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# EVOLUTIONARY INNOVATION AND HIGH TECH POLICY: WHAT CAN WE LEARN FROM ISRAEL'S TARGETING OF VENUE CAPITAL?

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# **Evolutionary Innovation and High Tech Policy: What can we learn from Israel's Targeting of Venture Capital?**

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# **Evolutionary Innovation and High Tech Policy: What can we learn from Israel's Targeting of Venture Capital?**

## **Abstract**

The paper analyzes Israel's Innovation and High Tech Policy from a Systems-Evolutionary (S/E) and Life Cycle Perspectives with a focusing on the targeting of the Venture Capital Industry during the 1990s. Other related research strongly suggested that the emergence of Venture Capital (VC) during that decade was a central vector in the re-configuration of Israel's high tech industry into a Silicon Valley, start up intensive, model of high tech. The paper undertakes a qualitative assessment of the central VC-directed program-Yozma; and compares it both with a prior failed program (Inbal) and with VC policies of other countries. It concludes that in all likelihood, Government intervention was justified and its impact was high. Absence of a clear policy evaluation methodology in the literature that follows S/E principles implies that the main thrust of the analysis lies in the *framing* of policies rather than in undertaking a quantitative analysis of economic impact.

Israel's success in its Venture Capital policies (with Venture Capital defined 'strictly' in the sense of early phase equity-based finance and support of high tech start ups) contrasts with the seemingly weak impact of policies adopted by other countries, including OECD countries. Moreover, and in contrast to much of the relevant literature, it also raises the possibility that targeting high tech clusters is possible provided adequate background and, even more important, adequate *pre-emergence* conditions have been fulfilled. In Israel those conditions were such that Yozma managed to spark a cumulative, auto-catalytic process of VC industry emergence.

Success in the implementation of 'targeted' Innovation and High Tech Policy (and more specifically, of Venture Capital industries) must be adequately timed, must explicitly consider the domestic and external environments of the country, and must be coordinated with other policy actions. The paper ends with a systematic analysis of VC policy failure.

**Keywords:** Venture Capital, High Tech Cluster, Emergence, Innovation Policy, Targeted Policy, System Evolutionary Perspective, and Industry Life Cycle.

## **Acronyms**

A&T-Avnimelech and Teubal. AKT-Avnimelech, Kenney, and Teubal;

BGS-Bresnahan, Gambardella and Saxenian

VC-Venture Capital, Venture Capital Company; PE-Private Equity, Private Equity Company, LP-Limited Partnership (a form of VC and PE organisation) ; IC= Investment Company; HC-Holding Company, BG-business groups

OCS-Office of the Chief Scientist, Ministry of Industry and Trade, Israel; IVA-Israel Venture Association

EVCA=European Venture Capital Association

SME-Small and Medium Sized Enterprise; SU-high tech Start Up company;

ITP-Innovation and Technology Policy; S & T: Science and Technology; ICT-Information and Communications Technologies; SF-System Failure; SFi-specific cause i of SF; PFi-Policy Failure i

ILC-Industry Life Cycle;

S/E-System-Evolutionary /System of Innovation perspective; SI-System of Innovation BS-Business Sector; SS-Supporting Structure

SBIC-Small Business Investment Companies; SBIR-Small Business Investment Research. SBA-Small Business Administration

SEC-Securities and Exchange Commission (US); TASE-Tel Aviv Stock Exchange

RBSi-Restructuring of Business Sector during phase I; ROR-Rate of Return

## 1. MOTIVATION AND OBJECTIVES

### 1.1 Motivation

In the diffusion of the Silicon Valley model of high tech, Israel's new high tech cluster of the 1990s is an important, possibly, primary example (A&T 2004a,c; BGS 2001; Carmell and Fonteney, 2004). Strongly linked to this, Israel during the 1990s was probably the most successful instance of a VC industry oriented to the *early phase finance of high tech* SU out of the US - despite Israel being a small country the *absolute* level of VC activity seems to have been one of the highest worldwide. Moreover, there is also increasing consensus about the role of Israel's highly successful VC targeted program (The Yozma Program or Yozma) in triggering the emergence of a VC industry during the 1990s. Together with Martin Kenney we have termed the process *Policy Led*; and in this and in other papers we have described some of the central characteristics of Yozma (see A&T 2004a,b; A&T 2005a). These include a once and for all 100M\$ government venture contribution that seeded 10 private, hybrid VC funds and which, by generating critical mass, triggered a cumulative process of VC emergence; and strong incentives to the upside which contributed to the partnering of world class investors (including leading Private Equity companies, corporations and financial institutions). Moreover, in past and in ongoing work (e.g. A&T 2005b) we have identified some critical background conditions which contributed to Yozma's strong impact.

Israel's success in creating a strong VC industry and the hypothesized high impact of its targeted VC-directed policy contrasts with the generally weak effect of VC policies in other countries during the 1990s (e.g. OECD reports and Becker and Hellmann, 2003 for the German case). In some cases like in the UK and Sweden an industry initially oriented to early phase finance of high tech SU seemed to have evolved into one increasingly dominated by late phase Private Equity investments. There seems to be no clear indication of emergence during the 1990s of a high impact early phase oriented industry in Europe.

While the situation in Europe during the early years of this century seemed to have improved and to some extent gone in the direction of the U.S. (e.g. Bottazzi et al., 2002) and Israel, the policy implications derived from such 'positive' analyses have at best been incomplete. Similarly with recent work (Bottazzi et al., 2003, 2004) on the creation

of 'active' VC markets i.e. VC markets oriented to early phase finance of high tech SU. In neither case is VC fully being considered as an industry which evolves through time, which co-evolves with high tech and with the policy institutions that support it. This leads to policy conclusions, which even if seemingly right (in some cases they seem not to be) need not by themselves contribute to the creation or emergence of a high impact, early phase SU finance and support VC industry.

From another perspective which includes the one underlying this paper, VC emergence and VC policies are related to the evolution, emergence and re-configuration of high tech clusters and to policies linked to these dynamic processes. For example the policy implications of the comparative analysis of high tech clusters (Bresnahan et al 2001)-while to some extent dynamic, fall short on three counts a) no clear view of the role of VC in the emergence or re-configuration of high tech clusters ( VC is "another Marshallian input supplier that arises after the high tech cluster attains a particular size"); b) the view that only *after* cluster creation will a 'new economy' type cumulative process with positive feedback take hold; c) an incomplete perspective of the structure of possible policies and their dynamic implications during the various phases of evolution prior to and after high tech cluster emergence. More specifically their analysis seems to imply that cluster creation policies and, more specifically, targeted policies directed to this objective, are bound to fail. To some extent this view contrasts with the policy implications of our analysis of the Israel's VC-intensive high tech cluster of the 1990s.

This paper is based on the presumption that the Israeli experience, once interpreted within a Systems-Evolutionary perspective and integrated into the knowledge base accumulated in the area, will generate new perspectives on the options and policies open to other countries, both advanced and industrializing. One important element for this is an **Industry Life Cycle (ILC)** analysis of VC (A&T 2003b; Avnimelech 2004) which focuses on VC emergence. The model is a five phase cycle comprising two phases preceding emergence (events here relate to high tech) and two following it. This framework of analysis enables an effective link between the evolution of VC and the emergence or reconfiguration of high tech clusters (one mechanism being VC-SU co-evolution).

From the policy or ‘normative’ point of view this paper adopts a **Systems-Evolutionary (S/E) perspective** to **Innovation and Technology Policy (ITP)** where, when applied to the Israeli case, favorable ‘Background and VC Pre-Emergence phase’ conditions may explicitly be promoted by Horizontal **Business Sector (BS)** R&D support programs. These programs generate both BS innovation capabilities and technological entrepreneurship while also promoting new SU foundations and ‘demand’ for the future VC industry. In Israel’s case these and other events/processes set the base for the successful targeting of VC at a later phase of that industry’s ILC (*third phase*).

The above suggests that a more detailed and integrated analysis of Israel’s policies—both those directly oriented to VC and other, relevant, policies—could shed light on why VC has not emerged in other countries, and what are the policies which countries could adopt to generate or re-configure high tech clusters.

### **1.2 Specific Research Objectives**

*i) Undertake a qualitative assessment of the Yozma Program’s design and impact; and compare it both with the other Israeli Program (Inbal) and with other European Programs of the 1990s and before*

Yozma was a targeted, VC directed program implemented in Israel during 1993-7. It is considered to have been a very successful program, leading to VC emergence sometime during 1993-2000. VC emergence was the outcome of a cumulative, multi-component and autocatalytic process of growth both of the ‘industry’ and of the ‘market’. Many of its distinctive features—and Yozma stands out as a class in its own as far as VC directed policies till and including the 1990s are concerned—suggest that policy makers at the time implicitly considered VC as an industry or private infrastructure serving the need of high tech SU. A major objective here is to assess why Yozma succeeded and other programs failed. Within this comparative perspective, Yozma’s success will be linked to favorable background and pre-VC Emergence conditions (themselves the outcome of policies implemented more than two decades before); the particular context and timing of the policy; to the specifics of its design and principles of implementation; and to the complementary policies implemented during the 1990s. VC policies of other countries have frequently been implemented ‘too early’ when the domestic and/or external contexts have not been favorable. Needless to say neither the

tools nor the conceptual framework for a thorough evaluation of a program such as Yozma in accordance with S/E principles exist in the literature. Still we argue in this paper and we provide strong, largely qualitative, support to this view that Yozma was a critical factor in the successful emergence of VC in Israel during the 1990s.

*ii) Assess, from a Systems-Evolutionary perspective, some analytical implications of Israel's VC targeted policies.*

Among other aspects the S/E perspective asserts that frequently Innovation and Technology Policy could be expressed by a set of interrelated and coordinated programs comprising a Cycle-with the policy portfolio evolving through time. For example, during the early 1990s in Israel there was a relative shift from direct support of **BS** R&D to the support of VC. This ITP cycle may have relevance both for advanced countries and for industrializing economies; and for targeting high tech or non-high tech areas. Some additional S/E analytical implications of interest include: the complexity of VC targeting; a criticisms of Gilson's analysis on forging VC markets; creation of policy capabilities particularly for targeting VC and other industries; and the possibility that the stronger the market forces operating in the area prior to and during early industry emergence-the greater the justification for VC targeting and the likelihood that it will be successful (see also A&T 2004c).

*iii) Comments on the policy implications of an analysis of high tech clusters (focusing on Bresnahan et al 2001)*

VC is a private infrastructure to SU so Israel's VC policies should be considered as part of a process of creating a Silicon Valley type cluster of high tech. This link has been ignored by most 'normative' analysis of high tech clusters (or it has been considered a marginal phenomenon). More specifically we believe that our framework of analysis can add significantly to the policy implications of Bresnahan's et al., (2001) comparative analysis of high tech clusters

*iv) Possible lessons for industrializing economies wishing to develop VC and high tech industries; and for ITP and industrial targeting more generally speaking.*

The conditions facing industrializing economies differ considerably from those surrounding the successful infant industry targeting of the last decade e.g. Korea (see Bell et al., 1984). On the other hand, they are much closer to some of the conditions

facing Israel with respect to its VC and high tech industries of the 1990s. The globalization-induced conditions under, which it operated (increasing access to global markets; global competition and an increasingly harsh selection environment) are increasingly making that experience relevant beyond VC and high tech (A&T2005a).

