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**ISRAEL'S INNOVATION AND TECHNOLOGY POLICY (ITP) CYCLE:
HOW IT LED TO THE EMERGENCE OF VENTURE CAPITAL (VC) AND TO THE
RE-CONFIGURATION OF ITS HIGH TECH CLUSTER***

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Table of Content

1. Background and Objectives

1.1 Antecedents

1.2 Specific Objectives and Structure of Paper

1.3 Definition of Venture Capital

1.4 Theoretical Framework: The Systems-Evolutionary Perspective to Innovation and Technology Policy (ITP)

2. The Emergence of Venture Capital in Israel

2.1 Antecedents: Support of Industrial R&D (1969-)

2.2 Creation of the Office of the Chief Scientist (OCS): The Grants to Business Sector R&D program

2.3 Emergence of Venture Capital (1993-2000)

2.3.1 Approach and Data

2.3.2 Yozma Funds

2.3.3 Structure of the Industry

2.4 The New High Tech Cluster of the 1990s

3. Israel's Three Phase ITP Cycle Model

3.1 Summary of the Model

3.2 The ITP Cycle: Phase Transitions

4. Israel's Successful Venture Capital Policy (Yozma)

4.1 Background: Problems with the Grants to BS R&D Program

4.2 A First Attempt: The failed Inbal Program

4.3 Emergence of Demand for the Services of a future VC industry

4.4 The Design of Yozma

4.4.1 Foreign Partners, "Privatization" of Government's Share, and Incentives to the Upside

4.5 Causes of System Failure

4.6 Yozma's Impact

5. Yozma's Success: Lessons for Other Countries

5.1 Yozma's Design and the Context/Timing of Implementation

5.2 How Yozma overcame the System Failure

5.3 Complementary Policies

5.4 Causes for VC Policy Failure

SUMMARY & CONCLUSIONS

Acronyms

SME-Small and Medium Sized Enterprise; SU-high tech Start Up company; VC-Venture Capital, Venture Capital Company; PE-Private Equity, Private Equity Company; IC= Investment Company, LP-Limited Partnership (a form of VC and PE organization)

OCS-Office of the Chief Scientist, Ministry of Industry and Commerce (Israel); ITP-Innovation and Technology Policy; HTP-Horizontal Technology Policy (program); SF-System Failure; SFj=Specific Cause j of SF

KBE-Knowledge Based Entrepreneurship; PCA-Potential Sustainable Competitive Advantage

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

A&T-Avnimelech and Teubal

1. Background and Objectives

We propose a ‘model’ of Innovation and Technology Policy (**ITP**) *Cycle* suggested by the Israeli experience of the last three decades which led to the successful emergence of a domestic Venture Capital (**VC**) industry and new, dynamic High Tech Cluster during the 1990s. The three phase policy model starts with direct Government support, including Horizontal support, to Business Sector (**BS**) R&D starting in 1969 (beginning of Phase 1) and culminates with implementation of a Targeted policy in support of Venture Capital (Phase 3). During an intermediate phase 2 a new set of policies was implemented to reinforce R&D and Innovation in general and in support of high tech Start Up companies (**SU**). During this phase other favorable conditions, including enhanced policy capabilities, were generated for a successful transition to Phase 3 (1993-2000). In this latter phase the economy experienced an acceleration of R&D and innovation and the share of R&D in GDP rose to over 4%.

The model is a generic model, which allows for different variants reflecting different country contexts. Along its ITP cycle the structure of Israel’s *policy portfolio* changed in response to changed policy objectives. This reflected differences in the combination of *direct* and *indirect support* of BS R&D and/or SU companies during Phases 1 and 2; and in the mix of Phase 3 between targeted and horizontal policies¹. Not considered as part of the ITP cycle presented here are large chunks of Israel’s policy in support of Science and Higher Education. During the three decades covered by the model Israel implemented successful Science and Higher Education policies, which at least initially were independent of the BS-, oriented ITP (starting in the 1980s there has been increasing interaction between both categories of policies).

1.1 Antecedents

The paper analyzes one variant of a more general Life Cycle model for Innovation and Technology Policy oriented to the emergence of VC and to the emergence or reconfiguration of high tech clusters. Life Cycle analyses have increasingly been applied to new areas starting in the 1930’s (Kuznets, 1930) with the analysis of trends in industry data such as sales. In the 1950s and 1960s several models in marketing were based on the life cycle concept (Polli and Cook, 1969). In part coinciding and in part following this work life cycle analysis was applied to patterns of international trade and investment (Vernon 1966); the evolution of firms and organizational learning (Kimberly and Miles, 1980; and Zollo and Winter, 2002); the

¹ Direct support measures contrast with indirect measures such as promotion of activities in organizations or institutions supporting the Business Sector (e.g. Universities, Technology Centers, Government Laboratories). Phase 3 policies could be considered a mix of direct and indirect cluster creating policies.

introduction and diffusion of new products; and the evolution of new industries (Abernathy and Utterback, 1978; Klepper 1996, 1997) including VC industries (A&T 2003; Avnimelech 2004). Life Cycle analysis of ITP has barely begun².

