technology). Inbal program didn't solve all market failures related to the pool of capital to the VC industry. Moreover, it didn't target any of the system failures related to the VC industry creation. There was no mechanism for drawing professional VC agents into the program; it did not generate VC companies with adding value capabilities; it didn't promote collective learning; it didn't create links with additional late stage VC pool or a significant IPO market; and it was exposed to 'stock market sickness'. Its model of VC company organization was not imitated, and the 'social impact' of the Inbal Program was very low (A&T2003c,d). Having said this, it is important to mention that policy makers and businessmen alike learned from Inbal's weak impact particularly the importance of aiming at the creation of a VC industry rather than just increasing the VC pool.

## ***2.2. The Design of Yozma***

The designing of the Yozma program was an outcome of a very long and intensive preparation, which included visits of OCS officers to Silicon Valley, interviews with U.S. entrepreneurs, venture capitalists, investment banks, financial institutions, and SBA officers. It was based on implementations of the U.S.- proven VC characteristics (form of organization, routines, procedures and etc.), with only necessary adaptations to the Israeli environment (such as using the NASDAQ as an exit path rather the local Stock Exchange- TASE). The Yozma program began operating in 1993. The explicit objective was to create a solid base for a competitive VC industry with critical mass; to learn from foreign limited partners; and to acquire a network of international contacts. It was based on a \$100M Government owned VC fund (with the same name) oriented to two functions: a) fund of funds- investment in

10 private VC funds ('Yozma Funds'-\$80M); and b) direct investments in high tech companies-\$20M (through the Government –owned 'Yozma Venture Fund'). The basic thrust was to promote the establishment of domestic, private LP VC industry that invested in young Israeli high tech startups ('early phase investments') with the support of government and with the involvement of reputable foreign financial institutions (generally a foreign private equity or venture capital company). Such funds must be managed by an independent, Israeli VC Management Company. Each 'Yozma Fund' would have to engage one such foreign institution together with a well-established Israeli financial institution. This emphasizes the point that the Yozma program favored entry of professional managers or of individuals with VC-related abilities into the infant VC industry. Moreover, the insistence on formal organizations as a pre-condition to become a Yozma fund, suggests that its initiators understood the significant role of institutions in the process of learning, generating capabilities and reputation. In an approved fund that fulfilled these conditions, the Government would invest 40% (up to \$8M) of the funds raised. Thus \$100M of Government Funds would draw \$150M of private sector funds (domestic and foreign)<sup>14</sup>.

Yozma did not simply provide capital and risk sharing incentives to investors--as was common in other Government VC support programs<sup>15</sup>; its main incentive was in the 'upside'-- each Yozma fund had a call option on Government shares, at cost (plus 5-7% interest) for a period of five years. The program also assured the realization of 'supply side learning' through the compulsory participation of foreign Financial Institutions ('learning from others"-a standard mechanism of infant industry development in developing countries); through participation of the Yozma Venture Fund manager (Yigal Erlich & other OCS officers) at the board meetings of all Yozma funds (they probably acted as a node in a vast information network); and through the stimulation of co-investment among Yozma Funds. Culturally speaking the stage was set for a lot of informal advising and interaction among the managers of the Funds. 'Demand side' support was provided not by Yozma itself but by the Backbone 'R&D support & Technological Incubators Programs (see A&T 2003a,b). Another major point was the pursuing of an aggressive investment policy, spearheaded by Yozma Venture Fund.

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14 There were 2 Yozma funds with \$35M, 9 with \$20M (including Yozma Fund) - a total of \$250M.

15 It did not provide guarantees or tax benefits; nor was it accompanied by new regulation rules for Pension Funds or corporate law. In both respects Israel's situation was 'level playing field' with that of other countries at the time.

Yozma Fund started operating in 1993 and was privatized in 1998, the total capital raised by its' funds was \$250M and they invested in over 250 SU companies. Box1 below summarizes the main features of Yozma's design.

**Box 1: Critical Dimensions of Yozma Program Design**

<i><b>Fund of Funds &amp; Direct investments in SU; Favored a LP type of VC company.</b></i>
<i><b>A focus on Early Phase investments in Israeli high tech Startup companies</b></i>
<i><b>Target Level of Capital Aimed at 250M\$ (Government Support- 100M\$) - this was the 'Critical Mass' of effort required for VC industry 'emergence'.</b></i>
<i><b>10 Privately owned Israeli VC Funds each managed by a local management company (formal institution) &amp; involving Reputable Foreign Financial Institution.</b></i>
<i><b>Government Participation in each Fund-8 million dollars (up to 40% of fund's capital)</b></i>
<i><b>Strong Incentive to the "Upside"- a 5 year option to buy the Government's share at cost.</b></i>
<i><b>Planned 'Privatization' of Yozma Fund &amp; Program: Privatization was completed in 1998. Yozma became a Catalytic Program.</b></i>
<i><b>The Yozma Program triggered a strong process of collective learning.</b></i>
<i><b>The Yozma design attracted professional VC agents into the program.</b></i>

**2.3 Yozma Impact**

The Israeli data show a quantum jump in VC activity and high tech exports after Yozma. This and the insights received and statements made during our interviews (20 interviews- see A&T 2003a,d) are the basis for our inference that Yozma triggered cumulative growth and VC emergence. An indication of Yozma Funds' success in triggering growth of the industry is their expansion, which took the form of 'follow up' funds not supported by the Yozma Program. This contrasts with Inbal funds that in most cases did not raise additional funds after establishment. Most Yozma funds (and some other funds that indirectly benefited from the Yozma experience) were followed by one or more funds managed by an expanding but related core of managers (again this contrasts with the Inbal program, where no additional Inbal-type VC Companies were founded after the original core of 4 public VCs). *The total sums managed by this group amount to about \$5.5 billion out of a total of \$10 billion managed in 2001.* Another measure of the success is the rapid entry of non-Yozma related funds, something triggered by the handsome profits obtained by Yozma Funds (in 2000 there were more than 100 VC management companies in Israel); and the creation of the IVA in 1996 (with strong leadership of Yozma VCs).

In A&T (2003a,b) we provide an 'explanation' why Yozma, through critical mass effects and other factors became the trigger for VC industry emergence and for the onset of a cumulative process of development. Over and beyond favorable background conditions already mentioned and other features of the pre-emergence

period we would like to point out here the role of three additional factors which contributed to Yozma's high impact: a) the likely prior existence of 'unsatisfied demand' for VC services- a consequence of a pre-existent pool of SU which included some high quality firms (Checkpoint, Galileo, ESC, etc.) who also made a significant direct & indirect contribution to cumulateness & emergence (A&T2003d); b) overlap between the learning & cumulateness process taking place domestically and the rising NASDAQ index (and other favorable conditions)<sup>16</sup>; c) supportive cultural environment; and d) Yozma's successful design.

### **2.4 Comparing Yozma with Inbal**

A comparison of Yozma and Inbal will further emphasize the crucial role Yozma's design (box 2). Yozma's design played a crucial role in explaining its differential performance (box 3) since both programs had almost similar goals; their date of initiation differed by only one year; with 5 years overlap in implementation.

#### **Box 2: 'Design' aspects of YOZMA & INBAL Programs**

<b>YOZMA</b>	<b>INBAL</b>
Promoted by the OCS & mostly structured as Fund of Funds with a Single Objective of creating a VC industry	Promoted by the Treasury & structured as a Government owned Insurance company. Dual objective: Promoting TASE & a VC industry.
Limited partnership form of VC-the ideal form of organization according to US experience and to Agency Theory.	Publicly traded form of VC; no value added; hard to leverage current success to fundraising, low incentives for managers, and bureaucracy.
Leveraged Incentives to the Upside. Attracting professional VC teams.	Downside guarantees, which favor entry of non-professional VC firms
No Government intervention in the day by day operation of Yozma Funds	Government frequently intervened and imposed bureaucratic requirements on VCs supported
Limited period of government incentives; and clear and easy way out of the program.	Unlimited period of government incentives and complex way out of the program.
VC abilities were one important criterion for selection of 'Yozma Funds'. There was flexibility in the choice of the funds. Personal recommendation of the OCS was important	Administrative & financial criteria figured prominently in selection of Inbal VCs (there being no assurance of existence of specific VC abilities). No OCS recommendation required
Limited number of Yozma funds- created an incentive to join fast. This in turn contributed to creation of critical mass in two-three years.	No explicit limit (neither time nor money) to the number of funds that could enjoy the INBAL benefit.
The program was designed and implemented by the OCS who was skilled in promoting high tech industries. It was a consensual outcome of an interactive policy process, which included the Treasury, the private sector and foreign investors.	The program was designed and implemented by the Treasury who had no specific hi tech knowledge & who emphasized financial rather than 'real' aspects. Presumed limited interaction with relevant stakeholders; and a more limited consensus among all interested parties.
Strong incentive to collective learning, to VC cooperation, and to 'learning from others' (through requirement of having a reputable foreign financial institution)	No incentive to collective learning, to learning from others or to VC cooperation (legal limitations to cooperation).