## **2. ISRAELS VC INDUSTRY AND VC POLICY**

### **2.1 *Structure and Distinctive Characteristics of Israel's VC industry***

VC companies are “independently managed dedicated pools of capital that focus on equity or equity-linked investments in privately held, high growth companies” (Gompers and Lerner 1999, p. 349). This definition allows for two variants, a narrow and a broad one. The *narrow or strict definition of VC* which is the relevant one for characterizing Israel’s VC industry involves a ‘dominant’ orientation to the *early stage* finance of *high tech SU* companies; while the broad definition, which is Lerner’s, allows for a non-high tech and non early phase focus (although they should still focus on high growth companies). **Private Equity (PE)** is a broader notion which focuses not only on (private) equity investments in SU but also in equity finance of mature companies undergoing restructuring through e.g. MBO/MBI.

The *distinctive characteristics* of Israel’s VC industry are shown below and the evolving structure of the VC/PE industry is shown in Table 1 (which focuses on the flow of capital, a critical aspect of VC industry activity). Table 1 strongly suggests that VC emergence took place during 1993-2000. Yozma is Israel’s successful targeted VC policy which will extensively be discussed below; and Inbal is a precursor Government program which failed. Yozma was launched in 1993 and implemented during the 93-97 period. It triggered the emergence of the industry by sponsoring 10 privately owned and managed hybrid Yozma Funds. Their success induced entry of other non-Yozma private VC companies (third line in table)<sup>1</sup>; of other private unaffiliated LP PE funds (second before last line in table) and of other organizations also involved in the equity finance.

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<sup>1</sup> Most of the Yozma VCs were created in the wake of the Yozma program, their 1<sup>st</sup> fund was a Yozma sponsored fund. This is the figure recorded in line 2 of the table. The subsequent funds of Yozma VCs are part of line three-non Yozma Funds.



Total capital under raised during 1993-2000 was \$9384M- a clear indication that the VC (or the VC/PE industry) *emerged* during this period<sup>2</sup>.

**Table 1: Capital Raised According to different types of PE Organization in Israel**

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Private VC</b>	49	27	172	112	135	309	620	594	1552	3682	1304	76	118
Yozma VCs	0	0	149	40	15	0	52	0	0	0	0	0	0
Non-Yozma	49	27	33	72	120	309	568	594	1552	3682	1304	76	118
<b>Public VC</b>	0	54	22	0	0	0	29	8	44	185	6	86	0
Inbal VCs	0	54	22	0	0	0	0	0	0	0	0	0	0
Non-Inbal	0	0	0	0	0	0	29	8	44	185	6	86	0
<b>LP PE Funds</b>	0	45	128	242	6	24	56	67	108	89	0	110	435
<b>IC/ HC</b>	9	34	40	20	25	80	134	141	149	601	83	0	5
<b>Total PE</b>	<b>58</b>	<b>160</b>	<b>372</b>	<b>374</b>	<b>166</b>	<b>413</b>	<b>839</b>	<b>810</b>	<b>1853</b>	<b>4557</b>	<b>1393</b>	<b>272</b>	<b>558</b>

Source: IVC and Authors Calculations.

IC/HC – Investment/Holding companies; Public VC- Publicly Traded VC; Private VCs – LP VCs; LP PE - Non-VC Private Equity LP funds (directed to late stages or/and non-ICT firms)

### BOX 1: Distinctive Features of Israel's VC Industry

<i>Highest VC investments as a share of GNP</i> (see table 2a and OECD 2003d) <i>and High Share of VC investments are 'Early Phase'</i> (see table 2b). This contrast with European VC/PE industries where 6% of annual European VC investments were early phase while 46% were MBO/MBI (see PWC 2003).
<i>A substantial share of VC entrepreneurs with S&amp;T backgrounds and with high tech experience</i> - many if not most VC and PE entrepreneurs in Europe have financial backgrounds rather than S&T backgrounds or High Tech experience <sup>3</sup> .
<i>90% of funds coming from foreign sources</i> - this contrasts with the US where the share of foreign investors in capital raised during 1995-99 was 3% (OECD 2000)
<i>Negligible investments by domestic Pension Funds</i> – only 0.1-0.2% of the Israeli Pension Funds & Insurance Company's assets are investments in VCs (OECD 2003d) which contrasts with between 3-5% in the US and Europe.
<i>Other Characteristics:</i> LP form; a strategy directed to early phases; a large pool of SU; and the highest number of IPOs in NASDAQ after the US and Canada.
<i>The VC industry co-evolved with high tech, particularly the SU segment of high tech industry</i> - as during consolidation of Silicon Valley's tech cluster around the SU Semiconductor companies (who where to a large extent VC backed) during the early 70's. This was the period of emergence of the US VC industry (AKT, 2004).

<sup>2</sup> This contrasts with \$218M raised during 1991-92, which figure is not significantly lower than the accumulated VC/PE funds raised during the 1985-1992 period. For a brief discussion of the conditions and characteristics of VC emergence see A&T 2003b, 2005b

<sup>3</sup> Recent work by Bottazzi et al., (2003) has shown a significant increase in VC entrepreneurs with S&T backgrounds in Europe. Our distinctive Israeli profile still holds, however, at least for the 1990s.

*Extent of Early Phase Investments*

**Table 1a: Capital Invested in Israeli Startups by stages**

	1997	1998	1999	2000	2001	2002	2003	2004
Capital Invested in Israeli SU	440	589	1,011	3,092	1,985	1,138	1,011	1,465
VC as % of GDP	0.4%	0.5%	0.9%	2.6%	1.7%	1.0%	0.9%	1.2%
Domestic VC Investments in Israeli SU	260	334	436	1270	812	481	421	665
Domestic VCs investment as a share of total investments in Israeli SU	59%	57%	43%	41%	41%	42%	42%	45%

Source: IVC and Authors Calculations

**Table 1b: Capital Invested in Israeli Startups by stages**

	1997	1998	1999	2000	2001	2002	2003	2004
Capital Invested in Israeli SU	440	589	1,011	3,092	1,985	1,138	1,011	1,465
<b>Seed as % of total</b>	10%	5%	5%	10%	5%	2%	6%	8%
<b>Early as % of total</b>	56%	53%	52%	38%	41%	35%	32%	24%
<b>Mid as % of total</b>	15%	31%	28%	30%	32%	54%	49%	56%
<b>Late as % of total</b>	19%	11%	14%	22%	23%	9%	13%	12%

Source: IVC and Authors Calculations

\* Seed – technological feasibility (firm age up to 1 year); Early – Alpha and Beta products (firm age up to 3 years); Mid – Initial sales (firm age up to 5 year); and Late – Revenues growth prior to Exit (firm age up to 8 years). Investments in late stages are insignificant in Israel and are not included in the VC investment statistics.

**Table 1c: Capital Invested in Israeli Startups by technological sectors**

	1997	1998	1999	2000	2001	2002	2003	2004
<b>Communication</b>	25%	32%	33%	34%	42%	37%	33%	29%
<b>Software</b>	18%	15%	15%	16%	17%	18%	19%	22%
<b>Life Science</b>	24%	25%	9%	8%	16%	15%	18%	22%
<b>Internet</b>	8%	12%	27%	30%	9%	4%	4%	4%
<b>Semiconductors</b>	19%	11%	11%	6%	4%	12%	11%	10%
<b>Other Technologies</b>	6%	5%	5%	7%	13%	14%	14%	13%

Source: IVC

Tables 1a, 1b and 1c present quite a clear picture of Israeli VC/PE industry patterns of investment during the last 8 years. On average 54% of the investments in Israeli startups were by foreign VC companies; the rest investments of Israeli VC companies (foreign investors were also the dominant source of capital of Israeli VC companies). Seed investment was on average 6% which is a very high figure compared to 1% in the U.S. and even less in Europe (VentureOne statistics). 78% of the capital invested in Israeli SU during the period was early stage and mid stage finance (as defined by EVCA terms); while that of late stage i.e. prior to an IPO was 16%. Moreover, the share of early stage finance decreased while that of mid stage finance increased through time.

The leading technological area of VC investments was communication with an average of 33% of the total (this share was relatively stable during the 8 years). The next two sectors are software with an average of 18% and Life Sciences (17%). While the software's share of total VC investments was quite stable this was less so for the life science's share. Internet investments were high only in 1999 and 2000 and went down sharply afterward.

## ***2.2 Israel's VC Industry Life Cycle***

Our Industry Life Cycle framework starts prior to industry emergence and consists of five well determined phases of evolution (two before and two after industry emergence). These are listed Box 2b with which also indicates the corresponding time periods for the US and Israel. Box 2a presents the main characteristics of each phase (see Avnimelech et al., 2005).

**Box 2a: 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 a variety of informal VC e.g. angels; and of VC-related activities</li> <li>• A few 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> <li>• Entry of less skilled VC managers/firms.</li> <li>• Excessive competition &amp; eventually overshooting</li> </ul>
<b>'Early' Emergence</b>	
<b>'Late' Emergence</b>	
<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 successful</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>

**Box 2b: Phases in the Evolution of the Israeli and the U.S. VC Industries**

Phase (sub Phase) in VC Evolution	Period- Israel	Period- US
<i>Background Conditions</i>	1970-84	1930-45
<i>Pre-Emergence</i>	1985-92	1946-57
<i>Emergence (Fluid, Growth, Overshooting)</i>	1993-2000 (93, 96, 99)	1958-73
<i>Crisis and Restructuring</i>	2001--2003	1974-81
<i>Consolidation</i>	Starting in 2004	Since 1982-

*The Israeli Experience*

A major aspect of any analysis of the VC industry life cycle is identifying the beginning of the industry, and whenever relevant, of the VC market. The presumption is that the VC industry was created sometime during the process of VC emergence (third ILC phase), that is during the 1993-2000 period. This because of a number of reasons: the acceleration of growth of VC activity (and the fact that this continued almost throughout the whole period); entry of large numbers of players both on the supply side (VCs and VC funds) and on the demand side (SU companies); and ‘selection/reproduction’ of critical features of the industry. Concerning the last point: both the *Limited Partnership form* of VC organization and the *early phase investment strategy* became dominant among VCs; while a ‘born global’ SU profile (one of whose objective was to exit through global capital markets, both IPO and M&A) was becoming standard among SUs.

During the *Background Conditions* phase (phase 1, 1970-84 in Israel) both the technological infrastructure and the financial infrastructure for the subsequent emergence of a VC industry was established<sup>4</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, 1985-92 in Israel) a VC industry with a clear identity does not yet exist although some (mainly informal but also formal) VC activity & experimentation takes place. SU foundations increased in response to lay-offs from

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<sup>4</sup> The Israeli case also suggests the need for a well developed **Innovation and Technology Policy (ITP)** ‘infrastructure’ of capabilities and institutions.

Military Industries, enhanced opportunities in the Software and Communications areas, and other factors. Also significant SU activity & business experimentation took place during this phase e.g. the 'born global' model of SU and a strategy focused both on global product markets and on global capital markets.

*VC emergence is a process* (not only a state) an outcome both of the accumulation of market & policy experience ('variation') during the pre-emergence phase and of other factors. In Israel it comprised three sub-phases: a *fluid sub-phase* (1993-1995); and an accelerated *rapid growth* phase (1996-1998) that eventually leads to *overshooting* towards the end of the decade. During the *fluid sub-phase* significant experimentation & collective learning takes place both with respect to VC strategies and with respect to VC organization. Many strategies, routines and organizational forms did not survive; some did and were adopted by varying numbers of VCs although their distribution is not 'stable'. VCs competed and cooperated<sup>5</sup>. The VC industry also begins experimenting with 'institutions' and with collective organizations (Israel Venture Association, founded in 1995). During the *rapid growth sub-phase* we observe an accelerated entry of new VC companies and of VC activity fed by a cumulative process with positive feedback effects (A&T 2004c). It is then that the industry attains a size which enabled it to sustain a large number of supporting services e.g. specialized attorneys. The sector converges to a relatively stable distribution of strategies focusing on 'early phase' investment; of routines (Nelson and Winter 1982) and of organization forms (Limited Partnerships). It also supports the creation and growth of large numbers of new SU<sup>6</sup>.