The paper is linked to previous work of ours (A&T 2004a,b; 2003) on the emergence of VC in Israel where a distinction was made between a ‘background conditions’ and ‘pre-emergence’ phases on the one hand and a ‘VC emergence phase’ on the other (see also Avnimelech 2004). This work emphasizes that success in VC emergence depends crucially on the creation of favorable conditions in the previous two phases. Our phase 2 is an extension of the ‘pre-emergence phase’ of that paper, although the experiments undertaken here could be interpreted not only as favoring the subsequent targeting of VC but as facilitating the development of generic ‘strategic’ ITP capabilities. These would enable the implementation of targeted policies in Phase 3-- not only in connection with VC but also for high tech sectors/technologies or other components of innovative clusters.

The paper is predicated on the assumption that while cluster creation policies are possible in many contexts they requires adoption of a Systems/Evolutionary (S/E) perspective to Innovation and Technology Policy (see next section). Previous work on clusters have emphasized the random nature of their particular geographical location (Kenney and Florida 1988; Klepper 2003)³ a fact which could be construed as implying, in accordance with the accepted view of policy makers, that cluster creation policies *oriented to a particular location* cannot succeed. We would like to note that in a similar vein of thought targeted VC policies have been assumed not to be possible (See Krugman 1983). This also contrasts with previous work of ours referred to above which suggests that failure of VC policies frequently resulted both from not adopting a S/E perspective and for visualizing VC as a ‘pool of money’ rather than an industry.

Israel’s success of the 1990s pertained both to VC emergence *and* to high tech cluster emergence (or re- configuration); and VC emergence was the main vector of cluster dynamics. It is our view that VC emergence could also play important roles in the dynamics of innovative clusters in other contexts, including high tech cluster emergence. In line with this view we tentatively hypothesize that absence or failure of VC policies might contribute to explain failure in cluster creation/re-configuration policies—not only with respect to high tech but also in connection with innovative clusters more generally speaking⁴.

2 For an early Life Cycle model of Horizontal incentives’ policies in support of companies see Teubal 1997.

3 This is also implied in Krugman’s (1991) work.

4 J. Matthews has already pointed out the case of Taiwan’s high tech cluster as a successful example of Government targeting.

1.2 Specific Objectives & Structure of the Paper

1. *Analyze from a S/E perspective Israel's three-phase ITP Cycle 'model' that culminates in the emergence of a VC industry in the 1990s.*

- This is the central objective of the paper (Sections 2 and 3).

2. *Analyze the reasons for Israel's success in developing a domestic VC industry and in the re-configuration of its high tech cluster.*

- These include conditions related to "Demand"; the context, timing and design of VC policies; and required ITP capabilities. These are discussed in Section 5.

3. *Suggest potential lessons, which other countries might derive from Israel's VC Policy experience.*

- Israel's success in implementing VC policies (in contrast to many attempts by other countries that failed), and the non-conventional nature of those policies suggests that lessons may be derived from analyzing that country's experience (Section 6).

1.3 Definition of Venture Capital

VC companies are "independently managed dedicated pools of capital that focus on equity or equity-linked investments in privately held, high growth companies" (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 this paper involves a 'dominant' orientation to the *early stage* finance of *high tech Start Up* (SU) companies. On the other hand, under the broad definition (which is Lerner's), VC's are not necessarily focused on high tech nor on the early phase although they should focus on high growth companies. Private Equity is even a broader category since it *also* allows for non-Venture equity investments (i.e. not related to high growth companies) especially in private companies such as leveraged buy-outs, consolidations, mezzanine, distressed debt investments, etc. Thus PE companies encompass both VC companies and other financial institutions whose dominant activity is late phase equity investments especially in non high tech industry and services⁵. Note that SUs are young high tech SMEs. A common form of organization of VC is the Limited Partnership (LP) form, which is also common for PE whatever the definition used.

The paper focuses on the *organized* VC market and, to some extent, on the *organized* PE market. It comprises "professionally managed equity investments in the unregistered securities of private and public companies" (Fenn et al. 1995, p.2) undertaken by *specialized companies*. PE & VC encompass other markets that are distinct from the organized market e.g. angel capital and the informal PE market (Fenn et al. 1995). The paper also emphasizes *independent companies*

⁵ The U.S. definitions of VC & PE described above contrasts with those used in Europe, at least till 2003. Under the EU definition used then VC was a broader category than PE. In their 1998 article Wright & Robbie state that the term VC is "increasingly being used in firms undergoing 'radical restructuring' rather than referring to 'new firms' (Wright & Robbie 1998 p. 522).

that are companies, which are not the VC or PE arms of financial institutions or large corporations.

1.4 Theoretical Framework: The Systems-Evolutionary Perspective to Innovation and Technology Policy (ITP)

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 2002; and A&T 2004 among others)⁶. 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 SI transformation by overcoming System (& Market) Failures*. 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 (Metcalfe 1995). Rather it should be determined by a set of *Strategic Priorities* (Teubal 2002)⁷. 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 promotion of R&D/Innovation in the BS (*vision*) 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.