<sup>16</sup> Expanding global market for IT- this overlap was not so consistent in other countries where VC-SU co-evolution began operating only after 1996.

### **Box 3: Factors Explaining the Differential Yozma-Inbal Impact**

<b>YOZMA</b>	<b>INBAL</b>
Created a critical mass of VC investment	Did not created a critical mass
Most 'Yozma fund' are among the 20 leading VCs in Israel	Non of the INBAL fund are among the 20 leading VCs in Israel
Investments focused on early stages	Investments also in later stages
Yozma Funds were models for the design of many other VC companies in Israel	Very few other public traded VC were established in Israel
Brought global financial and strategic investors into Israel	INBAL didn't bring any new global financial and strategic investor into Israel
Yozma Funds were involved in creating IVA	Not involved
Very high private VC performance	Low private VC performance
Follow up funds & strong growth of capital	Very few secondary issues
YOZMA Fund started to invest immediately. This encouraged other VCs to invest	No mechanism to encourage VC firms to invest immediately

### **3. An Industry Life Cycle model of the Evolution of VC Industry**

An Industry Life Cycle model is a particular variant and extension of the classical PLC model (Abernathy & Utterback 1978, Klepper 1996). In our opinion this model is the most suitable framework for the theoretical analysis of an industry's evolution. It includes both aspects of dynamic/evolutionary processes and of institutional perspectives (including issues of organizational capabilities). Our Industry Life Cycle framework differs from conventional ones in three main aspects: first it will consider one specific industry with unique characteristics- the VC industry; second, it is on the one hand more detailed and on the other a less formal/theoretical model than Klepper's models; and it starts prior to the industry emergence and consists of five well determined phases of evolution. This contrasts with Abernathy & Utterback's three phases and Klepper's dynamic analysis which both began after emergence or ignore it. From a wider perspective our Industry Life Cycle model when applied to VC in a country where High Tech is a dominant sector is linked to the analysis of Technological Revolutions (Freeman & Peres 1988, Peres 2003).

#### ***3.1 Phases in the Evolution of VC Industry***

The first step in developing our conceptual model is determining the generic phases of VC industry evolution and their main characteristics. Box 4 lists the five phases in VC evolution which follow from an Industry Life Cycle framework of

analysis as applied to Venture Capital. Box 5 presents their main characteristics as emerging from a detailed analysis of the Israeli and US cases<sup>17</sup>.

A major aspect of our analysis of the VC industry life cycle is identifying the beginning of the industry. This and the related issues of when a market is created are complex and controversial, and our purpose here is not to thoroughly solve these issues. For our purpose we state that the industry is established during the third, VC emergence phase. By that time a measure of stability in major, broad characteristics has been achieved. For example, in Israel, both the Limited Partnership (LP) form of VC organization (& its unique routines) and a 'born global' SU profiles whose objective is to exit through global capital markets (both IPO and M&A) was becoming a standard.

During the *Background Conditions* phase (phase 1, 1970-88 in Israel) both the technological infrastructure and the financial infrastructure for the subsequent emergence of a VC industry are being established<sup>18</sup>. They comprise a number of critical events/processes many of them not directly related to VC. Beyond R&D capabilities they include the beginning of global product & capital market links; creation of a favorable environment for foreign investment (for non-US cases); the gradual involvement of financial institutions in high tech industry; and the gradual acceptance of technological entrepreneurship. During *Pre-Emergence* (phase 2, 1989-92 in Israel) a VC industry with an identity does not yet exist although some (mainly informal but also formal) VC activity & experimentation takes place. Also important SU activity & business experimentation is carried out during this phase.

VC emergence (phase 3, 1993-2000 in Israel) begins with a *fluid sub-phase* (1993-1995 in Israel) followed by an accelerated *rapid growth process* (1996-1998 in Israel) that eventually leads to *overshooting* (1999-2000 in Israel). This overshooting has similarities to the natural overinvestment in the VC industry cycle (Lerner, 2002) but also has additional components related to Long Waves & Technological Revolutions (Peres 2003). The fourth *Crisis & Restructuring* phase encompasses not only the VC industry but the whole high tech cluster and in some cases the whole economy-especially in those where SU represent a high share of total activity. It can only be overcome through a long and painful process of *restructuring & adaptation*

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<sup>17</sup> In Box 5 we further extend the analysis performed in AKT 2003.

<sup>18</sup> The Israeli case also suggests the need for a well developed ITP 'infrastructure' of capabilities and institutions.

and through a new pattern of interaction & links between high tech and the rest of the economy. As in the US case, policy is likely to play an important role in the successful restructuring of VC industries and in the subsequent *Consolidation* (phase 5). By then, the core of the industry will consist of those VCs that survived the crisis. This last phase will also be characterized by a relatively stable set of VC strategic groups (defined by capabilities, strategy and performance) and by VC industry sustainability (Avnimelech, 2003).

**Box 4: Phases in the Evolution of the Israeli and the U.S. VC Industries**

Phase (sub Phase) in VC Evolution	Period- Israel	Peeriod- US
<i>Background Conditions</i>	1970-88	1930-45
<i>Pre-Emergence</i>	1989-92	1946-57
<i>Emergence (Fluid, Growth, Overshooting)</i>	1993-2000 (93, 96, 99)	1958-73
<i>Crisis and Restructuring</i>	2001--?	1974-81
<i>Consolidation</i>	???	1982-

**Box 5: Main Events/Processes in the Successful Evolution of a VC Industry\***

<b>BACKGROUND CONDITIONS PHASE</b>	<ul style="list-style-type: none"> <li>• Creation of High Tech Industry and R&amp;D/ Innovation capabilities;</li> <li>• Concern for the financing of SME not necessarily high tech SU.</li> <li>• Almost no formal VC activity; limited informal VC activity</li> <li>• Growing Acceptance of technological entrepreneurship</li> </ul>
<b>PRE-EMERGENCE PHASE</b>	<ul style="list-style-type: none"> <li>• A Technological Revolution which assures a continued stream of new business opportunities for SU</li> <li>• Mechanisms for supporting SME and / or SU</li> <li>• Growth of informal VC e.g. angels; and of VC-related activities</li> <li>• Some formal VC funds</li> <li>• Increasing numbers of SU → excess demand for VC services</li> <li>• Experimentation (variation) &amp; Learning (selection): VCs, SU and Policy makers</li> </ul>
<b>EMERGENCE PHASE</b>	<ul style="list-style-type: none"> <li>• High rate of growth of VC activity; large numbers of new funds &amp; new VC companies</li> <li>• Continuation of Experimentation and Learning → Enhanced Selection</li> <li>• Triggering of a Cumulative process (‘reproduction’) caused by positive feedback and by VC-SU (&amp; others) co-evolution processes within the cluster</li> </ul>
‘Early’ Emergence	<ul style="list-style-type: none"> <li>• Entry of less skilled VC managers/firms.</li> </ul>
‘Late’ Emergence	<ul style="list-style-type: none"> <li>• Excessive competition &amp; eventually overshooting</li> </ul>
<b>CRISIS &amp; RESTRUCTURING</b>	<ul style="list-style-type: none"> <li>• Overshooting leads to a deep crisis characterized by the drying-out of the sources of capital and by a shakeout of companies</li> <li>• A new set of institutions (formal and informal) emerge and a new set of policies are implemented</li> <li>• The VC industry restructures; the restructuring may be more or less.</li> </ul>
<b>CONSOLIDATION</b>	<ul style="list-style-type: none"> <li>• Success depends on the new industry structure; the institutional framework; the high tech cluster interaction with other industries; and the new set of policies implemented.</li> <li>• The major effect is Sustainability of the VC industry: the enhanced capacity to overcome crises in the future</li> </ul>

\* based on the US and Israel’s experience (AKT 2003)

3.1.1 VC Emergence

From the *Industry life Cycle* perspective presented here, VC emergence is the central process in the evolution of the VC industry. Contrary to the conventional PLC perspective which implicitly assumes that an industry exists with its first firm, the

central question asked once a Background Conditions & a Pre-Emergence phase are added to the theory is whether these will assure that the industry in question will be created. This issue is even more pressing from a VC policy perspective since, as mentioned above, the objective is not an increase in VC *per se* but whether policy has led to the creation of an early stage and high tech oriented VC *industry*.

VC *emergence is a process* rather than a state of affairs at a moment of time- an outcome both of the accumulation of market & policy experience ('variation') during the pre-emergence phase and of other factors. As mentioned it has three sub-phases. The first is a continuation of Abernathy & Utterback's 'fluid phase' (which starts with but does not end with Pre-Emergence) where significant 'variation' takes place which is followed by 'selection' of a number of aspects or features of VC operation. This sub-phase is followed by a period of *accelerated rapid growth* based on 'replication/reproduction' of the selected features; and by *overshooting (emergence overinvestment)*.