### **2.3 Israel's ITP Cycle**

We summarize the model and then describe in more detail Phases 1 and 2. Phase three will be dealt with in the next section 2.4)

#### **Summary of the Model**

Box 3 schematically outlines the three phases Innovation and Technology Policy model which culminated with emergence of a domestic VC industry during 1993-2000. The

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<sup>5</sup> This is a feature of young markets. VC cooperation involves collective learning, syndication, etc.

<sup>6</sup> Due to lack of space we do not detail neither the Crisis and Restructuring phase nor the Consolidation phase. This can be found in A&T 2005b. The information on our disposal strongly suggests that Israel's VC industry has initiated its Consolidation phase during 2004.

three phases represent the Innovation and Technology Policy component of (or overlap precisely with) the first three phases of VC's Industry Life Cycle. Thus the first Innovation and Technology Policy phase took place during the 'VC Background Conditions Phase'; the second phase-during the 'VC pre-emergence phase'; and the third -during the VC Emergence Phase. Beyond Israel's specific Innovation and Technology Policy Cycle there could be other variants to the model which could be associated with the successful emergence of VC industries in other countries or contexts.

**Box 3: Phases of Innovation and Technology Policy in Israel\***

<p><b><u>Phase 1: Diffusion of R&amp;D &amp; Generating Innovation Capabilities (1969-84)</u></b>  Horizontal Grants to Business Sector R&amp;D → <i>Creation of R&amp;D performing companies, and Creation of civilian High Tech industry &amp; first SU companies</i></p>
<p><b><u>Phase 2: Strengthening of Business Sector R&amp;D and SU/VC Experiments (1985-92)</u></b>  - Business Experiments &amp; Informal VC activity → <i>New Model of SU ('born global' with links to global capital/product markets)</i>  - ITP: Sharp Increase in Business Sector R&amp;D grants, Incubator and Magnet program (supporting cooperative, generic R&amp;D); First VC support program (Inbal) → <i>Business Sector R&amp;D expansion → Increased rate of SU formation → increased Demand for VC services → Learning from Inbal's failure and from Business Experiments → Identification of System Failure (absence of significant VC) &amp; Selection of Limited Partnership form of VC Organization</i></p>
<p><b><u>Phase 3: Targeting VC and Accelerated Growth of R&amp;D and High Tech (1993-2000)</u></b>  Targeted Support of VC (Yozma Program); continuation of all ITP programs, R&amp;D Grants peaked in 2000 → Emergence of a VC industry → Accelerated growth of SU segment and High Tech; large numbers of IPOs and M&amp;A, etc.</p>

\* The names of the phases reflect the main objectives of Innovation and Technology Policy

**Phase 1: Diffusion of R&D & Generating Innovation Capabilities (1969-84)**

*Creation of the OCS: Grants to Private Sector R&D*

The Horizontal Grants to Business Sector R&D program began in 1969 with the creation at the Ministry of Industry and Trade of a specialized agency, the Office of the Chief Scientist (OCS). This program was and continues to be the backbone of the country's R&D/Innovation strategy. Until the early 1990s, more than 90% of OCS disbursements to Civilian R&D came from this program, which supports the R&D activity of individual companies oriented to new/improved products and processes directed to the export market<sup>7</sup>. In contrast to a targeted program which is applicable to a

<sup>7</sup> This type of R&D could be termed 'regular' or 'classical' R&D to differentiate it from 'generic, cooperative' R&D, which is of a more infrastructural type (a generic, cooperative R&D program-the Magnet program- was implemented later in Phase 2). The latter's objective is to generate knowledge,

specific industry or technology an *Horizontal Program* is open in principle to all firms whatever their sector; and to all R&D projects whatever their product class and technology. Horizontal programs of this kind are *market friendly* R&D support programs which give primacy to the *bottom-up* identification and generation of projects. In Israel it extended a 50% subsidy to every R&D project accepted by the OCS, regardless of the firms' industry, product class and technology (Teubal, 1993).

The major objectives of the Horizontal R&D Grants Program during early implementation was to promote *collective* learning about R&D/Innovation<sup>8</sup>; to promote technological *entrepreneurship*; and to generate knowledge about potential areas where the country concerned might have or could develop a sustainable competitive advantage. R&D performing firms mutually learn from each other; and a lot of this learning relates not directly to technology or R&D proper but to organizational and managerial factors. Box 4 provides a categorization of intra-firm learning processes; and instances of collective learning. Both are based on the Israeli experience for the 1969-90 periods.

**Box4: Categorization of intra-firm learning processes and collective learning**

<p><b>Intra-firm Learning during Horizontal Program implementation-early sub-period:</b></p> <ul style="list-style-type: none"> <li>• Learning How to search for Market and Technological Information.</li> <li>• Learning How to identify, screen, evaluate, choose and configure new projects</li> <li>• Learning How to generate new projects, including more complex ones</li> <li>• Learning How to manage the innovation process (linking Design to Production &amp; Marketing; Selection of Personnel; Budgeting; Management of Human Resources etc.)</li> </ul> <p><b>Collective learning:</b></p> <ul style="list-style-type: none"> <li>• Firms learn about the importance of marketing</li> <li>• Firms learn how to establish and manage Strategic Alliances both with domestic and foreign companies; and how to generate links to Global Markets</li> <li>• The OCS and the firms learned how to better assess the quality &amp; economic potential of various types of projects and learned about areas with potential Competitive Advantage</li> </ul>
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*Phase 2: Strengthening of Business Sector R&D and SU/VC Experiments (85-92)*

The 1984 R&D Law further consolidated Israel's support of business sector R&D. The objective was to support knowledge intensive industries, through expansion of the science and technology infrastructure and exploitation of existing human resources;

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capabilities and components rather than directly marketable outputs. The output of generic R&D would facilitate a subsequent 'regular' R&D activity.

<sup>8</sup> Learning, including experience-based learning triggered by increased R&D in the Business Sector, is the main factor leading to enhanced R&D/Innovation capabilities.

creation of employment including absorption of immigrant scientists and engineers; etc. The outcome was a significant increase in R&D awards to industry; and recognition of software as an industry-a very significant event indeed. Box 5 and Table 2 bring data on new policies initiated in Israel during Phases 2 (which policies continued during Phase 3). The table also brings data on the backbone Business Sector R&D support program which was implemented throughout the three phases.

**Box 5: New Innovation and Technology Policy Programs**

1) <i>Inbal (1991) - a Government owned Insurance company, which gave partial (70%) guarantees to traded VC funds. Four VC companies were established under Inbal regulations. This early VC support program failed to create a VC industry</i>
2) <i>Magnet Program (1992- ) - a \$60M a year Horizontal Program supporting cooperative, generic R&amp;D involving two or more firms and at least one University.</i>
3) <i>Technological Incubators (1992- ) - a program supporting entrepreneurs during the Seed Phase, for a period of 3 years. The incubators are privately owned &amp; managed. Both they and the projects get financial support from the Government.</i>

**Table 2: OCS R&D Support (Million Dollars)**

<i>Year</i>	<i>Total Grants (Growth)</i>	<b>Regular R&amp;D Grants</b>	<b>MAGNET Budget</b>	<b>Technology Incubators</b>	<b>Royalties (Growth)</b>	<b>BIRD-F Awards</b>
1985	106 (2.5%)	106	0	0	6 (33.3%)	NA
1986	110 (2.8%)	109	0	0	7 (16.7%)	NA
1987	113 (2.7%)	112	0	0	8 (14.3%)	NA
1988	120 (6.2%)	118	0	0	9 (12.5%)	NA
1989	125 (4.2%)	122	0	0	10 (11.1%)	NA
1990	136 (8.8%)	133	0	0	14 (40.0%)	NA
1991	179 (31.6%)	171	0	4	20 (42.9%)	12
1992	199 (11.2%)	177	1	16	25 (25.0%)	10
1993	231 (16.1%)	199	40	24	33 (32.0%)	12
1994	317 (32.2%)	172	10	27	42 (27.3%)	10
1995	346 (9.1%)	294	16	31	56 (33.3%)	12
1996	351 (1.4%)	279	36	30	79 (41.1%)	13
1997	397 (13.1%)	309	53	30	103 (30.4%)	12
1998	400 (0.8%)	305	61	30	117 (13.6%)	14
1999	428 (7.0%)	331	59	30	139 (18.8%)	9
2000	440 (2.8%)	337	67	32	135 (10.8%)	8
2001	431 (-2.0%)	328	64	32	145 (5.2%)	11
2002	383 (-11%)	291	58	27	153 (1.4%)	10
2003	369 (-3.4%)	283	53	26	133 (-5.4%)	11

*From: Avnimelech (2004); Source: Office of the Chief Scientist and BIRD-F*



## 2.4 The Yozma Program<sup>9</sup>

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 (a Jerusalem Institute of Management report of 1987) mentions that 60% of the technologically successful OCS-approved projects failed to raise additional capital for marketing and had to close the business<sup>10</sup>.

Officials in the Treasury and the OCS concluded that despite massive Government support for R&D there were clear 'market & *system* failures', which blocked the successful creation and development of Startup companies. As a result a shift in policy objectives gradually took place—from promotion of R&D to enhancement of SU formation, survival and growth. System failures 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. Eventually policy-makers believed that the way to overcome these deficiencies was to foster a domestic Venture Capital industry which then became a *Strategic Priority* of the Government of Israel.

The first VC targeted program was Inbal (a failed program), its implementation started in 1992. The second one was Yozma, a successful program implemented during 1993-97.

### *Comparing Yozma with Inbal*

Yozma design has been extensively analyzed in previous work (Box 6 reproduces some of its main features). A comparison of Yozma and Inbal will further emphasize the crucial role Yozma's design (Box 7). Yozma's design played a crucial role in explaining its differential impact (Box 8) since both programs had almost similar goals; and their date of initiation differed by only one year; with five years overlap in implementation.

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<sup>9</sup> This would be Phase 3 of the ITP cycle model presented in 2.3 above.

<sup>10</sup> The weak reported impact of OCS's support was probably also due to a 'technology biases' in the grants.

### Box 6: Critical Dimensions of Yozma Program Design

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

### Box 7: Comparison of 'Design' aspects of YOZMA and INBAL Programs

YOZMA	INBAL
Promoted by the OCS and 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).
The Government-owned Yozma Venture Fund started to invest immediately. This encouraged other VCs to invest as well, and fast.	No mechanism to encourage VC firms to invest immediately

**Box 8: Factors Explaining the Differential Yozma-Inbal Impact**

<b>YOZMA</b>	<b>INBAL</b>
Created a critical mass of VC investment	Sub-critical mass of VC activity
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	Did not attract any new global financial nor strategic investor into Israel
Yozma Funds' managers were involved in creating the <b>Israel Venture Association</b>	Not involved in creation of IVA
Very high private VC performance	Low private VC performance
Follow up funds & strong growth of capital	Very few secondary issues

**2.5 The High Tech Cluster of the 1990s**

The possibility of latching into the global ICT revolution is probably the main reason why Israel's success in creating a VC industry is important not only for advanced industrialized economies in Europe and Asia but also for top tier developing economies like India and China. Table 3 summarizes the main characteristics of Israel's Silicon Valley 'model' of high tech cluster, which developed during the 1990s. It also compares with the situation prevailing towards the end of the 1980s and 1970s. Notice the prominent place played by variables related to VC activity and to SU.