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 (KBE) – *due to cultural constraints, Bankruptcy Laws, etc.*
- Limited SU Access to Financial Resources *e.g. due asymmetric information, uncertainty, etc.*
- Weak Supporting Structure *e.g. Technology Centers*

⁶ 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).
⁷ 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.

- Weak Institutional Framework
- Non existing or underdeveloped Networks
- Co-ordination Failures

The set of *specific system failures causes* to be addressed will vary from country to country and from phase to phase (and so would the policies resulting from these objectives). 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. From this it follows that ITP should be viewed as an integrated whole-- *a portfolio* of incentives programs & changes in institutions.

2. The Emergence of Venture Capital in Israel

2.1 Antecedents: Support of Industrial R&D (1969-)

Emergence of the VC industry, which took place in Israel during 1993-2000, was preceded by more than 20 years of development of favorable background conditions and pre-emergence events, many of them related to the penetration of R&D into Israel's business sector and appearance of a distinct high tech industry. No less important was the process of experimentation and learning by both the private sector and Government during 1985-1992 in connection with the new models of high tech SU and of the specialized institutions associated with their finance and support (VC).

A proactive Government Policy with a strong emphasis on R&D subsidies/grants to business sector R&D triggered and facilitated the above process. The main incentives program was a Horizontal Program supporting BS R&D, which was open to all firms in the business sector and to all R&D projects. This program started operating in 1969 and grew steadily in scope *pari passu* with the growth of R&D intensive companies. It stimulated an intensive *learning to innovate* process which was collective in nature (Teubal 1993, 2002) the outcome of which was the generation of R&D / Innovation capabilities in the business sector, the beginnings of a civilian-oriented High Tech industry and creation of early links with global product and capital markets (links with MNE, investment banks and NASDAQ).

The grants to R&D program was the backbone of Israel's ITP for more than 20 years in which period it set the basis for a new phase in the development of Israel's Business Sector- emergence during the 1990s of a *civilian oriented high tech cluster* involving large numbers of

innovative high tech SMEs (SUs) supported by a dynamic VC industry. The transformation of the old military-dominated “Electronics” industry of the 1980s to a ‘Silicon Valley-type high tech cluster’ was spearheaded by and co-evolved with the recently created VC industry.

Table 1: Annual OCS Grants, BIRD Grants and VC investments 1970-2003

	1970	1980	1985	1990	1995	2000	2002	2003
Total grants (M\$)	2.5	98	107	136	346	440	375	369
Regular fund (M\$)	2.5	98	106	133	294	337	291	283
Incubators (M\$)	0	0	0	0	31	32	27	26
Magnet (M\$)	0	0	0	0	16	67	58	53
Royalties (M\$)	0	2	7	14	56	135	149	135
BIRD Grants	0	2	7	12	12	8	10	11
VC Investments (M\$)	0	0	~5	~50	~400	3,100	1,139	1,011

From: Avnimelech (2004); Sources: OCS (2003), BIRD (2003) and IVA (2003).

2.2 Creation of the OCS: The Grants to BS R&D Program

The above-mentioned Horizontal Grants to 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 as far as the BS is concerned (till the early 90s. more than 90% of OCS disbursements to Civilian R&D came from this program). It supports the R&D activity of individual companies oriented to new/improved products and processes directed to the export market⁸. Being an *Horizontal Program* open in principle to all firms in that sector (rather than a *Targeted Program* applicable to a specific industry or technology) the ‘Industrial R&D Fund’ extended a 50% subsidy to every R&D project accepted by the OCS, whatever the firms' industrial branch, product class & technology (Teubal 1993).

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; creation of employment including absorption of immigrant scientists and engineers; etc. The outcome was a significant increase in R&D Grants to Industry; and recognition of ‘Software’ as an industry-a very significant event indeed.

The major objectives of an Horizontal Program during early implementation is *a) to promote learning about R&D/Innovation⁹ in general and b) to generate knowledge about potential areas*

⁸ 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 (generic, cooperative R&D received support later on). The latter’s objective is to generate knowledge, capabilities and components rather than directly marketable outputs. The output of generic R&D would facilitate (or become inputs) to a subsequent ‘regular’ R&D activity.

⁹ Learning, including experience-based learning triggered by increased R&D in the BS, is the main factor leading to enhanced R&D/Innovation capabilities.

where the country concerned might have or could develop a sustainable competitive advantage. Much of the former is ‘collective learning’ that is 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. We propose below first, a certain categorization of intra-firm learning processes; and second- *instances* of ‘collective learning’. Both are based on the Israeli experience for the 1969-90 periods.

Intra-firm Learning during Horizontal Program implementation-early sub-period:

- Learning How to search for Market and Technological Information.
- Learning How to identify, screen, evaluate, choose and configure new projects
- Learning How to generate new projects, including more complex ones
- Learning How to manage the innovation process (linking Design to Production & Marketing; Selection of Personnel; Budgeting; Management of Human Resources etc.)