During the fluid sub-phase of VC Emergence a lot of experimentation & collective learning takes place both with respect to VC strategies and with respect to VC organization. Many strategies, routines and organizational forms do not survive; some do and are adopted by varying numbers of VCs. Their distribution is not 'stable'. In addition from competing with each other, VCs also cooperate<sup>19</sup>. The VC industry also begins experimenting with 'institutions' and with various configurations of Supporting Structures. During the rapid growth sub-phase we observe a) a high rate of entry of new VC companies & of VC activity; b) a Cumulative Process of growth with positive feedback effects<sup>20</sup>. It is then that the industry attains a size which enabled it to sustain a large number of supporting services (e.g. National VC Associations, specialized attorneys, etc.). It also converges to a relatively stable distribution of strategies (in Israel, a strong focus on 'early phase' investment), routines (Nelson & Winter 1982) and organization forms. As long as external and internal conditions remained unchanged, the VC industry (and the wider high tech cluster) supports the creation and growth of large numbers of new SU.

### 3.1.2 VC Emergence in Israel

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<sup>19</sup> This is a feature of young markets. VC cooperation involves collective learning, syndication, etc.

<sup>20</sup> A number of processes explain cumulative growth- see A &T 2003a

We already mentioned that VC emergence in Israel was triggered by Yozma who, during 1993-7, invested \$100M of Government money which was divided into 10 hybrid, daughter funds ('Yozma Funds') and one Government-owned VC (Yozma Venture Fund). It leveraged an additional \$150M mostly from private, reputable & networked, institutions and corporations from abroad and Israel. This initial infusion of funds was invested in 250-300 SU companies.

The above infusion of capital triggered a cumulative process with positive feedback where more and more profitable VC activity 'today' spurred even more and more profitable VC activity 'tomorrow' (see Figures 1&2). At the center of this process was VC-SU co-evolution (see next section). Other dynamic processes were involved as well such as 1) entry of strategic investors e.g IBM, AOL, Nokia, Alcatel, Cisco and Microsoft, in response to the early reputation earned from some excellent Yozma Fund portfolio company exits during 1996/7; 2) cluster effects enabling a wider set of VC/high tech non-tradeable inputs & services to VC to be available locally (e.g. lawyers, financiers, accountants, consultants); collective learning concerning the VC business, etc<sup>21</sup>.

A final very important point is that there is strong evidence that –both because of these cumulative effects and because of the (almost) continued growth of the NASDAQ index during the relevant period – Government VC equity and investments, at the early emergence phase, did not 'crowd out' private VC investments<sup>22</sup>. In fact the opposite was the case: by triggering a cumulative process of growth, Yozma's investments *led to the creation of new SU and new business opportunities which the private VC sector exploited*. This includes a unique process of strong positive correlation between early entrants' private performance and their contribution to the high tech cluster and VC industry development (see A&T 2003d). Thus Government VC investment leveraged private VC investment instead of crowding it out as

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<sup>21</sup> Klepper's model of the PLC (Klepper 1996) also allows for cumulateness resulting from entry of new firms into the industry. In his model new entrants introduce new product innovations which, while initially serving a new segment of users, are subsequently diffused to the whole industry and market. Thus entry is associated with increased demand and collective learning. In the VC industry this would mean that VC entry would stimulate SU entry and lead to collective learning of VC companies.

<sup>22</sup> This has been a major concern of policy makers whenever 'direct' policies involving Government VC investments were involved (OECD 1997). The advantage of an Industry Life cycle perspective is that it shows that, under certain conditions and by virtue of cumulateness, a successful VC emergence process might involve strong 'dynamic' complementarities between Government and Private investments.; or alternatively the absence of direct Government investments may be the 'cause' of a low level of private investment. This possibility is one 'analytical' difference between the ILC perspective to a VC industry and a VC 'pool of capital' perspective (a neo-classical perspective).

expected from the neoclassical perspective. This non-neoclassical perspective to industry emergence increases considerably the potential scope and role of Government VC policy, although it also highlights a previously unsuspected level of complexity in the design, timing & implementation of such policies.

### 3.1.3 Differences between Israel and the U.S.

Box 6 summarizes the main differences between two patterns of VC evolution involving ‘successful’ VC emergence—the U.S. and Israel. One corresponds to the ‘innovator country’ who also is the global leader in the industry; the other (Israel) is the profile of a ‘successful follower’. Moreover, given that Israel is a small peripheral economy with insignificant domestic product and capital markets, its VC industry is dependent to a significant extent on foreign investors, and on *global* product and capital markets (currently the US). For further details AKT 2003. One major point is the relative speed of the pre-emergence and emergence processes in Israel compared to the US. A major cause of the speedier process in Israel was the possibility of copying the U.S. experience e.g. concerning the dominant form of VC organization. During VC emergence in the U.S. the LP form and its unique set of routines was not yet the dominant form; it only became so during the post crisis restructuring of the late 70s. In contrast to this, Israel had already experimented with VC forms during pre-emergence and key policy makers there concluded that LP fit very well with the local environment. Thus Yozma’s design already incorporated *policy-makers’ selection* of the LP a fact which also assured its dominance during VC emergence.

**Box 6: Differences between the VC Industry Evolutionary Paths of Israel and the US**

Phase	ISRAEL	U.S.
<b>General</b>	<ul style="list-style-type: none"> <li>• VC industry is an ‘Infant’ (follower) Industry (A lot of knowledge came from the US)</li> <li>• Length of Pre-Emergence &amp; Emergence Phases-11 years</li> <li>• VC Emergence was Policy-led</li> <li>• VC industry has not yet Consolidated</li> </ul>	<ul style="list-style-type: none"> <li>• The US ‘invented’ the VC industry and is its global leader</li> <li>• Length of Pre-Emergence &amp; Emergence Phases-26 years</li> <li>• VC Emergence was ‘market led’</li> <li>• Consolidation in the early 80s with significant role of Policy</li> </ul>

The main difference between the US and Israel concerns the role of policy in VC emergence although in both countries policy played important roles (some of them *indirect*). VC emergence in Israel was *policy led* since it was the result of a *deliberate, targeted policy*, which, by virtue of its scope, was clearly the dominant factor in the creation of that critical mass which triggered a cumulative process of

growth. In contrast to this the US's SBIC program was not directed to VC but to SME's (a priority of the Federal Government) and its direct effect on the process of emergence was presumably not the dominant one. In the U.S. VC emergence was *market led* in the sense a) that only some SBICs founded as a result of the SBIC program were VCs although other VCs were founded by spin-offs from SBICs; and b) due to the (presumed) dominance of market forces not benefiting from SBIC's incentives in triggering a cumulative process of growth<sup>23</sup>.

Another very important difference is that the US's VC industry has already been consolidated and achieved sustainability while Israel's has not. A central role in the post crisis restructuring of the US VC industry during the 1970s was played by new, flexible regulation of Pension funds which thereafter became the main source of capital of the US VC industry. Moreover Government subsidies through the US's SBIR program which supported early phase R&D of SMEs and SU were supposedly very important during for US VC consolidation.<sup>24</sup> Policy may also play an important role in the near future in Israel as well.

### 3.2 VC Crisis & Restructuring and Illustration from Israel

There are two different concepts of VC *industry* crisis: a domestic crisis associated with the evolution of the industry—emergence crisis; and a global *investment crisis* flowing from global capital market cycles—cycle downturn. The first, which is relevant to our Industry Life Cycle model, is a consequence of the industry having achieved a certain size & age and having become a strategic industry (Nelson 1984). At this point the industry cannot any more operate independently of the wider economy and social system. This *System Fitness crisis* occurs once in the development of the industry (prior to Consolidation). The second concept of crisis is linked to the empirically observed overinvestment in specific technologies (bubble) and is a process that repeats itself every few years. Gompers and Lerner (1999) identified 3 such crises between 1978 and 1995 and one ending in 2002 (Lerner 2003).

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<sup>23</sup> The SBIC program was not a VC directed but a *VC-related program*. Unintended effects of this program played a role in what was essentially a market led process of VC emergence (further empirical research is required to ascertain statement).

<sup>24</sup> Lerner has shown that pension fund de-regulation played a more important role than reductions in capital gain taxation in the recovery of the US's VC industry during the 70s (our 'restructuring' phase, see also ATK 2003). Moreover he shows the quantitative and qualitative importance of the SBIR program's subsidies after 1982 (i.e. during consolidation of the US industry). See Lerner 1999.

Restructuring will occur at various levels- the individual organization level; industry level with regard to their own internal restructuring; and industry level regarding the wider high tech- economy interface. At the individual organization level the possibilities are a better defined and more explicit VC strategy based on unique capabilities in part generated by the crisis; changed routines and patterns of VC investment; exiting of less capable SU and VC; mergers among SU with overlapping and duplicate activities; etc. These have to some extent occurred in Israel. For example in response to the crises the first Yozma Fund, Gemini, has focused even more on early stage and on specific technological areas. This is reflected in the structure of capabilities. Thus without exception all new partners and employees have a strong technological orientation including both S&T education and practical high tech experience; and later stage investments are now undertaken only in syndication with a lead foreign investor who can complement Gemini in the financial aspects and in capital markets' networking.