**Table 3a: Israel's high Tech Cluster - Selected Structural Elements (1970s-1990s)**

<b>Accumulated during the decade</b>	<b>1990s</b>	<b>1980s</b>	<b>1970s</b>
<i>Number of SU creation</i>	~2,500	~300	~150
<i>Funds Raised by VCs: M\$</i>	~8,500	~50	0
<i>Capital Invested in Israeli SU by VCs (inc. foreign): M\$</i>	~6,650	~50	0
<i>Accumulated No of IPOs (high tech):</i>	126	9	1
<i>Accumulated VC-backed IPOs:</i>	72	3	0
<i>Accumulated # of significant M&amp;As by MNE:</i>	~75	0	0
<i>Capital raised in NASDAQ in the decade: M\$</i>	~10,750	~50	~10
<i>Mergers and Acquisitions (M&amp;A): B\$</i>	~18,200	~0	~0
<b>Figure for the end of the Decade</b>	<b>1990s</b>	<b>1980s</b>	<b>1970s</b>
<i>Number of International Investment Banks in Israel</i>		1	0
<i>Number of VC Companies</i>	~100	2	0
<i>Share of ICT Exports in Manufacturing Exports</i>	54%	28%	~14%
<i>ICT manufacturing Exports M\$</i>	12,950	2,450	350
<i>Software Exports MS</i>	2,600	75	0
<i>Civilian R&amp;D as Percentage of GDP</i>	4.8%	2.8%	1.8%
<i>ICT Employees (thousands)</i>	152	~80	~60
<i>ICT Skilled Employees (thousands)</i>	57	37	~26
<i>Patents Issued</i>	969	325	140

Source: SU numbers come from three sources: CBS, OCS and IVA. Other sources: IAEL and USPTO.

\* Frequently the figures in the box are approximations due to gaps in the availability of data, the existence of various sources of information- including fragmentary information from non-official sources.

### 3. VC POLICY: THEORY, PRACTICE AND PROPOSALS

#### 3.1 Systems-Evolutionary Perspective to Innovation and Technology Policy<sup>11</sup>

The *Systems/Evolutionary (S/E) Approach* underlining this paper is not only a framework for understanding the ‘real world’ (e.g. Nelson 1993, Lundvall 1992, Edquist 1997, Lundvall et al. 2002) but also a framework underpinning the need, design and implementation of policy-particularly ITP (‘normative aspects’--see Metcalfe 1995; Teubal 1999, 2002)<sup>12</sup>. Normative aspects go far beyond the *justification for Government intervention*, which is the major topic discussed in the literature. Thus a central focus of analysis is the configuration, structure and dynamics of ITP; the nature of System Failure (see below); and the *policy process*.

The *General Objective of ITP* is to promote **System of Innovation (SI)** transformation by overcoming System (& Market) Failures<sup>13</sup>. Due to radical uncertainty, complexity etc. the nature of the desirable SI transformation cannot be determined within an ‘optimizing’ framework as was the case in early neoclassical analysis. Rather it should be determined by a set of *Strategic Priorities* (Teubal 2002)<sup>14</sup>. A *System Failure* exists when the existing SI will not, through its normal operation, achieve such a transformation. For example if the strategic priority is to achieve a significant deepening of privately financed, high impact BS R&D/Innovation (*vision*) achieved through development of a domestic VC industry (*strategy*), a system failure would exist if the operation of the existing system, particularly the BS (market forces), would not lead to this outcome.

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<sup>11</sup> This is a summary view of the perspective. For further analysis see Teubal 2002 and A&T 2004e

<sup>12</sup> Most Evolutionary/SI theories focus on understanding the real world (our ‘positive aspects’) rather than on policy (‘normative aspects’). Moreover, with few exceptions and not unlike Neoclassical Theory, policy (particularly its ‘incentives’ component, less its ‘institutions’ component) is considered an area of application rather than a field of knowledge in itself (See Teubal 2002).

<sup>13</sup> In our perspective ‘market failure’ is one form of system failure.

<sup>14</sup> A main issue is the appropriateness, robustness, adaptability, quality and degree of explicitness of the set of priorities arrived at in a particular context. A set of priorities should also be “feasible” and ‘desirable’. We will not be able to deal with this issue here, despite its importance. Rather, when describing the three-phase model, we will be assuming that the country concerned has identified a set of strategic priorities, which is ‘reasonable’, given the context in which it operates.

### Causes of System Failure

To overcome a system failure pertaining to a particular context it is necessary that the ITP implemented address the *specific causes of the system failure*. These could include:

- Innovation, Knowledge and Learning Externalities *e.g. from R&D, Penetration of new Markets, Management, etc.*
- Failure to assemble a critical mass of capabilities in a short period of time
- Weak High Tech or Knowledge Based Entrepreneurship – *due to cultural constraints, Bankruptcy Laws, etc.*
- Limited SU Access to Financial Resources *e.g. due asymmetric information, uncertainty, etc.*
- Weak BS Supporting Structure *e.g. Technology Centers*
- Weak Institutional Framework
- Non existing or underdeveloped Networks
- Co-ordination Failures

It should be noted that a special kind of system failure is establishing arbitrary, non-feasible and/or non-desirable or appropriate strategic priorities. Coordination failures may result when the un-aided market is incapable to coordinate among agents with the required effectiveness and speed. They frequently arise, like in Israel's VC case, when the system failures involve a number of specific causes which have to be overcome in a coordinated way.

The *System Failures* to be addressed will vary from country to country and from phase to phase and so would the resulting policies. It is obvious that effective SI transformation requires looking at the whole system and at the broader domestic and external context. It also means that the success of any one program or policy action will depend on the simultaneous existence or non-existence of other policies- so coordination and appropriate timing of policies should be explicitly considered.

### Portfolio of Policies

From the above it follows that ITP should be viewed as an integrated whole-- *a portfolio* of incentives programs & changes in institutions

### Strategic and Operational Levels

The operational ITP level involves implementing existing programs which, through learning and due to changes in circumstances, will have to undergo continuous adjustments. When circumstances change radically, new priorities may have to be identified, and a new portfolio of policies will result. The *policy process* in this case will be more complex than that underlying the operational ITP level.

### 3.2 OECD reports

A 1997 OECD report states that “OECD Governments are investing an estimated \$3B per year of risk finance in small, innovative firms... governments are mounting programs to fill ‘funding gaps’ that prevent small businesses from obtaining sufficient capital” (see also OECD 2000, p.35). The report mentions three broad directions of policy: government direct supply of capital to firms; providing financial incentives to venture capital investments; and broadening investment rules. It also mentions the controversies surrounding these schemes namely their impact on private capital sources (“crowding out”). Similarly the 2000 OECD report lists ‘supply side measures’ in support of VC which include promotion of private VC investment<sup>15</sup>; *development of an active second tier capital market; direct equity investments by Governments* -generally targeted to firms in the early stage of development where the risk profile is too high to attract private capital; and *equity guarantee programs* (a few Governments only). That report also states that ‘critiques argue that Government policies ...displace or retard the development of private sector venture capital’. However it also argues that past experience showed that governments could play a useful venture capital role if such schemes are properly conceived and designed. Other OECD reports emphasize the role of governments in promoting or building *business angel networks*, with the UK having the most developed schemes in this regard<sup>16</sup>; *creation of an European IPO market; funding of pre-finance appraisals and evaluations* as a means of reducing transactions costs; and *stimulating dynamic entrepreneurship* (OECD 1996).

#### Comment

Our short review of VC policies in OECD countries shows that VC directed policies largely seem to have been based on VC as a ‘pool of money’ rather than an ‘industry’ view; on static rather than evolutionary or **Systems- Evolutionary (S/E)** analysis; and on a non precise definition of what VC is and is not<sup>17</sup>.

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15 An OECD report stated that a number of countries have introduced tax incentives to encourage private individuals to invest in unquoted companies i.e. the UK introduced the *Business Expansion Scheme* in 1983 and replaced it by 3 new schemes: the *Enterprise Initiative Scheme*; *Capital Gains Tax-Re-investment Relief*; and *VC Trusts*. Similar schemes were implemented in Canada and in Sweden. It was stated that some of these schemes were successful in raising substantial amounts of finance (OECD 1996, p.11).

16 For a VC review of the UK see OECD 2003. Similar reviews were done for Canada, Israel and Korea.

17 In Sweden and the Netherlands the implementation of VC policies oriented to early stage finance of SU was accompanied by a gradual shift of the focus to later stage finance (personal communication). These changes have significant implications for the nature of the industry and for its role in hi-tech growth.

### **3.3 Gilson work on Engineering a VC Market**

According to Gilson (2003) the central lesson from the successful US experience in generating a VC market is “the extremely effective *contracting structure* that covers the entire VC cycle starting with the initial VC fund, its investments in portfolio companies, the latter’s exit and VC’s cash and non-cash recycling”. Gilson asks whether this model could be replicated elsewhere and if so who, and in particular whether the Government, could engineer the process of creating a VC market. His analysis assumes that the foundational structure of capital markets (e.g. honest investment banks, effective auditing structures, transparency of information flows, etc) already exists.

According to Gilson, creation of a VC market is a difficult coordination problem, which he terms *simultaneity*. Three factors are required: entrepreneurs/SU companies, existing or to be created; investors with funds who are also willing to invest in high risk/high return investments; and a specialized intermediary (the VC management company or fund) to serve as a *nexus of sophisticated contracts*. His analysis also assumes that given two of these conditions, the third will follow endogenously. Once the Government undertakes these two functions they will endogenously induce high tech entrepreneurship and the founding of the required numbers of SU companies. Gilson’s template for engineering a VC market is shown in the Box below.

#### **Box 9: Gilson’s Template for Engineering A VC Market**

- *The Government should issue a request for proposals for privately managed VC funds*
- *The Government should then select a subset which are run by competing & competent professionals*
- *The organization and structure of the VC funds and the VC-SU contracts should broadly track the US pattern- e.g. a fixed term for the new intermediaries which could induce the recycling after a few years both of the cash and non-cash contributions of VC companies towards a new set of young and inexperienced entrepreneurs/SU.*
- *Initially at least and to compensate for the lack of a ‘reputation market’ fund owners/managers should make significant investments in their funds much beyond the 1% share of VC capital which is common in the US and like Chile’s CORFO program which invests 15%<sup>18</sup>*
- *Government should be a passive investor in these financial intermediaries*

The above conditions would assure that there are strong incentives to the Government sponsored VC companies to succeed: to seek out promising entrepreneurs; and to monitor and provide added value or non-cash resources. He partially dismisses the arguments that lack of entrepreneurial culture could block creation of an entrepreneurial

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<sup>18</sup> This is supposed to create a better alignment of VC fund managers' incentives with those of investors.

or SU sector. This would stand in stark contrast to the negative experience of Germany's failed WFG program which was implemented during the 1970s and 1980s (Becker and Hellmann, 2003; Fiedler and Hellmann, 2001, pp. 4-5; and Gilson 2003, pp32-5).