Collective learning

- Firms learn about the importance of marketing
- Firms learning how to establish and manage Strategic Alliances both with domestic and foreign companies and generating links to Global Markets
- The OCS and the firms learned how to better assess the quality & economic potential of various types of projects and learned about areas with potential Sustainable Competitive Advantage

According to the ITP perspective, proof of a program’s success (in this case the Grants to BS R&D program) would be *program take-off* i.e. a situation where the number of new projects applying for support increases fast and eventually outstrips the possibilities of support.¹⁰ Under favorable conditions program take off may happen a few years after initiation of program implementation. Two other indicators of success are ‘*endogenization*’ of the activity supported and achieving ‘*wide diffusion*’ of such activity/functions. The former would mean that an increasing number of projects would be implemented even without (or with reduced) Government Support. Achieving wide diffusion, in our opinion, should at least substitute in part the objective of achieving a suitable rate of return on Government disbursements supporting the activity (this means that ‘overall *social* return’ should consist of a qualitative component—wide diffusion of a strategically important activity within the business sector- and a quantitative one-measured rate of return). Achieving all these objectives would be indicative of the cumulative, learning-induced process mentioned above¹¹.

¹⁰ This might but need not coincide with the point of inflexion of the S-curve used in Diffusion Studies.

¹¹ An additional success indicator for programs where system failures are not necessarily permanent is the extent by which a program becomes irrelevant in the future i.e. it may be cancelled or privatized. This was not the case with Israel’s Grants to R&D program; but it was so with Israel’s targeted VC program-Yozma (see below).

2.3 Emergence of Venture Capital (1993-2000)

2.3.1 Approach and Data

In a number of papers (A&T 2003, 2004a; Avnimelech 2004) we analyze the process of emergence and development of Israel's Venture Capital Industry in terms of an Industry Life Cycle Perspective comprising five phases: Background conditions (1969-84); Pre-Emergence (1985-92); the central VC Industry Emergence phase when the industry got established (1993-2000); Restructuring (starting in 2001); and the final Consolidation phase¹². VC emergence in Israel was a *policy-led process* in the sense that it was triggered by a deliberate & targeted policy directed to this objective (the *Yozma Program*, see particularly A&T 2003). From an evolutionary and Industry Life Cycle (ILC) perspective *Emergence* is the process, which leads to the 'creation' of a new industry-in this case an *infant* VC industry (and market) in Israel. Central to this is the onset of an autocatalytic, cumulative process with positive feedback involving not only VC but also SU and the entire high tech cluster. It was a complex process triggered by Yozma and involving a number of co-evolutionary and other processes such as 1) VC-SU co-evolution (see A&T 2004a; Avnimelech 2004); 2) Domestic VC industry- Global capital markets interaction (see Avnimelech 2004); 3) collective learning & emergence of a relatively stable structure for the high tech cluster and VC industry; and 4) appearance of a wide spectrum of ancillary services e.g. consultancies, accountants, legal experts, etc. The new VC industry was an *emergent phenomenon* involving a new set of specialized agents with strong connections with SU companies and with Global Capital Markets for technology companies (such as NASDAQ). The quantitative dimension of this process can be appreciated from Tables 2 and 3.

The Israeli experience is quite unique in that it is one of the most successful instances of diffusion of the Silicon Valley model of Venture Capital & High Tech beyond North America (see A&T 2003, p. 1-2). This model focuses on VC oriented to *early stage investments in high tech SU*. It was implemented in the wake of a new era in the Globalization process where capital markets focusing on IPOs of young technology companies became Globalized. While in principle any SU in any country could float in Nasdaq, the possibility of building or transforming a new high tech cluster, which exploits the IT revolution, may well depend on the emergence of an indigenous VC industry. Only then will the possibility of connecting large numbers of innovative SU to global capital (and indirectly, product) markets become a reality.

¹² The phases of VC evolution should not be confounded with the phases of our ITP cycle. However, they partially overlap. Thus the first three phases of the evolution of VC industries correspond one by one to the phases of the ITP cycle model. See Boxes 1 & 2. At this stage our policy cycle model will not be linked to the two remaining post emergence phases of VC.

Table 2: Venture Capital Raised and Invested

Year	VC Raised	VC under Management*	VC Invested (% of foreign)	VC investment as % of GDP
1991	58	80	NA	NA
1992	160	240	NA	NA
1993	372	612	NA	NA
1994	374	986	NA	NA
1995	156	1142	NA	NA
1996	397	1539	NA	NA
1997	729	2268	440	0.41%
1998	706	2974	589 (36%)	0.54%
1999	1851	4825	1011 (43%)	0.9%
2000	3701	8504	3092 (59%)	2.6%
2001	1100	9546	1985 (59%)	1.65%
2002	63	9609	1140 (58%)	0.96%
2003	300	9600	1000 (61%)	0.84%

From Avnimelech (2004): Source: IVA and Money Tree.

* Management companies that invested at the current year and with at least \$3M available for investments at the end of the year.