At the VC industry level as regards internal restructuring we expect to find sharp decreases in the number of active VCs and SUs, in VC capital raised and invested; in SU valuation; an increase in syndication and other cooperative arrangements among firms in the industry; and the elimination of some strategic groups/types of VC organizations & strengthening or foundation of others. Also there will be changes within the wider high tech cluster. In Israel there was a 70% reduction in the capital raised during 2001 and a first time-ever *negative* amount of capital raised in 2002 (due to cancellation of commitments). The aggregate number of PE & VC companies investing in SU dropped from a peak of more than 120 to less than 80 towards the end of 2002. Since mid 2001 there was no IPO of a SU company. We also observe a sharp decline in the share of total VC investment in 'seed phase' (from about 17% of total in 2000 to 7% in 2001 and 4% in 2002) and a movement towards later stage financing and significantly greater effort put on screening and due diligence. In addition, we observe a sharp increase in syndication and in the number of VCs who do not invest at all. Finally, we observe exit of non professional angels and small or non-professional PE/VCS; the practical disappearance of Corporate VC; and the closing of Israeli offices of foreign investment banks. There also are signs of increased intra-cluster social tension e.g. some Pension Funds wanting to withdraw capital commitments; increased litigation involving VC & SU and VCs and their investors. On the positive side we observe the beginning of a pattern of long term relationships between top tier

Israeli VCs and world class foreign financial institutions. Thus the disposition of the latter to invest in Israel seems to be less depend on the short term vagaries of the environment and more on a strategic decision to maintain and even reinforce strategic networks with leading VCs. This is reflected both in announcements of planned new funds and the positive response to this by existing and new foreign investor.<sup>25</sup> We also observe the setting up of offices by two leading US VCs (Benchmark and Sequoia); the growing dominance of Israeli offices of European VC networks (such as Vertex and Apax); a steady flow and increased share of foreign investment; and initial attempts to create Israeli gate-keepers/fund of funds. There is also encouraging evidence that that the top-tier VC and entrepreneurs posses excellent reputation and capabilities in the global market (some VCs have become more important in the global networks to which they belong). Some high quality SU were acquired by MNE; while other younger SU were successful in raising capital from foreign VCs and strategic investors. This is evidence that despite the problems facing the Israeli VC and High Tech cluster these are still regarded as being of high quality and with high potential.

The above changes do not complete the list of adaptations that have to be undertaken by Israel's VC and high tech industries. The large size reached by these industries and the gradual realization that these industries are here to stay, raises the issue of their *Systemic Fitness* in the wider economy and society. Additional VC/high tech industry adaptations with this wider perspective in mind are also required. These changes if successful could lead the way to *Industry Consolidation*.

In Israel economic growth during the period of VC emergence was an extreme form of *high tech led growth*. While ICT (a measure including both high tech and other closely related branches of the economy) explained about 40% of the growth of Business Sector value added during the 90s, there was a reduction of 8% in the share of non-high tech in total industrial output during 1996-2000. Moreover, despite the very high rate of growth of high tech, Israel's overall economic growth was not high and declined after 1996 (see figure 1). The anomaly of strong high tech performance and relatively weak economic growth performance reflects a bias against mid & low tech industry and to some extent against non-R&D aspects of growth (Teubal 1999). This is reflected in total factor productivity data where most calculations show that it

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<sup>25</sup> Evergreen for example raised 140 M\$ in Q3 2003 and Pitango who, one month after announcing the beginning of a campaign to raise 300M\$, already had commitments for 50M\$.

was *negative* during the 1990's (Trajtenberg 2003). Troubling signs of a *dual* economy were appearing during late emergence—a high wage and high profits in the low-employment high tech sector; and low wages & profits in the rest of the economy where most of the employed worked (see Fig. 3). This anomaly led to *Social Tension* even before onset of the crisis in 2000 (it is much higher now)<sup>26</sup>.

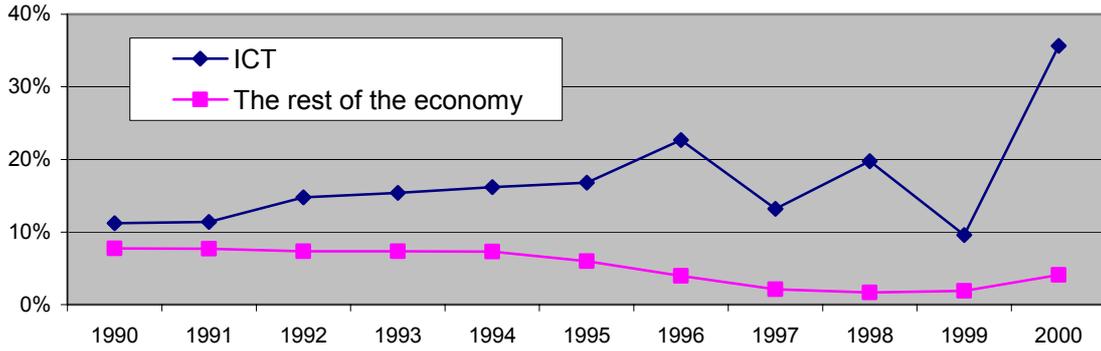
The above context of VC emergence during the 90s explains why the post crisis restructuring process should also aim at enhancing the contribution of high tech to other sectors through e.g. diffusion of technologies and management capabilities to existing non high tech sectors; and through the creation of new non high tech branches whose competitive advantage derived from high tech R&D outputs (e.g. manufacturing of prototypes semiconductor components for the significant IC design sector in Israel or novel medical equipment & associated operating procedures which may generate a competitive advantage in sophisticated medical services). Given the level of social tension that has accumulated in the last years (as measured for example by the accumulated gap in growth rates, wages and numbers of employees between high tech and non- high tech industries) the only possibility for effective pro -high tech Government action is to embed this action within a wider set of policy initiatives which takes the economy & society as a whole as the main focus and objective (rather than assume as was in the past that what is good for high tech is good for the economy and society). These broader policies-- by improving the economy, reducing social tension & other conflicts created during emergence (e.g. greater inequality of income and wealth) - will facilitate the implementation of specific high tech and VC-directed policies.

Only after the successful VC industry restructuring; reconfiguration of the VC-SU-Government relationship; and diffusion of technologies & skills from the cluster to other industries, will the *Consolidation phase* begin (this took place in the US during the early 1980s; it has not taken place yet in Israel). The resulting 'mature' VC industry will then be able to survive the normal & regular cycle crises that beset the VC industry. This will assure a more 'healthy' and stable growth process.

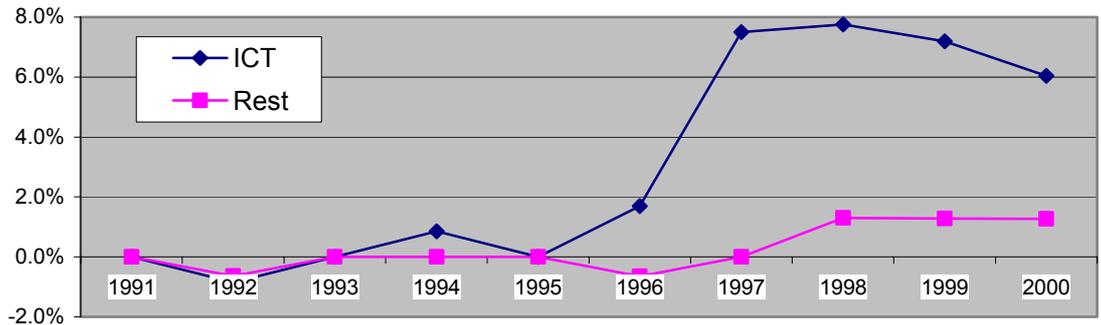
### **Figure 1: Growth Rates in Sales-ICT versus the rest of the Economy**

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<sup>26</sup> This parallels the building up of social tension during the 'frenzy' phase of a new Technological Paradigm (Peres 3003, chapter 5).

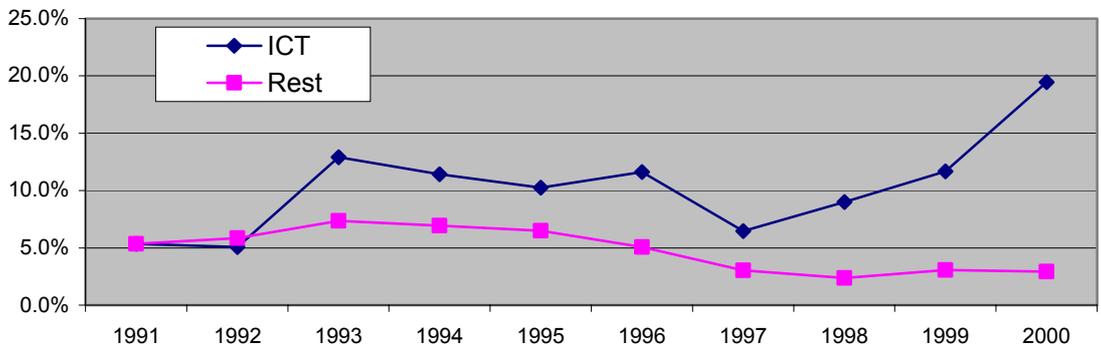


**Figure 2: Growth Rates in Wages-ICT versus the rest of the Economy**



Source: Avnimelech 2003 (IVC, CBS, and IAEl)

**Figure 3: Growth Rates in Employment-ICT versus the rest of the Economy**



Source: CBS 2001

#### 4. Virtuous Co-Evolutionary Processes

The variables influencing VCs ILC are related among themselves within and across phases. They form links and co-evolutionary chains which may underpinn VC evolution within specific phases or cause the transition from one phase to the next. They also could reflect links with other sectors of the economy. Identification of these links and co-evolutionary chains could therefore contribute to the analysis of ‘causes’ of a particular *profile* of VC evolution. For this reason, an analysis of co-evolutionary processes should be part of the ILC framework of analysis. Nelson (1994) has traced the co-evolution between an industry and the institutions supporting it. In this paper

we trace three co-evolutionary processes: Finance-High Tech co-evolution; VC-SU co-evolution (most significant at the emergence phase) and ITP-High Tech co-evolution. The last is consistent with our view that VC emergence in Israel was policy-led.