Gilson does recognize that his template for engineering a VC market is based on the assumption that the supply of entrepreneurs is responsive to venture funding and to the appropriate financial institutions (one interpretation of the German failure according to the Becker & Hellmann and Fiedler & Hellmann papers). However, he assumes that the first successes with VC would endogenously attract or 'reveal' new entrepreneurs<sup>19</sup>.

### **3.4 Other VC Policy Proposals**

In recent years there has been a renewed research interest on policies to promote VC-both econometric works attempting to identify policies which have succeeded in generating 'active VC markets' (Da Rin et al., 2004) and policy implications from 'positive' research on VC e.g. the work of Bottazzi et al., (2003) which analyzes the results of the Survey of European VC. We will briefly review the first and link it to the ITP conceptual framework of this paper.

#### *Promoting active VC markets*

One motivation of Da Rin and collaborators is the attempt of many countries to emulate the experience of the US (and to some extent of Israel) in developing an early phase, high tech oriented VC industry. On the basis of a very simple formal model which they extend, they focus on two groups of 'independent' variables: variables directly affecting the profitability of VC investors ('incentives') and the 'absolute flows of VC'. The former which show a positive effect on 'active' VC markets includes three variables: creation of domestic stock markets for technology companies; reductions in capital gains taxation; and reductions in 'barriers to entrepreneurship' e.g. de-regulation of labor markets. The 'absolute flow of VC' on the other hand is shown not to have any effect. The dependent variables used to represent the extent of 'active' VC markets are two ratios: the ratio of early phase to total VC funds of a particular year; and the ratio of high tech investments to total VC funds.

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19 Gilson is aware of the complexity of contexts so that 'different countries may respond quite differently to the same engineering efforts'. But no effort is made to further his analysis in this direction. We will further comment on Gilson's analysis and conclusions in the conclusions of this paper.



Their conclusion is that an active VC market will strongly respond to ‘incentives’ but will not respond to attempts by Governments to directly affect the flow of funds directed to venture investments. This conclusion squares with past failures of Government owned VC funds to promote active capital markets, and to the accepted view reported in OECD documents that such funding would ‘crowd out’ the flow of privately owned funds to VC markets.

Our comments have two parts: a general part (to be specified here) and some specific criticisms to be mentioned in the next section.

### *General Comments*

We have essentially three: the use of independent variables which are ratios is problematic (this is partly recognized by the authors) from the point of view of our perspective of VC as an industry which evolves since the process of VC emergence involves strong cumulative effects associated with dynamic economies of scale and positive feedback. Thus an increase in the *absolute* amount of VC i.e. a positive push towards VC emergence could accompany a decline in the ratios estimated rather than to an increase.

A second comment is that the analysis is not based on a Systems-Evolutionary perspective, which means that there is no focus on the emergence or non-emergence of the industry and no organic link among policies implemented at different points in time. Thus Government grants to R&D, while having little effect on the authors’ ratios, may have a significant effect on the long-run possibilities of developing a VC industry (e.g. through enhancing the rate of SU foundations and thereby the demand for VC). This effect would not be captured in the regressions. Furthermore any success in Government actions to promote VC will depend strongly on the right timing and the right context, factors which are reflected neither in the variables nor in the information used in the analysis

The final but no less important comment is that including Israel in the sample of countries might have affected the estimated impact (and possibly the direction of impact) of a Government venture contribution to the creation of active VC markets. Like the European countries in the sample used, Israel is a ‘follower’ country as far as VC is concerned. It is also a country where successful VC emergence was *policy led* and

where, like with many other European countries, the Government made a direct venture contribution (albeit a highly original one) to the new industry. This raises the possibility that success will not depend only on whether or not a Government venture contribution exists or does not exist. Rather it will depend on the specifics of that venture contribution e.g. a Fund of Fund function which seeds private, highly capable domestic VC management teams versus a Government owned VC Company.

#### **4. THE IMPACT OF YOZMA ON VC EMERGENCE: A Qualitative Analysis**

##### **4.1 VC Emergence Requirements & System Failures**

In previous microeconomic work of ours (A&T 2004c) it was suggested that VC emergence required

- *Accessing sophisticated and reputable foreign partners and investors which was difficult due to the inherent lack of market tested reputation at the level of the VC & high tech industry as a whole*
- *A complex multi-component coordination process linking the above mentioned foreign agents with highly skilled domestic VC entrants and with financial resources.*
- *Assuring the minimum required level or critical mass for each one of the above resources.*
- *Assuring that the Yozma funds adopt a clear early phase, high tech (ICT) SU investment strategy<sup>20</sup>; and accelerating selection of the LP form of VC organization*
- *Assuring that a cumulative process with positive feedback be initiated and completed within a short period of time. This implies among other things effective exploitation of increasing returns to scale (e.g. in the supply of inputs) & of dynamic economies (including learning)*
- *Country/Government signaling concerning the excellent opportunities in the country and the resolve of Government to overcome all obstacles to VC emergence & High Tech Development. This substituted for lack of VC industry reputation which, absent sophisticated Government support, would be acquired only after completion or during VC emergence rather than at the beginning of such a process*

In our opinion most of the above constraints or obstacles were *specific causes* of the **System Failure (SF)** blocking VC emergence i.e. they explain why unaided market

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20 The experience in implementing VC policies in non US OECD countries showed that what was originally intended to be promotion of VC according to a strict definition of the industry could very easily 'drift' or metamorphose into Private Equity. See M. Brown 2002 for the UK case. This seemed also to be the case of Germany and the experience of Sweden during the second half of the 1990s. The experience coincides with the view of Nelson 2002 on the relative difficulty of 'diffusing' social technologies.

forces would not by themselves overcome these failures<sup>21</sup>. There is also sufficient evidence to support our view that the design and mode of implementation of Yozma succeeded in overcoming each one of the above specific SF causes (see below). Therefore *Yozma assured the onset of a successful cumulative process and a strong economic impact despite the short window of opportunity resulting from the regular cycle of the global VC industry.*

#### *How Specific VC industry Characteristics reinforced the System Failure*

In our opinion ‘accessing intelligent & reputable foreign partners’, multicomponent ‘coordination’, ‘attaining critical mass’, ‘strengthening collective learning’ & ‘country/industry signaling’ (the substitute for lack of VC reputation) could not have been fulfilled by un-aided market forces. This is even more so once we recognize the relatively narrow window of opportunity for high tech transformation i.e. both VC emergence and a significant economic impact could not have taken place prior to the ‘next’ downturn in the global VC industry without the ‘trigger’ and ‘acceleration’ induced by Yozma. It meant that even if un-aided market forces could have led to VC emergence by themselves it would have been a much slower process (with the risk of not attaining sustainability during the available window of opportunity) and one which a much lower economic impact<sup>22</sup>.

There are additional *idiosyncratic aspects* of the VC industry that reinforce this view. One could say that once ‘basic’ capabilities & other factors were in place the critical input for VC industry emergence was availability of capital and accessing reputable & experienced financial institutions & strategic partners from abroad. Absent a strong reputation of the VC industry the probability of prompt and extensive partnering with such sophisticated foreign agents must have been low. Our interviews showed that *the fact that, through Yozma, the Government of Israel was willing to invest directly and indirectly in SU<sup>23</sup> was an important profitability confidence signal to such investors<sup>24</sup>.*

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<sup>21</sup> Ascertaining that these were *system* rather than *market* failures also meant that simply providing incentives would not assure the overcoming of such failures (see A&T 2004c).

<sup>22</sup> The likelihood that this would be so held despite the fact that market forces were Class A (see 4.3 and A&T 2004c)

<sup>23</sup> Directly since a portion of the Yozma Program budget (20M\$) was earmarked for direct investment in SU - Yozma Fund; and also since the Regular R&D subsidies by the OCS were increased during 93-00.

No less important was the fact that *a seemingly necessary condition for the first VC funds created under the auspices of Yozma to trigger entry of subsequent funds is that the former be highly profitable*<sup>25</sup>. Such a performance would generate what we termed *market-tested reputation*, which would considerably facilitate the raising of additional capital (& the participation of a wider set of foreign partners). Strong early profitability was due to very good exits (during 1996-7) from early investments; and this led immediately to Venture Capitalists worldwide and to business agents domestically to consider investing in Israeli VCs and to cooperate with them, hence the onset of cumulativeness<sup>26</sup>. The Israeli experience shows that, once several Yozma funds had such high returns early, *the individual reputation effects spilled over to the VC industry/high tech cluster as a whole (or coalesced into a strong reputation for the industry as a whole)*; and that this led not only to expansion (i.e. follow up funds) of existing VCs but also to entry of new VCs.

By the same token, early funds and early investments, which are not *highly profitable*, risk truncating the subsequent process of VC industry emergence<sup>27</sup>. Avnimelech 2004 takes the "Reputation leads to Capital leads to Added Value" argument further and argues that, through a path dependent process, initial success/reputation may attract high quality investors and deal flow and therefore increase success and strengthen reputation. This in turn will trigger a new reputation-capabilities cycle and through this generate a national, sustainable competitive advantage in the VC industry.

#### **4.2 How Yozma overcame the Specific Causes of System Failure**

We argued that System Failures blocked the purely endogenous attainment of Israel's Innovation and Technology Policy Strategic Priorities of the early 1990s-creation

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<sup>24</sup> Lerner (1999) in his study of the US SBIR program (which supported 'early' R&D of SMEs operating in areas of interest to the Federal Government) found a similar phenomenon that operated at the level of individual companies—the 'certification effect'. SU backed by this program had superior performance mostly due to a signaling effect. Beyond signalling, Yozma's Fund of Fund activity had another very important effect since investors/limited partners were granted the option of buying Government's share at (approximately) cost. This represented a strong incentive to the 'upside'.

<sup>25</sup> Yozma's upside incentives created strong incentives to VCs to select and groom very good SU over and beyond what the market or an outright subsidy (or Government Guarantee) would provide.

<sup>26</sup> This effect has been analyzed by Gompers (1995) who focuses on how early 'exit' successes of young, unknown VCs enhanced the flow of capital to follow up funds of these organizations. In Israel the contribution of this effect to cumulativeness and VC emergence in Israel was *also* due to the effect of such reputation in bringing a wider set of world-class foreign investors as Limited Partners in existing VC.

<sup>27</sup> A weak Reputation effect could lock –in VC into a low-level *non-Emergence* trap

of a domestic VC industry and market. Here we will show why and how Yozma overcame these failures thus paving the way to the new high tech cluster. Our argument is summarized below. The headings in bold refer to the *specific cause of System Failure (SFi)*. This is followed by an explanation of how Yozma overcame each one of them. Note that the impact of the program was not only a result of its ‘design’ but also a result of the principles guiding its implementation. Moreover, the policy process that preceded Yozma’s design also influenced its subsequent impact, and not only through the design of this program.

***SF1: Difficulties in accessing intelligent & reputable foreign partners***

Active search and interaction with highly qualified and reputable foreign VCs  
Sharing risk with private investors (government share in Yozma funds was 40%)  
Upside incentive to private investors in Yozma funds—mostly attractive for highly skilled professional managers/owners and investors/partners

***SF2: Assembling a Critical Mass of Capabilities***

Required participation of foreign VC companies and investors in each Yozma funds (as limited partners).  
Required participation of capable local agents (individual and institutions) as general and limited partners.  
Having S&T background and experience in High Tech were important although not the only criteria used  
Selection of Yozma VC management company candidates according to their background and potential

***SF3: Critical Mass of Financial Resources***

Direct government VC investment through Yozma Venture Fund (\$20M).  
Government Fund of Fund investment (\$80M) in 10 hybrids, privately owned VC management companies.  
It leveraged an additional 150 M\$ of private funds (foreign and local).  
The total of \$250M was sufficient to trigger a cumulative emergence process

***SF4: Coordination among Agents and between Agents and Financial Capital***

Prior to policy implementation an intensive process of interaction took place between Government officials, agents from Israel’s high tech & financial sectors; and individuals & organizations from abroad.