Table 3: Startups – Formation, VC backed, OCS awarded, Exit and closure

Year	SU* Foundation	New VC backed SU	First Time OCS Grant (SU)	# IPO** (VC backed)	# M&A*** (VC backed)	SU Closure
1991	NA	NA	179 (109)	3 (0)	0 (0)	NA
1992	NA	NA	241 (165)	9 (1)	0 (0)	NA
1993	NA	NA	245 (179)	10 (3)	0 (0)	NA
1994	NA	NA	291 (218)	9 (2)	3 (2)	NA
1995	NA	NA	236 (146)	9 (4)	5 (5)	NA
1996	NA	NA	257 (200)	27 (14)	10 (10)	NA
1997	250	119	219 (158)	22 (9)	6 (6)	NA
1998	300	152	217 (156)	17 (8)	14 (14)	NA
1999	450	208	212 (169)	24 (18)	12 (12)	94
2000	550	372	172 (126)	26 (25)	23 (22)	161
2001	150	164	260 (193)	2 (2)	7 (7)	386
2002	98	108	284 (199)	0 (0)	6 (6)	412
2003	134	106	NA	0 (0)	8 (8)	118

Sources: IVA, Money Tree and OCS, Globes Newspaper

* Estimates; ** Established after 1990; *** not including fire sales or buybacks (at least \$25M or Annual ROI of 25%).

Table 4: ICT and Software Manufacturing: Sales, Exports (Thousands US\$) and Employees

Year	ICT Sales	ICT Exports	ICT Employees	Sale per Employee	Software Sales	Software Export	Software Employees	Sale per Employee
1990	3,300	2,100	32,000	103	400	75	5,000	80
1991	3,600	2,280	33,000	109	540	110	5,000	108
1992	4,000	2,660	34,200	117	600	135	5,500	109
1993	4,600	3,200	36,400	126	700	175	6,200	113
1994	5,200	3,750	37,600	138	800	220	7,000	114
1995	5,900	4,300	39,200	151	950	300	7,700	123
1996	6,500	4,880	42,000	155	1,300	600	8,500	153
1997	7,200	5,700	43,700	165	1,780	1,000	10,000	178
1998	8,000	6,550	45,600	175	2,350	1,500	11,500	204
1999	8,600	7,130	48,000	179	2,950	2,000	13,000	227
2000	12,500	11,000	54,800	228	3,700	2,600	14,500	255
2001	11,250	9,750	47,000	239	4,100	3,000	15,000	273
2002	10,000	8,800	43,200	231	2,800	1,900	13,200	212

Source: Israel Association of Electronic and Information Industries and Israel Association of Software houses.

2.3.2 Yozma Funds

A total of 10 private 'Yozma funds' were created by the Yozma Program. The program also directly invested \$20M through a Government-owned Yozma Venture Fund which started operating in 1993 (it was privatized in 1997). Five were founded in 1993: Gemini, Star, Pitango, Walden; Inventec; three in 1994: Concord, Eurofund and JVP; one in 1995: Medica; and one in 1997: Vertex. The total capital raised by Yozma funds was about \$260 million (\$100 million out of it government capital) and they invested in over 200 SU companies.

Table 5: 'Yozma Funds' and associated VC companies; Yozma Venture Fund

VC Name	Foundation Date	Number of Funds (& Dates) 1993-03	Capital Under Management 1993-2003 (in M\$)	Capital to be raised in 2004
Star	1989	11 (1989-2000)	975 (90-7: 275, 98-9: 300, 00: 400)	NA
Gemini	1993	3 (93, 97, 00)	346 (36, 110, 200)	\$170M
Inventec	1993	1 (93, 97)	33 (20+13)	NA
Pitango	1993	4 (93, 96, 00)	665 (20, 145, 500)	\$350M
Waldenn	1993	2 (93, 98, 00)	184 (33, 61, 90)	NA
Yozma	1993	3 (93, 98, 01)	150 (20, 80, 50)	\$60M
Concord	1994	3 (94, 97, 00)	280 (20, 80, 180)	\$150M
JVP	1994	4 (94, 97, 99, 01)	675 (20, 75, 175, 405)	\$250M
Eurofund	1994	2 (94, 99)	72 (20, 52)	NA
Medica	1995	2 (95, 00)	65 (15, 50)	\$70M
Vertex	1997	4 (97, 97, 00, 02)	545 (39, 46, 160, 300)	\$150M
Total		39	\$3,990M	\$1,200M

2.3.3 Structure of the Industry

Table 6: Capital Raised According to different types of PE Organization in Israel

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Yozma VCs	0	0	149	40	35	0	52	0	0	0	0	0	0
Private VCs	49	27	33	72	100	309	568	594	1552	3682	1304	76	118
Public VCs	0	54	22	0	0	0	29	8	44	185	6	86	0
PE Funds	0	45	128	242	6	24	56	67	108	89	0	110	435
IC	9	34	40	20	25	80	134	141	149	601	83	0	5
Total PE	58	160	372	374	166	413	839	810	1853	4557	1393	272	558

From: Avnimelech (2004); Sources: IVA (2004). * IC – Investment companies, ** Public VC- Publicly Traded VC