#### 4.1. VC-High Tech & Finance-High Tech Co-Evolution

The development of high tech is linked and might co-evolve with the development of those financial institutions which loan, underwrite, invest or perform other financial services to or in relation to the industry. Moreover after VC emergence high tech or segments of this industry will co-evolve with Venture Capital.

The experience of the US and Israel clearly shows that a VC industry does not arise in a vacuum, that a certain level of high tech, high tech sophistication and other favorable conditions (particularly a continued stream of new technological and business opportunities) are required for, and prior to, VC emergence. Once these conditions hold high tech may ‘pull’ (a demand effect) and ‘push’ (a supply effect) VC as implied in Figure 4. In the US and Israeli contexts, the exploitation of the new business opportunities required large numbers of SU (Chesbrough 1999 and others) of high quality many of whom spun-off from incumbent high tech companies. However the foundation, operation and growth of these SU require VCs: although some SU could survive without formal VCs large numbers require a well developed VC industry<sup>27</sup>. Thus spin-offs from high tech could ‘pull’ the future VC industry & market. Moreover this same mechanism was, at least in the case of Israel, an important source of founders & managers of the new VC organizations. Thus high tech ‘push’ is also an important relevant factor (see A&T2003d)<sup>28</sup>.

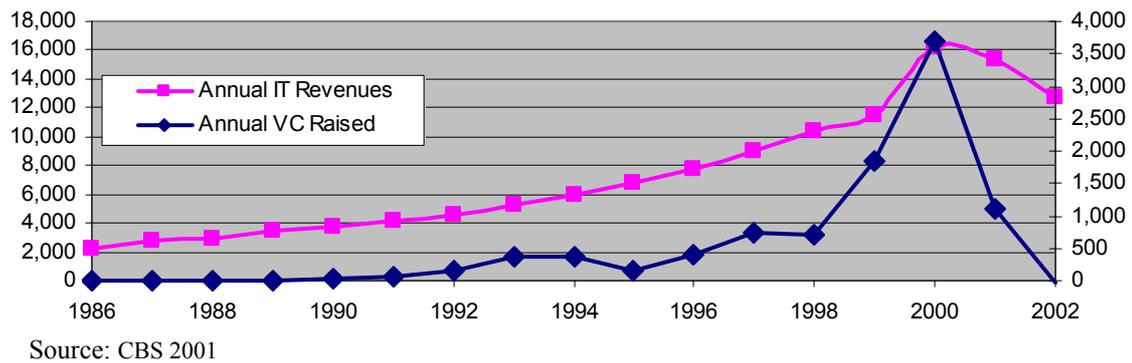
In addition to high tech pushing and pulling VC - *the VC industry, once in existence, pushes high tech*, particularly its SU segment (during the 90s in Israel). At this point VC-high tech co-evolution is closely linked to VC-SU co-evolution.

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<sup>27</sup> There always will be other SU founded by returning Israelis or by recent graduates from Universities. However SU founded by spin-offs of existing high tech companies presumably will be playing important roles in the future industry (see Klepper 2002). Thus prior experience in a sophisticated domestic company is also the source of important management skills and capabilities both for new SU. It is also important for new VC entrants.

<sup>28</sup> As shown above in the Israeli case, these two processes were not enough to cause VC industry emergence: a targeted VC-directed program (“Yozma”) was also required. This adds an element of policy driven (rather than high tech sector driven) push to the creation of the Venture Capital industry.

Figure 4: The co- evolution of VC and High tech industries (M\$)



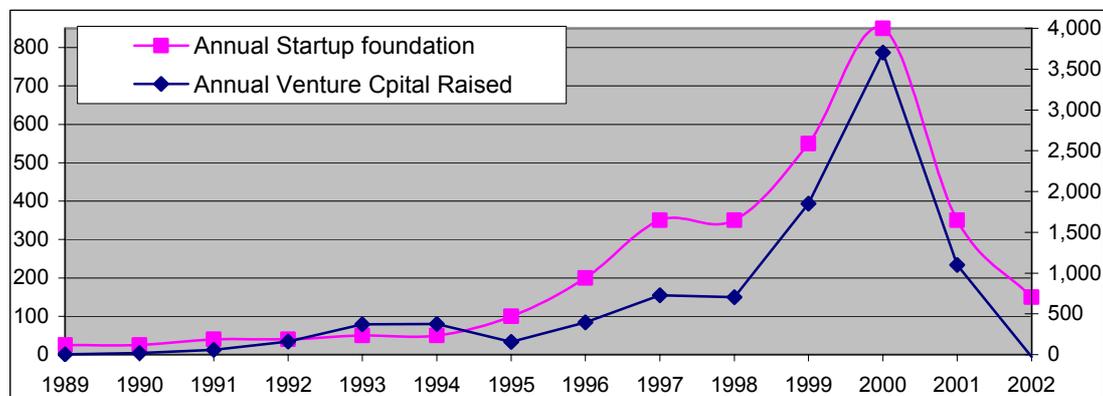
#### 4.2 VC-SU Co-evolution

VC-SU co-evolution bears a similarity to supply-demand links fueled by product innovation, interactive learning and excess profits in new markets/industries. High profits in the short-term resulting from ‘excess demand’ (sub-period 3) will induce new industry entrants and a corresponding shift in the supply curve. Due to cumulative and cluster effects they will not necessarily reduce profits, at least for a time. Also users learn from producers and viceversa so for a time both supply and demand curves are shifting. In this VC-SU co-evolution resembles the user-producer relationships area of the innovation and evolutionary economics literatures. These relationships may evolve into virtuous or vicious cycles (Malerba 1993).

In Israel the antecedents & starting point of VC-SU co-evolution can be found in the early 1980s when new opportunities (e.g. in Software) induced the foundation of a group of SU and emergence of new SU business models. These were linked to new forms of finance including project or SU -specific Limited Partnerships involving the OCS, financing of high tech by Investment Banks (IB) and Business Groups (BG) etc. (Also the first formal VC was created in 1985). A more dynamic co-evolution began in the early 90s fueled both by the ongoing technological revolution, by the globalization of capital markets for technology companies (particularly NASDAQ), and by the growth of the NASDAQ index after 1992. A significant numbers of SU were founded then a fact leading to a presumed *unsatisfied demand* for VC services during 1989-92 (see figure 5). It continued with a policy response, Yozma, which led to a significant increase in VC activity and to a temporal *excess supply of the VC pool* during 1993-94. From then on and for a time we observe a rapid mutual adjustment process involving startup formation (1995-98); further and more rapid responses by

VC; and eventually continuous VC-SU co-evolution leading to overshooting (1999-2000) and crisis during (2001-)<sup>29</sup>.

*Figure 5: VC fundraising (M\$)-SU formation (numbers) co-evolution*



Source: Avnimelech 2003 (IVC, OCS)

#### 4.3. ITP –High Tech Co-Evolution

A *virtuous* ITP-High Tech co-evolutionary process requires that the Government identify SF and craft an adequate policy response; and that business/high tech (and other components of the system) adapt, thus effectively cancelling the constraint to growth represented by the original SF. It also requires that the new, restructured & more sophisticated high tech sector which emerges from this first round of policy making and policy impact be capable of exploiting a new set of opportunities that exogenously makes its appearance-- provided a suitable policy response is found to a new System Failure that stands in its way. Israel's experience suggests that a virtuous co-evolutionary process may require i) a specialized policy institution in charge of national ITP (like Israel's OCS); ii) strong accumulation of 'policy capabilities' through time; and iii) a political process such that the aforementioned agency not be captured by private interests and lobbies<sup>30</sup>.

In Israel ITP-high tech co-evolution started during the background conditions' phase and continued during the pre-emergence, and emergence phases. It underlies and underpins the finance-high tech and other more specific co-evolutionary processes touched upon previously. More importantly, *it explains why the SF which triggered Yozma was identified and why such an acceptable policy response was*

<sup>29</sup> After 1993 both VC and SU co-evolved with other elements of the high tech cluster the combined effect of which was VC emergence and the transformation of high tech.