***SF5: Coordination with other Policies***

Parallel implementation of complementary *ITPs* (expansion of R&D grants program, MAGNET program & Technological Incubator program)

***SF6: Investment Coordination in early operation of Yozma Funds***

Participation of OCS representative in the board of all Yozma funds.

***SF7: Selection of VC strategies consistent with strict definition of VC***

This was a requirement for Yozma Fund status (also the adoption of a LP form of organization)  
Yozma/Government representation on Yozma Fund boards monitored implementation of this requirement

***SF8: Assurance of Fast Learning***

Required participation of professional foreign VC companies and investors in Yozma Funds (as limited partners) and of capable local agents (individual and institutions) as general and limited partners

New or indirect learning mechanisms: the requirement that Yozma funds involve a formal VC company relatively focused according to stages and areas of investment; and through OCS participation in the boards of Yozma funds.

***SF9: Country/Government Signalling***

The \$100M venture investment contribution of the Israeli Government, the extensive interaction process; and the implementation of complementary ITPs-- sent a strong signal to foreign partners and investors both about the distinctiveness or even uniqueness of Israel's VC/high tech potential and about the government commitment to these areas.

***SF10: Selection of VC Characteristics***

Selection was enhanced by the above mentioned interaction process and by OCS-led coordination among agents both prior and during Yozma program implementation. Frequently once OCS identified a desirable sub-group of activities, structure, etc, they became a requirement for Yozma candidates to follow.

From the above it is clear that in order to overcome System Failures Israeli Policy makers in the early 1990s had to deal simultaneously with: achieving fast a critical mass of highly qualified domestic VC managers that would be willing to enter the industry; idem with respect to world class foreign players who would be willing to partner with the Israeli ones; the effective coordination between these two resources; signaling that Israel was serious about developing its VC and high tech industries; and promoting collective learning in the new industry/market. This is a tall order; and it illustrates the complexity of 'targeting' in this era of globalization.

The mechanism of selection of teams seems to have been sequential. At some point a reputable local VC management team submitted a request for 'Yozma VC Fund' status. The Yozma Program would then check whether or not the following three conditions held: existence of a reputable foreign investor like Advent, in the case of the first fund (Gemini); of a reputable domestic investor; and having raised at least 12 M\$. There were cases of rejected proposals which did not fulfill the requirements. The 'initiative' could come from the reputable foreign partner who had already made a decision to invest in Israel (e.g. the case of Advent Private Equity); or from the domestic VC management team. In either case the Yozma Program helped identify suitable partners and or/VC management teams, depending on the case<sup>28</sup>.

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<sup>28</sup> Thanks to Gilles Durufly for his questioning of this aspect of Yozma's implementation. It contributed to clarify parts of the policy process.

### **4.3 Role of Class A Market Forces**

The success of Yozma in creating a new VC industry was also depended on the strength or quality of the market forces operating in the area prior to implementation of the program or who entered the industry shortly after its implementation i.e. during pre- or early emergence. This can only be ascertained by looking at microeconomic data and by building indices of private performance and social impact of such ‘early entrants’.

This was done for 20 leading VC companies (see A&T 2004c). We found out that the above mentioned *early entrants* possessed strong capabilities, were eventually highly profitable (*high VC private performance*) and had a significant indirect impact on the subsequent growth and development both of VC and of the high tech cluster as a whole (*high VC social impact*). This condition has been termed *Class A market conditions/ forces* (or simply Class A)<sup>29</sup>. Prevalence of such conditions explains both the extremely *rapid* process of growth during VC emergence and the high impact of the targeted policy implemented for this purpose.

The fact that *early entrants* not only generated, on average, strong ‘social impacts’ (in the sense of strong indirect contributions to SU and other VCs) but were also highly profitable (Class A) explains why they expanded and why they also paved the way for ‘later’ VC entrants and for more and better SU. One important mechanism in this process involved the reputations created by individual VCs e. g. from a successful exit which later permeated the high tech and VC industries as a whole. This enhanced the flow of foreign investors and indirectly new entrants to the industry. The outcome was an increasingly synchronized and mutually reinforcing VC-SU co-evolutionary process (A&T 2004a; 2005b) accompanied by high rates of growth both of the VC industry and of the SU segment of High Tech.

## **5. ISSUES ARISING FROM AND IMPLICATIONS OF THE ANALYSIS**

### **5.1 Complexity of VC Policy and Importance of Adopting a Systems-Evolutionary Perspective**

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>30</sup>.

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<sup>29</sup> The social impact indices used were aimed at the externalities generated by VCs rather than on total social profitability.

<sup>30</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)

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 though necessary may not be 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.

Right timing was important due to both the internal and external environments of the country. The earlier the timing of the targeted policy the greater the risk that domestic demand (for the services of the future VC industry) would not have had enough time to build up to the level which, in conjunction with the policy-induced increases in ‘supply’, would trigger a cumulative process of VC emergence. On the other hand, the shorter the period between the initiation of such a process and the next downturn of the world VC industry (i.e. the later the targeted policy), the shorter the remaining time period available for industry emergence and for a significant high tech impact to materialize.

### **5.2 Critique of Gilson’s Analysis and Other Policy Proposals**

The theoretical framework proposed by Gilson and associates which emphasizes the organizational, governance and contractual structure of the privately owned/managed VCs sponsored by Government programs is indeed a very useful and revealing one. It has been applied to the German case, a fact that has added important insights about the ‘background and pre-conditions’ required for emergence of a VC industry.

Our S/E perspective and our analysis of the VC Industry Life Cycle also suggest that an appropriate VC policy should recognize the potential importance both of simultaneity of actions/ states and their sequencing. Gilson’s view is that once there are investors and intermediaries (VC) then the remaining factor-entrepreneurs-will emerge endogenously. Our view, in contrast, is that a critical mass of SU should exist prior to targeting VC i.e. *sequencing rather than simultaneity*; otherwise the new industry will not take off. This view is supported both by Israel’s successful Yozma program and by



the failure of VC policies of many other countries e.g. Chile's CORFO program which was predicted to succeed but which failed (due to lack of deal flow).

The analysis of Yozma also suggests that the DaRin et al 2004 analysis of policy measures for creating active VC markets (see 3.4 above) underemphasize the potential role to be played by a Government venture contribution to the industry. First, such a contribution would help achieve the 'critical mass' of financial resources required for triggering a cumulative, self-sustained process of VC emergence—although here the emphasis must shift from a Government VC fund to the seeding of new, privately owned and managed VC companies. Second, through the incentives to the upside that it could facilitate, it would better be able to attract world class foreign investors to partner with the early entrants to the new industry. In this way true complementarity between private and public funding may be achieved.

Our analysis also provides insights to their conclusion that 'there was no shortage of VC funds' during the period studied. An alternative explanation to theirs could be absence of large numbers of high quality SU! This SU shortage could be the main obstacle to the development of a VC market in Europe (in our terminology it would manifest unfavorable background and pre-emergence conditions). Moreover, given a clear strategic priority in favor of VC (and SU) the shortage of SU would reflect a System Failure. Our tentative concluding hypothesis concerning ITP is the need to stimulate SU, both through incentives (like Horizontal support of BS R&D, incubators, etc). Israel's experience with horizontal support of BS R&D—a prime mechanism for developing innovation capabilities and technological entrepreneurship, received scant attention from the authors (as well as from other researchers). We are in the opinion that any systematic effort to identify policies in support of SU and VC should seriously consider this option<sup>31</sup>.

### **5.3 Creating Policy Capabilities**

Policy capabilities for VC targeting in Israel were generated by a) experienced-based policy capabilities which arose from a virtuous Business (mostly High Tech) –

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<sup>31</sup> We mentioned that Grant support to BS R&D was the 'backbone' policy implemented in Phase 1 of Israel's ITP cycle (see 2.3 above).

ITP co-evolutionary process spanning three decades; and b) a pro-active ‘problem solving policy process’ led by the OCS and, more specifically, by the future manager of the Yozma program. Given the Israeli context at the time, b) provided the additional (not experienced-based) inputs required to effectively target the new industry.

*Operational Policy Level: Virtuous High Tech- ITP 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 canceling the constraint to growth represented by the original SF. It also requires that the new, restructured & more sophisticated business or 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 an effective co-evolutionary process may require a specialized policy institution in charge of national ITP (like Israel’s OCS); strong accumulation of ‘policy capabilities’ through time; and a political process such that the aforementioned agency not be captured by private interests and lobbies<sup>32</sup>.

In Israel ITP-high tech co-evolution started during the background conditions' phase and continued during the pre-emergence, and emergence phases. More importantly, *it explains why the SF which triggered Yozma was identified and why such an acceptable policy response was 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 1960s; and *SF1\** -- absence of links/alliances with foreign companies (a mechanism to penetrate global technology markets--mostly in the US- through R&D leverage). Each led to a distinct Innovation & Technology Policy (ITP) response during this phase: ITP1- creation of the OCS & implementation of the

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32 The possibility of ‘regulatory capture’ has been raised in the literature e.g. by Lerner 1999

'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>33</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; a business model for international expansion based on forging links through the leverage of R&D, the startup model of R&D projects & industrial innovation; enhanced links and alliances with US firms, some global marketing capabilities, etc.

RBS1 and other changes in the environment-including the globalization of capital markets for technology firms (external) and significant structural change domestically (e.g. restructuring of Defense industries, see A&T 2004a)- 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. They were supported by three new programs (Technological Incubators & Magnet on the one hand, and Inbal on the other) and from and by an increase in the OCS regular R&D grants fund (ITP2). ITP2 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 outcome was new market tested information about desired high tech structure; a growing SU segment; and information about the aims of an ITP directed to exploit the new opportunities. SF3 which stood in the way of materializing this potential included weak management capabilities and weak 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

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33 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. For details of policies that preceded Yoznma see A&T 2004a,d.

Limited Partnerships and linked to reputable, world wide financial institutions and strategic partners<sup>34</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).

#### *Strategic ITP: A Pro-Active Problem Solving Policy Process*

Yozma represented a new type of ITP program: a targeted program directed to a new economic sector of strategic importance for high tech under the new international and domestic conditions. It contrasts with the horizontal BS R&D program implemented up to then. Moreover it probably was Israel's first incursion into Civilian ITP strategic policy making after the creation of the OCS in the late 1960s.

There were two main alternatives for effectively underpinning this shift to a targeted program and to strategic policy making: *Problem Solving & Pro-active building of 'strategic' ITP capabilities* (and their utilization). Both are oriented to acquire the additional, non-operational inputs for effective targeting. The policy process leading to the Yozma Program- described in 3.1 and 3.2 above (including the Inbal program)- was the outcome of what was essentially a 'problem solving approach'. Pro-active building of *strategic ITP capabilities* was not the Israeli model at the time. One implication is that no mechanism involving new organizational routines and specialized resources manning the strategic level of policy was set up at the time<sup>35</sup>.