Table 6 shows the changing structure of Israel's PE (including Investment Banks) and VC industry since 1991. The main categories of the VC industry are: Yozma Funds which are private VC companies organized under the auspices of the Yozma Program¹³; Private VCs which are 'Other' VCs; and Public VCs traded in the Tel Aviv Stock Exchange. Yozma Funds started in 1993 where a total of 149 M\$ was raised, with the amount gradually (but not monotonically) declining to zero in 1998 and afterwards. The data is consistent with the fact that Yozma not

only did not ‘crowd out’ prior ‘private’ VC (which already existed before 1993) but positively stimulated this category of funds which through accelerated growth became the mainstay of Israel’s VC industry. This provides support to the thesis that Yozma ‘triggered’ a cumulative process of growth of Israel’s VC industry. Note also the relative insignificance of the publicly traded component of Israel’s VC industry: while such companies existed prior to Yozma-their beginning was with the prior Inbal program which was implemented in 1992-their share was never significant beyond 1993/4 and continuously declined thereafter (excepting perhaps during 1999-2000).

2.4 The New 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 (e.g. Taiwan and Singapore) but also for top tier developing economies like India and China. Table 7 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 7: Israel's high Tech Cluster - Selected Structural Elements (1970s-1990s)

Accumulated during the decade	1990s	1980s	1970s
Number of SU creation	~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
Accumulated # of significant M&As by MNE:	~75	0	0
Capital raised in NASDAQ in the decade: M\$	~10,750	~50	~10
Mergers and Acquisitions (M&A): B\$	~18,200	~0	~0
Figure for the end of the Decade	1990s	1980s	1970s
Number of International Investment Banks in Israel		1	0
<i>Number of VC Companies</i>	~100	2	0
<i>Share of ICT Exports in Manufacturing Exports</i>	54%	28%	~14%
ICT manufacturing Exports M\$	12,950	2,450	350
Software Exports M\$	2,600	75	0
Civilian R&D as Percentage of GDP	4.8%	2.8%	1.8%
ICT Employees (thousands)	152	~80	~60
ICT Skilled Employees (thousands)	57	37	~26
Patents Issued	969	325	140

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

¹³ The data on Capital Raised for each one these VCs refers to their Yozma Fund only, not to other funds raised by these companies (e.g. follow up funds).

3. Israel's Three Phase ITP Cycle Model

3.1 Summary of the Model

Box 1 schematically outlines the three phases ITP model for the support of high tech SU. It is important to note that there could be other variants (beyond Israel's) to ITP cycle models leading to successful emergence of VC industries (it is likely that most of have not yet been formulated).

Box 1: The ITP Phase in Israel

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

Box 2 and Table 8 bring data on policies initiated and/or implemented in Israel during Phases 2 and 3. They complement Table 1, which also refers to Phase 1.

Table 8: OCS R&D Grants (Million Dollars)

<i>Year</i>	<i>Total Grants (Growth)</i>	Regular R&D Grant	MAGNET Budget	Technology Incubators	Royalties (Growth)	BIRD-F Awards
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

Box 2: New ITP Programs

1) Inbal (1991) - a Government owned Insurance company, which gave partial (70%) guarantees to traded VC funds. Four VC companies were established under Inbal regulations.
2) Yozma (1993-98) - a \$100M Government owned Venture Capital company, which invested in 10 Funds, which operated in Israel (\$8M per fund).
3) Magnet Program (1992-) - a \$60M a year Horizontal Program supporting cooperative, generic R&D involving two or more firms and at least one University.
4) Technological Incubators (1992-) - a program supporting entrepreneurs during the Seed Phase, for a period of 3 years. The incubators are privately owned & managed. Both they and the projects get financial support from the Government.

3.2 The ITP Cycle: Phase Transitions

A main issue is identifying the conditions under which the early phase of strong Government support of SME innovation & learning would create conditions for the subsequent emergence of a VC industry and innovative cluster. We suggest three necessary conditions: a) a minimum level of diffusion of R&D/innovation and associated capabilities throughout the business sector (reflected by increased “demand” for R&D grants); b) emergence of ‘demand’ for the finance and other services provided by a VC industry (SU formation)¹⁴; and c) generation of a policy makers’ capability for undertaking ‘targeted’ policies.

A minimum of innovation capabilities (*Condition a*) is required for the economy to be able to exploit the ongoing Technological Revolution and Globalization process which are opening large numbers of new technological and business opportunities; and in order to effectively access and exploit the constantly increasing global pool of knowledge and technology (A&T 2004b). Also the share of those capabilities which are enshrined in existing companies some of them large will enhance the potential pool of technological entrepreneurship that may be spinned-off from such organizations. They may, like in the case of high tech in Israel during the 1980s and 1990s and of India currently, be an important source of new innovative SU in the economy the impact of which could be strongly felt in subsequent phases.