<sup>30</sup> The possibility of 'regulatory capture' has been raised in the literature e.g. by Lerner 1999

*formulated and successfully implemented.* Thus for Israel and for other policy led cases virtuous ITP- High Tech co-evolution is important for VC emergence. The process described encompasses at least three and possibly four of the five Industrial Life Cycle Phases. There are two System Failures during the first, Background Conditions phase: SF1-- absence of R&D performing firms and of innovation capabilities in the late 60s; and *SF1\** -- absence of links/alliances with foreign companies (a mechanism to penetrate global technology markets-mostly in the US). Each led to a distinct Innovation & Technology Policy (ITP) response during this phase: ITP1- creation of the OCS & implementation of the 'Backbone, Horizontal R&D Grants Scheme' starting in 1969; and ITP1\*- complementary policies supporting cooperative R&D programs involving an Israeli and a US company (BIRD Program, 1977- )<sup>31</sup>. The impact was restructuring of the business sector or of high tech industry (RBS1) during this phase. It comprised a number of dimensions such as emergence during the 80s of a large segment of R&D performing companies mostly in Electronics; widespread diffusion of Innovation Capabilities throughout the business sector; the startup model of R&D projects & industrial innovation; enhanced links and alliances with US firms & acquisition of some global marketing capabilities; etc.

RBS1 and other changes in the environment-including the globalization of capital markets for technology firms (external) and significant microeconomic processes (internal)- created a *potential* opportunity in the early 90s (pre-emergence phase) for an Israeli new high tech SU segment directed not only to product markets but also to global capital markets. This is the origin of the second link of the ITP-High Tech co-evolutionary chain. A first condition to exploit this potential was to undertake a wide process of business experiments and, no less important, policy learning. These Pre-Emergence phase activities came from three new programs (Technological Incubators & Magnet on the one hand, and Inbal on the other) and from an increase in the OCS regular R&D grants fund. They constitute ITP2 which could be visualized as being a response to a 'System Failure' (SF2) which stands in the way of a broad process of experimentation and learning by both private and public actors and agents. The result was new market tested information about desired high tech structure; a growing SU segment; and information about the aims of an ITP

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<sup>31</sup> Thus Israel's small market disadvantage, by forcing it very early to forge links with the US, indirectly contributed to generate a competitive advantage in high tech during the 90s. This conforms with Porter's analysis (Porter 1990) where action and creativity caused by a competitive disadvantage can generate forces leading to a competitive advantage.

directed to exploit the new opportunities. SF3 which stood in the way of materializing this potential<sup>32</sup> included weak management capabilities and global-business & marketing know how and links. Policy makers were aware of these and succeeded in identifying the cause- absence of Venture Capital particularly of early phase oriented VC organized as Limited Partnerships and linked to reputable, world wide financial institutions and strategic partners<sup>33</sup>. Creation of such an industry would reduce the above weaknesses of Israel's high tech sector and induce transformation of high tech to a Silicon Valley type, SU-intensive cluster. The resulting policy response-Yozma, implemented during 1993-7- led to *Emergence of the VC industry* and to a *new SU segment of high tech* (RBS3).

We conclude that Yozma—Israel's successful targeted VC policy- was the outcome of a complex co-evolutionary process which started more than 20 years before VC emergence. The OCS – a specialized agency in charge of national ITP-- played a central role in the process. Moreover, the Israeli case suggests that

- *A policy led, successful VC emergence process may have to be preceded and underpinned by a 'virtuous ITP-Business co-evolutionary cycle';*<sup>34</sup>
- *Sustainability of the new industry requires a continuation (or a new round) of virtuous ITP-High Tech co- evolution in the interface between VC emergence and VC consolidation.*

### **5. Lessons from the Israeli Case and Types/Causes of VC Policy Failure**

Abandoning the view that VC is a pool of capital and adopting a ILC perspective to the evolution of the VC industry has a number of important implications for VC policies not only in Israel but also elsewhere<sup>35</sup>. These include

- *The Centrality & Complexity of VC emergence Policies*
- *'Specific' post-emergence VC-relevant policies are justified*
- *Policy Failures roughly match PLC phases*

We will deal with each one of the above points separately.

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<sup>32</sup> The role and justification of government policy in the context of strong background conditions and market forces is analyzed in Avnimelech and Teubal 2003d.

<sup>33</sup> The Inbal program had sharpened policy makers' view that LP was the right form of VC companies.

<sup>34</sup> An important point to recognize is that the failures that spurred Israeli policy-makers to transform the System of innovation were not only market but system failures (Metcalfé 1996, Teubal 1998). The fundamental weakness or insufficiency was not under-investment by market forces; it rather was the lack of innovation capabilities & links in Phase1; and of a VC industry in Phase3.

<sup>35</sup> Some of these are also the result of a systematic comparison between the Israeli and the US cases, see ATK 2003.

### 5.1 The Centrality & Complexity of VC emergence policies

The central event in the VC industry's ILC is "VC Emergence. Whenever VC-related policies are justified in countries which do not yet have VC industries, their final objective should be inducing VC emergence. Once this is accepted, *the major decision to be made in this phase is whether or not to implement a targeted VC policy*<sup>36</sup>.

If the pre-emergence phase was successful and market forces are poised to enter the new industry it may be wise not to intervene directly and let market forces do the job. If despite this Government intervention is justified (see A&T 2003d) the scope and design of the program should effectively deal with the various components of the relevant System Failure. The Israeli case suggests that these relate to a) entry of professional managers of VC companies; b) participation of reputable/linked foreign partners; c) achieving critical mass; d) selection of a suitable form of organization which supports the generation of capabilities; d) spurring a collective learning process; and e) accelerating appropriate 'selection' of VC organization, strategy, etc. This is a formidable task: it complicates the structure of incentives; and it requires policy makers to take account of a wide range of other factors not directly linked to incentives. Moreover, achieving critical mass is not enough; additional conditions might have to be fulfilled for a subsequent 'cumulative VC emergence process' to take place. This may call for not only appropriate principles of 'design' and timing of VC policies but also appropriate principles of policy implementation.

Even with respect to incentives -supposedly an area where professionals have much knowledge- the fact that these should induce the creation of a critical mass of capabilities (where 'quality' rather than quantity is critical) and not only a critical mass of financial resources, might considerably complicate design. Thus to effectively taking care of a) and b) above may require *direct Government equity investments in VCs* (fund of fund role) plus other provisions such as offering a 'buy option' to

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<sup>36</sup> A distinction should be made between 'targeting' industries or technologies and 'picking winners' which might support particular or specific commercial products (Stoneman 1987, p.216) or specific companies. Nelson 1984 in his study of high technology policies in five nations argues that Japanese MITI type projects aimed at creating a commercially competitive industry have been relatively successful, while government involvement or partnership in the development design and production of particular commercial products seems to be fraught with difficulties and dangers and often leads to failure (this is also Stoneman's opinion).

private investors to purchase the Government's share<sup>37</sup>; simple tax breaks may not be effective. This means that in estimating the scope of Government investments account must be made not only of the fixed costs of managing a Government VC fund (OECD 1997), but the specifics of capabilities-both internal and external-that have to be accumulated. Moreover *the greater the scope of Government investments, the greater the incentives to the upside that may have to be offered and, at least up to a certain point, the greater the expected entry/participation of skilled agents in the new industry*<sup>38</sup>. This is a crucial link that seems to have been missed in the literature. Also the point that leveraging 'public' venture investments to assemble a critical mass of *private VC capabilities* is the way to transform a potential private capital crowding out effect into a strongly complementary public-private capital contribution.

The above also explains why Government investments could trigger a cumulative process of VC emergence. VC emergence on the other hand is a complex process involving much more than exploitation of 'agglomeration economies' (for an excellent survey of the latter see Maggioni 2003) since the generation of new capabilities though agent and collective learning should also be explicitly addressed<sup>39</sup>. The latter also requires that Government investments induce at least a critical mass of VC activity which triggers collective learning & continued growth of VC activity (through new entry and growth of incumbents) during a certain period.<sup>40</sup> For example early successes from early entrants will induce new entrants and even greater successes and so forth. The increased industry size in turn will induce collective learning ('dynamic economies of scale') and potentially lead to even greater increases in efficiency and volume of activity. Materializing the potential for collective

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<sup>37</sup> This would provide strong incentives to the upside which is an important factor inducing entry of highly skilled agents who are capable, through significant adding value activities, of managing and profiting from high return, high risk investments such as early phase investments in high tech SU.

<sup>38</sup> The set of skilled entrepreneurs and investors lined up may also depend crucially on whether there exists a possibility of selecting groups that will benefit from the Government program (in Israel, of being assigned 'Yozma Fund' status); and whether policy makers are sufficiently skilled and networked to make the right choices.

<sup>39</sup> Agglomeration Economies seems to be a 'flow concept' which means that they may disappear if the number of firms in a particular area declines. While these are important factors, the processes of cluster dynamics must also consider the accumulation of capabilities (a 'stock' variable) and other factors such as 'Reputation' and 'External Links'(which are not directly dependent on the number of firms in the cluster). Moreover, these capabilities both affect agglomeration costs and benefits and also the 'carrying capacity' of the cluster.