#### **5.4 A Policy-Market Forces Paradox?**

A major conclusion which also follows from prior research is that *at least within a certain range of domestic capabilities, Class A conditions could enhance both the justification for a targeted VC emergence policy and the probability that such a policy will be successful*. Still Class A conditions by themselves need not be sufficient for triggering a successful process of VC emergence. For example the existing subset of Class A market forces might not assure that VC/high tech reputation will spread to the

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<sup>34</sup> The Inbal program had sharpened policy makers' view that LP was the right form of VC companies.

<sup>35</sup> This distinguishes Israel's approach to targeting to that of Korea and Finland, see A&T 2004e.

industry and country levels despite their linking to reputable and networked foreign partners. This because the ‘momentum’ engendered would probably not be enough to trigger an autocatalytic process of cumulative, self-sustained growth which could have an economic impact within a short period of time.

Such *System Failures* could arise from a number of sources: slow rate of entry of highly skilled and experienced domestic VC entrepreneurs; ‘failure’ (due to country reputation problems) of existing market forces to partner with a sufficiently large number of world class foreign agents within a short period of time; and weak and slow exploitation of static & dynamic economies.

It follows that *Class A* conditions may still justify a targeted policy directed to VC emergence. Moreover, within a certain range, an increase in the sophistication of local VC capabilities could, by reducing the ‘gaps’ in foreign resources required for triggering VC emergence, enhance the justification for implementing a targeted policy (it would also increase the probability of success). However, beyond a certain level of domestic capabilities policy would not be justified since VC emergence would occur without Government intervention. Similarly when conditions are *not Class A* policy may not be justified since even the best policy design might not trigger VC emergence<sup>36</sup>.

The above is the so-called Policy-Market forces Paradox which emerges from our S/E perspective and from the mix between microeconomic and industry level data. Rather than substituting for policy & within a range of capabilities, the stronger & more capable market forces the greater the justification for new policies to help materialize their industry-generating potential. The paradox is more apparent than real once ‘capabilities’ of the new industry & cumulative processes of VC emergence are visualized as central component of the phenomenon which policy is supposed to influence.

## **6. A CRITIQUE OF ACCEPTED VIEWS OF CLUSTER POLICIES**

Our analysis of VC and of VC policy is intimately related to the emergence in Israel of a new high tech cluster (the Silicon Valley model) or, alternatively, to the re-configuration of the old, military R&D dominated high tech cluster based on the Electronics industry. More specifically it suggests that Yozma triggered VC emergence

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36 Formal modeling is required to make these points more precise.

which was the main vector in the above high tech cluster re-configuration. This means that our analysis of Yozma goes far beyond the VC policy area in the direction of an analysis of policies for the creation or re-configuration of high tech clusters.

The BGS (Bresnahan et al., 2001) article summarizes the result of a comparative study of the dynamics of high tech cluster in several countries (including the ‘early’ phase of Silicon Valley, Ireland, Israel, India and Cambridge, England). In analyzing the forces at work, the authors make a distinction between old economy forces (entrepreneurship, risk taking, investment) and new economy ones, the latter being the exploitation of dynamic increasing returns to scale resulting from external economies and positive feedback i.e. cumulative processes of growth. Their central argument is that old economy forces rather than cumulative forces were operating prior to the establishment of new high tech clusters; while new economy forces –after. On the normative side, the authors seem to hold the view that targeting is not desirable and cluster creation policies generally not possible.

### General Comments

Our main criticisms of the article (and associated book) starts with the fact that Israel’s 1990s high tech cluster was not a Nascent Cluster but one that emerged and got established during that decade. More generally (i) their classification of clusters into nascent and established ignores the *process of cluster creation/emergence*; (ii) while the direct and indirect external effects and associated cumulative processes are very important in established clusters they are also important during the preceding *process of Cluster Emergence* (moreover they also engulf ‘old economy’ forces such as entrepreneurship, investment and risk taking); and (iii) the policy implications from their analysis, while valuable, are incomplete and/or not inevitable; and, in some instances, possibly incorrect.

### The Approach to Cluster Dynamics

The above seem to result from adoption by the authors of a rather *restricted* dynamic framework of analysis which emphasizes two extreme states (*nascent* and *established clusters*) without a systematic analysis of Phases and, particularly, of Phase transitions. Moreover, when identifying the common factors characterizing successful

clusters (their sample does not, and cannot structurally, include ‘failed’ clusters) they adopt what could be considered *a list of critical factors* associated with success. While this approach is useful as a first approximation to the problem it falls short of being a fully dynamic analysis of ‘cluster emergence’ (see e.g. Breschi and Malerba, 2001). Finally their two states characterization of clusters may have *forced* the authors to adopt a dichotomy of effects namely-scant cumulative processes during the nascent cluster state; and strong such effects in the established cluster state.

The alternative approach represented by this paper is to consider explicitly processes over time and phases in the evolution of high tech clusters or of central cluster components such as VC. In our analysis of the Israeli case the focus is on cumulative emergence processes taking place during the phase in which a VC industry and a high tech cluster *eventually* developed. This approach naturally leads us to study the factors or developments which spark cumulateness and to characterize such a process. This takes place during the pre-emergence phase (1985-92) and it includes a number of critical sub-processes including eventual ‘selection’ or ‘identification of focal points’ of the central, distinctive components of the future high tech cluster: VC firms and SU companies. Thus, through the activity of numerous market agents who undertook trial and error activities with respect to organization of VC and SU companies; and through Government policy experimentation and ‘learning’ -a consensus was arrived at as to the desirable characteristics of such companies: born global SU which also focus on global capital and on global product markets; and LP VCs oriented to early phase finance and support of high tech SU (with an additional focus on Software and Communications related equipment/software). An additional factor was generation of a ‘critical mass’ of activity in the SU field prior to development of the VC industry. Concerning the nature of the above mentioned cumulative process our ongoing work records a gradual accretion of new dynamic sub-processes which feed on and reinforces emergence.

The above cumulative processes with positive feedback were sparked and started to operate a few years *prior* to the *establishment* of the new VC industry and high tech cluster. They then continued till the end of the 1990s. Under our own approach there is less need to define precisely when a VC industry got established or when the new high tech cluster was constituted. It is enough to be able to ascertain empirically that- given

the scope and structure of activity; the variety of agents active in the field and other factors-that the industry/cluster got (or did not get) established sometime during the period when the emergence process was in operation. Still if we would want to define when a high tech cluster got established we would like to add to Porter's definition "a collection of interconnected firms belonging to a certain area" both a *critical mass condition* and the post establishment '*cumulative growth condition*' which emerges from our and BGS's analyses<sup>37</sup>.

A phased approach to the study of VC and high tech clusters will also clarify not only under what conditions could a VC industry emerge but also the role it could play in the creation or reconfiguration of a high tech cluster. While the authors correctly point out that appearance of VC requires a measure of prior entrepreneurship and cluster activity is correct, their analysis is incomplete<sup>38</sup>. In this regard little has yet been said in the literature- the exceptions are Braczyk et al., (1998) and ATK (2005). They and past and ongoing research of ours (A&T 2005b) strongly suggests that VC emergence processes could be central to the creation/reconfiguration of high tech clusters. Needless to say more research is needed in this area.

### BGS's Policy Conclusions

The authors focus on the forces inducing the creation of high tech, entrepreneurial growth and on the perspectives underlying these forces. They refer to comparative advantage theory (largely associated with Old Economy variables) and to 'new economic theories of *social* increasing returns to scale' (New Economy variables). Their conclusion is that both perspectives are required. "Much of the opportunity for new regions arises because old regions find themselves running up a steeply rising supply curve of land and

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<sup>37</sup> In fact we would have two critical masses: one to spark the cumulative process leading to VC/cluster emergence; and a much larger one-that which would be a defining characteristic of a VC industry/new high tech cluster.

<sup>38</sup> As mentioned above and in previous work of ours prior demand, the effective coordination of capable agents both domestic and foreign, and achievement of critical mass could be critical (as they were in Israel's case). Moreover a high impact VC emergence process requires a cumulative process of growth with strong momentum which could lead to a sustainable industry prior to the next crisis in the global VC market. Thus adequate timing of the process and an adequate context may be crucial. It is thus clear that the theoretical framework required for analyzing the emergence of VC is quite distanced from the well understood Marshallian Specialized Supplier case suggested by the authors (footnote 6, p.840).



of highly skilled labor”- a classical diminishing returns phenomenon. This is the opportunity, the materialization of which requires that regions wanting to develop high tech clusters “invest in education, have open market institutions, tolerate and even encourage multinationals, tolerate and even encourage brain drain”. On the other hand, *once clusters are founded*, “the mechanism by which entrepreneurial-led growth takes off and becomes a contributor to regional and even national development is one with a strongly increasing returns flavor”. Still the authors emphasize that the big issue is ‘*how to start a cluster*’ and this requires a strong basis in Old Economy variables.

The specific policy conclusions of BGS are:

- 1) *There is no basis for supporting protectionist, infant industry, national champion or directive industrial policy programs.*
- 2) *Efforts to jump-start clusters or to make top-down or directive efforts to stimulate entrepreneurship will fail*<sup>39</sup>.
- 3) *In contrast, accommodative government policies can be an important part of cluster development*<sup>40</sup>.

#### Specific Comments

Our main critique of BGS’s policy analysis is based on our view already mentioned above that the cumulative processes and ‘social increasing returns to scale’ characterizing high tech cluster emergence take place both prior to and after the establishment of a new cluster. Moreover they might be strongly linked to the emergence of a VC industry. Also Israel’s case strongly suggests that *once sufficient background and pre-emergence (or in BGS’s terminology, nascent cluster) conditions have been generated- targeting may contribute to the triggering or sparking of such a cumulative process*. By that time a lot of information about the potentiality of such a cluster and/or VC industry might have been accumulated. Alternatively, targeting a VC industry or high tech cluster would not possible nor desirable in the earlier, ‘background conditions

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<sup>39</sup> BGS refer to Wallstein et al., 2001 which analyzes the impact of the US’s SBIR program. He analysis does not empirically find any effect of a public-sponsored program as important as the SBIR program in the US on high tech employment in US counties (BGS p. 857).

<sup>40</sup> "Apart from public investments in areas like education, government played an important supporting (though not leading) role in making entrepreneurship easier in many of our regions, notably in Ireland, Taiwan, Virginia and Israel"

phase'-a fact that corresponds to BGS's view about the (greater) difficulty of how 'how to start a cluster' (which should be understood as policies for the 'nascent cluster phase').

To further structure our comments we make use of the distinction between *Horizontal* and *Targeted Programs*. We mentioned that the former are entrepreneurially friendly programs supporting innovation or R&D in the business sector of a region or country without specifying a priori sector, technology or product class (Teubal 1996). They are *bottom up* programs in the sense that entrepreneurs have complete freedom to choose their projects provided they satisfy a check list of factors or set of general criteria<sup>41</sup>. Beyond achieving R&D/Innovation 'additionality'-Horizontal programs have three objectives: i) *generation and diffusion of R&D/Innovation Capabilities* throughout the Business Sector; ii) *promotion of Technological Entrepreneurship*; and iii) contribute to 'evolutionary variation' and-through experience with alternative innovative areas- to the identification and 'selection' of those with a potential for *Sustainable Competitive Advantage (SCA)*. These are all important Background Conditions for the emergence of high tech clusters.