A sufficient level of pre-existing ‘demand’ for VC services (one which flows from the critical mass of SU generated during phases 1 and 2) seems to be an important if not critical facilitator of phase 3 policies in support of the creation of a VC industry. This factor presumably underlies both Israel’s success and the failure of other countries’ attempts at developing VC

¹⁴ This demand would originate in the innovative SME segment established during Phase 1 & 2 and as a result of new entrants. See A&T 2004a.

industries¹⁵. Sufficient demand for VC services or sufficient ‘deal flow’ is the result of a critical mass of SU.

Our presumption concerning the third necessary factor for a successful transition from Phases 1 and 2 to Phase 3 largely concerns the need of adopting a *strategic view* of ITP and a *leadership role* by policymakers (see next section); and the related need to implement targeted policies. Targeted policies seem to be inherently more complex than horizontal policies and therefore require a longer and more complex preparatory period. There are clearly a priori reasons for these particularly in contexts with very little experience with innovation & ITP. Moreover, based on the comparison between the horizontal support to R&D, which started in Phase 1 and the successful targeted support of VC of Phase 3, this has been so in Israel. A summary statement for this policy capabilities requirement is that the business sector on the one hand and policy institutions & capabilities on the other *should co-evolve* (A&T 2003). This process is a specific instance of the co-evolutionary processes between technology, industry structure and institutions analyzed by Nelson (1994).

It should be emphasized again that the conditions stated in the last three paragraphs are *necessary but not sufficient* for a successful transition to phase 3. Thus, emergence of a high impact VC industry may also require *a timely and suitably designed targeted policy* (A&T 2003, 2004b). Only then would a high impact new industry come into being. Its effectiveness in inducing accelerated growth of the country’s innovative SME segment is linked to the bundling of financial services with *adding value activities* related to management, production, marketing, international expansion and network creation¹⁶.

4. Israel’s Successful Venture Capital Policy (Yozma)

A successful Phase 1 & 2 would generate ‘background conditions’ for the targeting of domestic VC industry. Overall this was the case in Israel. Israel’s second attempt at targeting its VC industry -Yozma Program- was extremely successful. In previous work we contend that among attempts at implementing VC-directed policies this program stands out as a category in itself. However, neither the new strategic priorities underlying this program nor its design were obvious to policymakers at the time.

4.1 Background: Problems with the Grants to BS R&D Program

15 For an evaluation of VC policies see Black & Gilson 1999 (Germany); and OECD reports. See also Gilson 2003. Chile’s VC policy implemented during 2000/1 seems not to have been successful for similar reasons (personal communication).

16 This is due to the mode of operation, links and capabilities of VC. By overcoming well known imperfections in the market for ‘bank loans’ to SMEs through equity investments, intense involvement in the activity of ‘portfolio companies’ and ‘learning from

During the late 1980s and early 1990s officials in the treasury and the OCS realized that despite massive Government support for R&D there were clear 'market & *system* failures', which blocked the successful creation and development of Startup companies. While an important problem was insufficient finance for the post R&D activities required for the commercialization of R&D results (especially for SUs whose access to bank finance was limited) this was only part of the problem. No less important were such companies' weaknesses in management abilities, business know how, production/marketing capabilities (and orientation) and links/networks with global capital and technological markets.

In response to this a gradual shift in the OCS's policy objectives gradually took place-from promotion of R&D to explicit enhancement of SU formation, survival and growth¹⁷. The head of OCS, Yigal Erlich, pondered how to make OCS support more effective. He could not find even one real success "similar to those we see today" (interviews 1998, 2000). The basic problem was lack of capability to grow after the product development phase. By identifying a joint 'finance' and 'marketing/management' skills' gap the System Failure was defined and characterized in terms of absence of a particular type of financial institution-VC.

4.2 A First Attempt: the failed Inbal program

The Inbal Program was the first attempt at implementing a targeted ITP directed to the VC industry. It was launched by the treasury in 1992 one year before the implementation of Yozma. Its central idea was to stimulate *publicly traded* VC funds by guaranteeing the Downside of their investments. The mechanism used was a Government Insurance Company ("Inbal") that guaranteed VC funds traded in the Israeli stock market (TASE) up to 70% of initial capital assets. The program imposed certain restrictions on the investments of the VC companies covered by the program ('Inbal Funds'). Four 'Inbal' funds were established. They and the Inbal program as a whole were not a great success. Inbal funds valuations in the stock market were low, similar to Holding Companies' valuations; and the funds encountered bureaucratic problems. More significant was the fact that the program didn't attract any 'adding value' agents or capabilities. Moreover, the funds did not succeed financially and did not raised additional capital. Eventually all four 'Inbal' funds quit the program¹⁸.

The Inbal program not only didn't overcome the market failures related to the 'pool of

specialization' - VC companies will represent loci of capabilities, networks and reputation with enormous 'adding value' potential. See Gompers and Lerner 1999, 2001

¹⁷ This means that the 'additionality' criterion was increasingly perceived as being irrelevant if not accompanied by additional criteria pertaining to the economic impact of BS R&D.