<sup>40</sup> Achieving critical mass is important for inducing, through a number of dynamic processes, a cumulative process of growth and development of the fledging VC industry. In fact, critical mass should be defined in terms of this objective. The desired *speed* of VC emergence is an important factor.

learning, however, may require new institutions for sharing information and even for investment coordination.

The upshot is that VC emergence policies are considerably more sophisticated than the conventional set of measures recommended to increase the flow of financial VC. <sup>41</sup>We have emphasized some of the virtues of direct Government investments in VC (like in the Yozma program); but the use of these either alone or in conjunction with tax benefits, equity guarantees, and/or regulatory changes even if necessary are not sufficient for successful emergence of a sophisticated, early phase & high tech SU- oriented Venture Capital industry. To be successful Governments must also be able to *assess and even to influence the context under which the VC emergence policies will be implemented*. These will affect *the timing of VC emergence policies* and other Government action, particularly when background conditions have not yet matured and when external conditions are not right.

#### 5.2 Post-emergence VC-relevant policies may be justified

The task of policy need not end with a successful VC emergence process since new System Failures may pop up and stand in the way of a successful post-crisis restructuring and consolidation process. However, with the possible exception of policies for VC consolidation-post emergence policies will probably be “milder” or less radical than targeted VC-directed policies oriented to VC emergence since the industry and markets already exist. The ‘static’ distortion they would create would be lower than that created by a targeted program directed to VC emergence; and so are their cost in terms of Government disbursements. These policies will be termed ‘*VC industry specific policies*’ and should be clearly distinguished from *Targeted VC emergence policies*. Their potential justification follows from an Evolutionary Perspective to Economic Change which, by virtue of its emphasis on dynamics, capabilities and persistent heterogeneity of agents (Nelson & Winter 1982, Metcalfe 1994, Coriat & Dosi 1998 among others)- naturally emphasizes the specificities of each sector. Their justification is more likely in countries in which, like the US and

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<sup>41</sup> This is the normative counterpart to Nelson & Winter’s statement that “...evolutionary theory identifies a more complex ‘economic problem’ than the orthodox theory, and we think this is an advantage. Evolutionary models tend to be more complicated than orthodox ones.”(Nelson & Winter 1982, p. 402)

Israel, high tech is a key driver of economic growth. This contrasts with *targeted policies* which should be implemented, if at all, only ‘once in a decade’<sup>42</sup>.

### 5.3 A typology of Policy Failures<sup>43</sup> that matches Industry Life Cycle phases

The Israeli case (which we know best) and to some extent the US (AKT 2003) and the Indian cases (D&K2001, A&T 2003e) suggests a *set of possible failures* in the implementation of VC policies. For countries where VC emergence is likely to be policy led and in contexts where targeted VC policies are both feasible and desirable—there are six possible causes of such failure. All of these may be present under a ‘VC as pool of money’ perspective and some may also be present under the alternative ‘VC as an industry’ perspective (e.g. due to the complexity of policy as discussed above). We now proceed to analyze each one of them.

#### ***Failure 1 (F1) - Unfavorable Background Conditions Prevailed when VC policies were implemented***

We argued that VC policy should not be the main policy used to create a high tech industry but may be relevant once that industry attains a certain size; and we also based this contention through our analysis of Israel’s VC industry. It follows that a significantly earlier implementation of Yozma (e.g. during the 70s) would have failed e.g. due to the scarcity of Innovation Capabilities in the Business Sector; and due to the low number of pre-existing SU. F1 involves *a timing problem* with respect to VC emergence. Since, under these circumstances it is not possible to identify the ideal design for the VC policy and any targeted VC policy wouldn’t be effective, it is inappropriate to link F1 with an inappropriate design. Rather than VC-directed or VC-emergence policies other ITP must be implemented during this phase. Thus it is

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<sup>42</sup> The distinction between targeted & (other) VC industry *specific* policies is also important due to the continued adaptation required of an already established VC industry -a result of changes in the environment & the likelihood that System & Market Failures could block autonomous, unaided adaptation.

<sup>43</sup> The term ‘policy failure’ indicates an inadequate policy response to a market or system failure. It is related to J. Stiglitz’s concept of ‘Government Failure’ (Stiglitz 1988, p.5). After recognizing that ‘market failure led to the major government programs of the 1930s and 1960s’ Stiglitz asks the question “under what conditions will government programs not work well?”. While his is not an explicit evolutionary approach his four reasons are related to three of the failures we will be analyzing (F2,F3,F4). In the economics literature there is another notion of Government failure: government action not oriented to overcoming a ‘market failure’ which creates a distortion in the system (related to F1).

no surprise that the VC policies implemented by India in the late 80s & early 90s failed to create a VC industry<sup>44</sup>.

In Israel the policies implemented during the ‘background conditions’ phase included the OCS R&D Grants scheme; and in the US during the late 50s and 60s-- implementation of the Small Business Investment Company (SBIC) program. The latter program positively contributed to the emergence of a Venture Capital industry in the US during the late 60s and 70s. In both instances, Government Policy generated background conditions, which subsequently facilitated the emergence of the new industry.

***Failure 2 (F2) - Insufficient Business Experiments and/or absence of excess demand for VC services prior to Targeted VC Policy Implementation***

The Israeli experience suggests the importance of Business Experiments in connection with SU and VC (organization, strategy, routines). These experiments are critical as part of the *variation process* and in order to ascertain combinations representing good fits both with respect to the requirements of global product & capital markets and with respect to the institutional, cultural, tax, legal and other aspects of the domestic context. That policy makers have a ILC perspective of the industry is no guarantee neither that the business environment will be appropriate nor that a specific programs directed to these ends will be implemented.

During Israel’s pre-emergence period a new model of SU was experimented with, one oriented not only to global product markets but also to global capital markets. Also numerous informal VC activities (and the experience with Inbal) generated relevant experience and knowledge concerning VC organization (in particular, the advantage of an LP form). This experience set the base for the rapid growth of SU (co-evolving with VC) during VC emergence.

***Failure 3 (F3) - Insufficient Policy Experimentation prior to the implementation of the VC policy → inappropriate design of VC targeted policy***

The Israeli experience also suggests the importance of *policy experiments* to ascertain both the design and other aspects of the subsequently-implemented targeted VC-direct program and for adapting the domestic institutional context to the requirements of a new, Silicon Valley model, of high tech. A major instance here is

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<sup>44</sup> Despite that the objective of such policies was to create a VC industry, Indian policies of the late 80s and early 90s should be evaluated in terms of their contribution to the creation of favorable background conditions for high tech & R&D intensive industry growth.

the Inbal program which facilitated selection of the LP form by Israeli policy makers. Also policy makers learned from the business experiments carried out during the pre-emergence period (they also identified high skilled individuals which could serve as future Yozma funds' entrepreneurs and managers). It also provides vital information about possible Government action directed to enhance the rate of SU formation (in Israel this resulted in greater disbursements on R&D grants and implementation of a Technological Incubator Program).

The importance of policy experimentation and learning is greater once we recognize that *targeted programs*, while potentially very effective, are fraught with dangers. This because of the complexity of the coordination problem that has to be solved to overcome System Failures such as those encountered in the Israeli case (see F1 above). Insufficient experiments may lead to a targeted program which is not appropriate given the task and the opportunity at hand, even if background conditions were favorable. The weaknesses of the program may refer to various aspects e.g. objective, mix of tools used, scope of direct government investments, structure of incentives, etc.

***Failure 4(F4): Flawed Implementation of a well-designed targeted VC emergence program***

The Yozma program suggest the importance of adopting a right set of implementation principles which would facilitate the coordination problem involving money, high level VC entrants, and reputable/networked foreign partners. Numerous sources of flawed implementation could be thought of such as: political problems, an economic downturn leading to budget cuts in the relevant agencies; inefficient distribution of responsibility and decision making among several agencies; reshuffling of top personnel and loss of policy capabilities; or new strategic priorities.

In Israel, the Chief Scientist which headed the OCS during the previous 8 years and who spearheaded the design of Yozma, became the head officer in charge of the program. There was extensive knowledge in the OCS about high tech, about high tech needs, about the System Failure to overcome, and about how to do it (e.g. significant 'know-who' knowledge about actors/agents who could play significant roles in implementation of the program). This knowledge and some of the OCS capabilities and links were easily transferred to the directorate of the new program. This assured appropriate coordination and other actions leading to the onset of a cumulative process of VC emergence.

***Failure 5 (F5) – Unexpected narrow window of opportunity for VC emergence → Insufficient cumulative effects***

The principal cause of failure in this case pertains to the unexpected changes in the environment surrounding both the high tech cluster and the period of implementation of the targeted VC policy e.g. a sudden crisis in product markets or in capital markets (e.g. due to the loss of confidence in the aftermath of a bubble). This may render useless what could have been an excellent design for a targeted VC program and even what was an auspicious early implementation.

F5 might have been relevant to the case of some advanced countries who implemented well designed and adequate VC policies in the late 90s –the cause of failure being the crisis in product markets and the fall of NASDAQ starting in 2000. Not enough time elapsed for VC emergence and consolidation prior to the crisis in global markets: what was emerging might have been truncated or might have disappeared altogether.