In contrast to horizontal programs, *targeted programs* are focused on a particular sector or technology. They are difficult to identify and their design and implementation is complex. Moreover their impact may crucially depend on the region having accumulated favorable background conditions including a focused vision and strategy (which, like in Israel, a well designed and implemented Horizontal program could contribute to generate). *Thus targeting may be more appropriate during the cluster emergence phase rather than during the 'nascent cluster phase*. Israel's above-mentioned Business Sector Horizontal R&D support program started being implemented in 1969; while its successful targeting of VC (Yozma) came almost 25 years after. Our detailed analysis of that program strongly suggests that its success depended strongly on the consistent implementation of the R&D support program for more than two decades (A&T 2005a).

Successful targeting directed to cluster emergence also depends on the clear identification of strategic priorities, system failures and corrective policies and policy

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<sup>41</sup> For example that the projects submitted for support are 'bona fide' R&D projects which the firm, given its resources (both financial and human) and strategy, can and will (with the help of Government) undertake; that the market to which the R&D results or innovations resulting from the project has been identified, etc.

designs. Again, in Israel most of this occurred late in the ‘nascent cluster or VC background & pre-emergence phase’ when Venture Capital was identified as a strategic priority for that country’s economic development. The system failures that blocked the un-aided materialization of such a priority spurred an interactive ‘problem solving type’ policy process which led eventually to Yozma (and its unique design) which started being implemented in 1993<sup>42</sup>.

With the above in mind we now comment on 1) and 3) above (we fully agree on 2).

1’) *While picking winners in the sense discussed by Nelson (1984) and by BGS is undesirable this does not exclude other types of policy targeting* (even when recognizing the relative difficulty of this type of incentives program). Like with Israel’s Yozma program, *the targeting of Venture Capital or high tech clusters could be justified* as long as they be delayed till appropriate background and pre-emergence conditions (including a clear vision and strategy for the future cluster) have emerged<sup>43</sup>.

3’) *Horizontal (in contrast to Targeted) BS R&D/Innovation programs are a class of ‘accommodating’ (i.e. supporting but not leading) programs facilitating high tech entrepreneurship’ in ‘nascent’ clusters’*. This potentially highly effective policy has not been considered in BGS’s analysis<sup>44</sup>.

By supporting BS R&D such a program in Israel promoted the foundation and growth of new companies and directly and indirectly the subsequent establishment of SU companies with an orientation and strategy suitable to the ‘global’ conditions of the late 1980s and early 1990s. Co-evolving with this- new opportunities were generated for un-experienced albeit technically trained & skilled agents (e.g. Engineering School graduates) to acquire managerial and other non-technological capabilities.

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<sup>42</sup> It should be pointed out that Venture Capital is not a ‘regular’ industry; rather it is a privately-owned ‘infrastructure’ whose role is to finance and support the SU segment of high tech clusters (this was the reason why it was ‘strategic’ for Israel). Another successful case of high tech policy targeting was the policies leading to creation of Taiwan’s Hsinchu Technological Park near Taipei during the late seventies and eighties.

<sup>43</sup> That is once a ‘nascent *potential* cluster’ becomes a serious future cluster candidate.

<sup>44</sup> Not in relation to all US high tech clusters can the SBIR program be considered a ‘nascent cluster accommodating’ entrepreneurship-stimulating program since its implementation started in the 1980s. Moreover, it is not clear that it was a bottom-up horizontal program in the sense mentioned in the text. Therefore its weak measured effects (Lerner 1999) do not contradict our point of view about the potential role of horizontal programs in clusters (nor, BGS’s contention that top down, directed programs are not appropriate). Its low impact may have been due to the objectives of this program –promotion of SMEs through the promotion of R&D rather than Horizontal Program objectives i)-iii) mentioned above.

A final point concerns the link between the two comments mentioned above: There are unrecognized organic links between horizontal program supporting R&D and entrepreneurship in the 'nascent cluster phase' and targeted programs supporting cluster emergence (A&T 2005a). Some of these have been mentioned above; others have been mentioned in the bibliographical items quoted in this and in the previous paragraphs. This suggests that a major 'normative' issue in the analysis of emergence of high tech clusters is the ITP *Cycle Profile* (see 2.3 above).

## 7. CONCLUSIONS

### **7.1 The Importance of VC Emergence Policies and of Program Design**

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 or triggering VC emergence*. This would be a 'Strategic Priority' which substitutes for the more conventional 'additionality criterion' which permeates practical policy making thinking. Additionality should be such that a whole new industry (and/or market) is created. Moreover, Israel's VC experience and that of other countries suggest that this process might also have to take place within a short period of time<sup>45</sup>. Once this is accepted, *the major decision to be made in this phase is whether or not to implement a targeted VC policy*<sup>46</sup>.

ITP Program Design for VC Emergence should consider the crucial links between a) the structure of incentives and the extent by which a critical mass of capabilities is achieved; and b) Government's venture contribution and how this could influence both the structure of incentives and the mass of financial resources. The Israeli experience suggests that simple tax breaks to investors in SU (as has been common in Europe during the 1980s and 1990s) need not suffice. Rather, attracting world class players as limited partners would require strong incentives to the upside. This in turn requires a

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<sup>45</sup> Another criterion in use is achieving an adequate ROR to Government's investment in a policy program. Again, from a Systems-Evolutionary perspective, this need not always be adequate.

<sup>46</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).

‘Government venture capital contribution’ in order to seed private VC funds; and a ‘buy option’ to private investors (limited partners in LP VCs).

Alternatively and more extensively, 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 (see previous paragraph)<sup>47</sup>. 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 be offered and, at least up to a certain point, the greater the expected entry/participation of skilled agents in the new industry*<sup>48</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.

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47 Direct Government equity investments in VCs (fund of funds role) plus a ‘buy option’ 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.

48 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.

## **7.2 VC Policy Failures**

The Israeli case (which we know best) and to some extent the US (AKT 2005) and the Indian cases suggests a *set of possible Policy Failures (PFi)* in the implementation of VC policies as far as inducing a successful process of VC emergence is concerned. All of these may be present under a ‘VC as pool of money’ perspective and, due to the complexity of policy; some may also be present under the alternative ‘VC as an industry’ perspective. We now proceed to analyze each one of them.

### ***PF1 - Unfavorable Background Conditions Prevailed when VC policies were implemented***

We argued in past work that VC policy should not be 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<sup>49</sup>. Frequently PF1 involves a *timing problem* with respect to VC emergence. Thus 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 or other factors; Failure in these cases will not be due to inappropriate program design. Rather than VC-directed or VC-emergence policies other ITP must be implemented during this phase. Thus it is no surprise that the VC policies implemented by India in the late 80s & early 90s failed to create a VC industry<sup>50</sup>.

### ***PF2- Weak Demand for VC services prior to VC emergence***

This has been a major reason for VC policy failure, and it has gradually been recognized as such. For example, OECD reports have increasingly recognized that policies should not only consider the “supply side” e.g. tax concessions to investors but also the “demand side” for VC. There are two opposing views: one based on the assumption that VC policy can be successfully implemented *to create* an innovative, R&D performing business sector: and the view expressed by Gilson and his colleagues,

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<sup>49</sup> Under a strict definition of VC success requires a measure of pre-existent demand which can only flow from a critical mass of SU(see A&T2004a,c,f and PF2 below).

<sup>50</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. In this respect those policies may have made a contribution to the future emergence of India’s VC industry.

namely that ‘demand; for VC (i.e. entrepreneurship and SU) will emerge endogenously once a pool of money and suitable intermediaries are created by policy. The former is a naïve view frequently held by policy makers with a macro perspective in both advanced and industrializing economies(it has frequently been associated with a non-strict definition of VC and/or with a view that VC is a means to support SMEs or innovative SMEs). Gilson’s view, while focusing on a strict definition of VC, assumes an institutional context very close to that prevailing in the US. Moreover, it seems not to have been confirmed empirically<sup>51</sup>.

***PF3- Insufficient Business Experiments***

The Israeli experience suggests the importance of Business Experiments in connection with SU and VC (organization, strategy, routines, etc). 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 that the business environment will be appropriate or 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.

***PF4 - Insufficient Policy Experimentation and/or Policy Capabilities prior to the implementation of the VC 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

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<sup>51</sup> A related point concerns whether a domestic VC industry can initially base its activity on exports; and whether a domestic VC market can benefit from a global VC industry. The answer seems to be **no** (at least for the time being, see A&T 2004c).

requirements of a new, Silicon Valley model, of high tech. A major instance here is the Inbal program which facilitated selection of the LP form by Israeli policy makers. A second source of policy learning arose from the business experiments carried out during the pre-emergence period (which also helped identify highly skilled & experienced 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).

***PF5: Flawed targeted program design***<sup>52</sup>

There are many possible reasons a classical one being an almost exclusive focus on financial aspects and financial incentives for promoting VC. Israel's Yozma program strongly suggests that program design should link financial incentives with a (possible) venture contribution by the Government, with VC capabilities and associated critical mass and coordination problems; and with country signaling. The problem is not only avoiding a 'crowding out' of private VC but also the participation of or partnering with world class agents and companies in the global industry.(alternatively or 'intelligent', reputable and networked capital).

***PF6- 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 inter-agency distribution of responsibility and decision making; reshuffling of top personnel with loss of policy capabilities; or new strategic priorities.

In Israel, the Chief Scientist which headed the OCS during the previous eight 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 (including

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<sup>52</sup> see 2.4 and 3.2 above



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.

***PF7 – Narrow window of opportunity for VC emergence and impact***

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.

This cause of failure might have been relevant to the case of some advanced countries who implemented well designed and adequate VC policies in the mid or 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.

***PF8 - Inadequate post emergence restructuring process leading to non-consolidation of the VC industry***

In previous work we illustrated, based on Israel’s experience, the numerous frictions that could surround a 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 (A&T 2003b) including the social tension and signs of a ‘dual economy’ (Peres 2003) in Israel. An appropriate restructuring process under these circumstances would require changed behavior of individual agents; changed collective behavior by both VC and high tech; new patterns of interaction with the Government; and new policies. Even new National Priorities may be required both concerning ITP and spheres e.g. a peaceful resolution of the Israeli-Palestinian problem. In many contexts, the required post VC emergence follow-up and complementary activities will not be forthcoming.

### **7.3 Evolutionary Targeting for Industrializing Economies**

Given the trends in Globalization and associated opportunities and threats for developing new innovative industries (a global market on the one hand, global competition on the other) the conditions analyzed for effective targeting of VC Industries would seem to be of wider applicability. For example, the *speed of emergence* (and attaining rapidly a non-insignificant market share) could be a critical factor in the success of targeted policies directed to innovative infant industries, including high tech ones. Otherwise, new competitors might emerge which could considerably erode the benefits to be achieved domestically. *Strong participation of foreign players* in the infant industry may therefore be imperative in many cases e.g. to effectively and speedily access foreign markets; to engage in complex contracting (such as alliances) etc. Since speedy market coordination may be unrealistic Government should take an active role in *coordinating both domestic and sophisticated foreign agents*. Moreover, effective coordination in this sphere cannot be separated from the provision of adequate incentives to both domestic and foreign players. This means that both sophisticated incentives and other important features (policy selection, signaling, coordination, etc) must characterize targeted program design (Yozma's incentives to the 'upside' are also very suggestive about a possible means of attracting world class foreign players).

The last point concerns which industries to be targeted. This paper suggests that special thought should be given to those industries with Class A conditions i.e. where early entrants to the not-yet-established industry are either already profitable or have the capability to become so; and where they also have strong social impacts in the sense of paving the way for entry of other agents. Our analysis suggests that within a range a higher level of such capabilities may increase the justification and the impact of implementing a targeted infant industry policy. This means that effectively there would be no Market Forces-Policy Paradox,

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