***Failure 6 (F6) - Inadequate post emergence restructuring process → the VC industry didn't consolidate***

We mentioned that numerous frictions could surround the new VC industry and the re-configured high tech sector into which it got embedded. Many of these pertain to the wider economy and system of innovation (Peres 2003). In Israel we mention social tension and the appearance of signs of a ‘dual economy’ and of ‘social tension’. An appropriate restructuring process under these circumstances would require the changed behavior of individual agents; new patterns of collective behavior of both VC and high tech; new patterns of interaction with the Government; and new policies. Even new National Priorities e.g. concerning a peaceful resolution of the Israeli-Palestinian problem may be required. It is uncertain whether the long list of requirements will be materialized.

From a more general, non-Israeli perspective and following the insights from Long Wave Theory and the literature on Technological Revolutions --inappropriate restructuring means that the agents in the cluster didn't success in leveraging the potential high tech impact of VC into significantly wide economic growth through diffusion of the high tech cluster technologies and skill to other industries. There is a time limit for implementing the restructuring process- too long a crisis will cause

erosion of the cluster's reputation and to a concomitant destruction of agents' confidence and capabilities.

## **Conclusions**

This paper presents an *extended* PLC perspective to the Evolution of a VC *industry* which emphasizes the processes associated with the creation (VC Emergence) or non-creation of the industry and the role of policy. The perspective is then applied to explain Israel's success in creating an industry specialized or dominantly focused on early stage, high tech SU companies. The case is worth studying because of the small number of successful instances of this kind beyond North America (despite numerous attempts in OECD countries) and because VC emergence in Israel was *policy led*. Moreover there are strong reasons to believe that the 'Yozma Program'-Israel's targeted VC emergence policy program- stands out among the set of VC policies applied in non-US OECD countries in terms of objectives, nature of program, its design, and the context and timing of its implementation. To a very significant extend this program is an example of *Successful Evolutionary Venture Capital Policy* (Metcalf 1995, pp 447-462)- one following 'normative' Systems/Evolutionary principles (Teubal 2002); and based on an industry specific Evolutionary Theory of Economic Change-**Industry** Life Cycle theory.

### *Industry Life Cycle*

An Industry Life Cycle model is a particular variant and extension of the classical PLC model (Abernathy & Utterback 1978, Klepper 1996,7,9; Klepper 2000) which considers both aspects of dynamic/evolutionary processes and/or institutional perspectives (including issues of organizational capabilities). Our Industry Life Cycle framework differs from conventional PLC theory in three respects. First, the industry we refer to when crafting the theory is the VC industry rather than the automobile (or other industry), which stood in the background of the early PLC theory development. Thus the inherent cyclical nature of VC is explicitly considered in the model (crisis, and restructuring/consolidation phases) and related to Israel's and to some extent the US experience. Moreover, the context is that of a country where High Tech is a dominant sector or an important 'driver' of economic growth; and of a VC emergence process that takes place during a global IT Revolution. This links the life cycle

analysis to the analysis of Technological Revolutions (Freeman & Peres 1988, Peres 2003); and requires an explicit consideration of High Tech-VC co-evolution.

Second, at this stage the model is formulated in appreciative theory terms rather than as a mathematical formal theory as is the case in Klepper 1996 (this also enables us to consider a wider range of features and processes during VC evolution). Casting the Israeli case into this theoretical framework enables us to compare it with other cases, e.g. the US case. Third, it consists of five well determined phases of evolution (each one characterized by more or less specific events, facts and processes) which contrasts with Abernathy & Utterback's three phases and Klepper's analysis which, while dynamic, is not explicit about periodization.<sup>45</sup> Two phases- creation of background conditions and pre-emergence events- precede the central VC Emergence phase; and two others- crisis & restructuring, and VC consolidation- follow it.

The analytical focus of this paper is on *VC industry emergence*. This derives both from the view that *VC is an industry* and from the evolutionary perspective adopted. It differs from the analysis of VC in the literature which focuses on the 'operation' of VC rather than on the dynamics of evolution of the industry; and where frequently VC is considered as a 'pool of money' rather than an 'industry'. *Successful VC emergence* is concerned a) with *early entry* and the dynamic benefits brought about by this process b) with a *cumulative process* which we intuitively associate with successful VC & high tech cluster emergence processes; and c) with *co-evolutionary processes* which are likely to underpin cumulativeness. Successful 'targeted' VC emergence policy-a central part of the emergence story in Israel- depends not only in understanding the role of Government in sparking entry of private capital, but also its direct and indirect role in initiating the above-mentioned cumulative process. Our in-depth analysis of this phase focuses on several critical co-evolutionary processes including High Tech- VC, VC-SU co-evolution & policy-business co-evolution. At the policy level it focuses on the two targeted VC policies implemented in Israel during the early 1990s: the early Inbal program which failed; and the later Yozma program which succeeded.

Concerning post-emergence processes, the Israeli and U.S. cases suggest that there may be endogenous reasons why a VC industry that emerges will experience a

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<sup>45</sup> Gort & Klepper (1982), whom focus mainly on entry and exit, present five phases of industry evolution which approximately parallel our four last phases in some aspects. Their phase 1 corresponds to our pre-emergence phase; their phase 2 to our emergence, phase 3 & 4 to our crisis, and phase 5 to our Consolidation Phase.

post- emergence crisis. For example the new industry and the associated high tech cluster may not ‘fit’ well within the overall system; or there may have been ‘overshooting’ or a downturn in the global industry/market. The process of overcoming this crisis and the reconfiguration of the high tech cluster, will determine the sustainability of the industry and its future strength. We believe that an important element in this restructuring process is adjusting to the changing role of the high tech cluster & VC industry within the wider social-economic system. As part of this the diffusion of technologies and managerial capabilities from the high tech sector toward other sectors and the release of social tension both within the high tech cluster & between the cluster and other agents in the economy.

### *Policy*

The significance of an early phase, high tech SU oriented VC industry as a component of the ‘Silicon Valley’ model of high tech led many countries to implement government policies aimed at creating a VC industry. Most of these failed. We argue that most of these failures are due to the simplistic attitude of policy makers toward the creation of a VC industry. More specifically, we argue that policy makers of non-US OECD countries and frequently academic researchers in the field viewed the VC market as a ‘pool of capital’ rather than an industry. In many cases issues of capabilities, VC organization, links between high tech and VC, and etc., were ignored. Moreover market failures rather than the system failure were considered the main obstacle to the creation of the industry. This paper’s analysis suggests that effective VC emergence policies require adoption of an evolutionary perspective to VC as an industry and a systems/evolutionary perspective to VC policy.

The Israeli experience shows that a *targeted VC Emergence policy* is feasible and could be desirable. It also shows that it could be a central vector in the re-configuration of high tech towards a SU-intensive cluster. Also suggests that such a policy could be more complex both in design and implementation than most VC policies of OECD countries excluding the US (see for example OECD 1996, 1997, 2000, 2003). The policy requires a strong sensitivity to context and timing, and greater coordination with other policies. Success depends on characteristics of an evolutionary process which converged, with the help of policy, into a successful VC emergence process. Rather than elucidating a ‘critical set of success factors’ our analysis emphasizes the importance of background conditions and pre-emergence

events both in terms of high tech industry capabilities and links (technological, organizational, managerial) and in terms of policy capabilities and institutions.

Israel's policy-led VC emergence process of 1993-9 was triggered by the Yozma program which provided Government equity investments in hybrid, daughter 'Yozma Funds' focusing on early stage investments in high tech SU. This feature enabled the crafting of an original set of 'incentives to the upside' which induced entry of sophisticated VC entrepreneurs and participation of reputable & networked foreign investors which together provided significant added value to SU. The Yozma program managed to coordinate and match VC entrepreneurs with both foreign investors & financial resources; and it succeeded in sparking a process of cumulative VC industry growth in a short period of time. Central to this was stimulation of 'collective learning' processes within the industry and of other autocatalytic, dynamic processes such as subsequent entry of non- Yozma VC funds, and the generation of VC industry and high tech cluster reputation.

Yozma was implemented at the right time, the outcome of an evolutionary process and luck. We would emphasize three crucial aspects: *First-* the overlapping of the VC emergence processes it triggered with the expanding global product & capital markets on the other; *second-* implementation only after the creation of significant R&D/Innovation capabilities within the business sector, intensive experimentation & learning of business sector agents; and the appearance of an excess demand for VC services; and *third,* the considerable policy capabilities accumulated before and during the implementation of the Yozma program.

### *Applicability*

The Israeli experience is not directly replicable elsewhere. What can be adopted are specific aspects both of the analytical approach followed in this paper and of the policies implemented. VC emergence policies are complex and their design and implementation require a rare combination of broad perspective on the one hand and attention to detail on the other. In the concluding section we have identified six cases of VC policy failure. Despite this and due to our enhanced understanding of past experience, an increasing number of countries may be poised to attempt a second round of VC policies; and their chances of succeeding would seem to be at least as great as those of past policies, if not greater.

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