¹⁸ Today all of them are 'held' by one holding Company-Green Technology

capital' aspect of the VC industry but it didn't target any of the system failure causes related to VC industry emergence (4.5 below). There was no mechanism for drawing professional VC agents into the program; it did not generate VC companies with adding value capabilities; it didn't promote collective learning; it didn't create links with additional late stage VC pool or a significant IPO market; and it was exposed to 'stock market sickness'. Also its model of VC company organization was not imitated, and the 'social impact' of the Inbal Program was very low (A&T2003). Having said this, it is important to mention that policy makers and businessmen alike learned from Inbal's weak impact particularly about the disadvantages of public VC organizations. These included company taxation (which a Limited Partnership (LP) form of VC organization could avoid); the difficulty of having investors contribute to the operation of the fund; difficulties in rapidly exploiting the reputation earned from early exits in order to raise new capital; limits on management decision making flexibility and on management compensation; and absence of incentives to the "upside". Awareness of these favorably influenced the design and implementation of Israel's successful Targeted Policy- Yozma Program¹⁹.

4.3 Emergence of Demand for the Services of a future VC industry

In A&T 2004, we estimate SU foundations during the 'late' Pre-Emergence period (1990-93). The annual flow experienced a quantum jump in the early 1990s; and the stock of SU must have approximated 300 by 1993. This 'mass' of SU companies and their 'quality' implied a very favorable environment for the fledging VC industry as far as the 'demand side' or 'deal flow' is concerned. Indirect evidence of the existence of 'high quality' SU is the fact that VCs in the pre- and early Emergence period (Star, Giza and Mofet, and to a lower extent Athena) *were either making profits or were soon going to do so* (see A&T 2004b). What is implied is that *very rich pickings* existed among the growing stock of SU²⁰; and that the small numbers of leading investors and VCs active at the time identified and invested in them²¹.

4.4 The Design of Yozma

The designing of the Yozma program was an outcome of a very long and intensive preparation, which included visits of OCS officers to Silicon Valley, interviews with U.S. entrepreneurs, venture capitalists, investment banks, and Small Business Administration (SBA) officers. It was based on implementation of U.S. proven VC characteristics (form of organization, routines, and

¹⁹ Inbal played two additional roles. First it was an important part of the variation process preceding selection of the right configuration of VC; second it also contributes to signal the Government of Israel's determination to create a VC industry.

²⁰ Another ex-post indicator of the high quality of SU in the early emergence phase is the fact that most Yozma VCs had very high returns (5 out of the 11 Yozma funds had an annual ROR of more than 100%).

²¹ This also meant that 'the market' was already 'pointing the way' to activities typical of VC & SU.

etc.) after taking care of necessary adaptations to the Israeli environment (such as using the NASDAQ as an exit path rather the local Stock Exchange). The Yozma program began operating in 1993. The explicit objective was to create a solid base for a competitive VC industry with critical mass; to learn from foreign LPs; and to acquire a network of international contacts. It was based on a \$100M Government owned VC fund oriented to two functions: a) fund of funds-investment in 10 private VC funds ('Yozma Funds'-\$80M); and b) direct investments in high tech companies-\$20M (through the Government owned 'Yozma Venture Fund'). The basic thrust was to promote the establishment of a domestic, private LP VC industry that invested in young Israeli high tech SU ('early phase investments') with the support of government and with the involvement of reputable foreign financial institutions (generally a PE company). The funds involved would be managed by new independent²² Israeli VC (Management) Companies. Each 'Yozma Fund' would have to engage one such foreign institution together with a well-established Israeli financial institution. This emphasizes the point that the Yozma program favored entry of professional managers or of individuals with VC-related abilities into the infant VC industry. Moreover, the insistence on creation of a formal organizations as a pre-condition for becoming a Yozma fund, suggests that its initiators understood the significant role of institutions in the process of learning, generating & accumulating capabilities and reputation²³. In an approved fund that fulfilled these conditions, the Government would invest 40% (up to \$8M) of the funds raised. Thus \$100M of Government Funds would draw \$150M of private sector funds (domestic and foreign).

Yozma did not simply provide capital and risk sharing incentives to investors-- as was common in other Government VC support programs²⁴; its main incentive was in the 'upside'-- each Yozma fund had a call option on Government shares, at cost (plus 5% interest) for a period of five years. 'Demand side' support was assured not by Yozma itself but by the Backbone R&D Grants program & by the relatively recent Technological Incubators Programs. Another major point was the pursuing of an aggressive early SU phase investment policy, spearheaded by Yozma Venture Fund.

²² This would ensure that the traditional financial institutions wouldn't block the development of this new industry (as the case of Germany in the 1970s and 1980s see Schafer 2003; and Fiedler and Hellmann 2001)

²³ In choosing among candidate management teams for Yozma Funds the Government also took into account the high tech experience of team members.

²⁴ It did not provide guarantees or tax benefits; nor was it accompanied by new regulation rules for Pension Funds or corporate law.

Box 3: Critical Dimensions of Yozma Program Design

<i>Explicit Government Venture Capital contribution-100M\$. This was used mostly as a Fund of Fund (80%) where the Government invested 8M\$ in each one of 10 private, hybrid Yozma Funds</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>Favored type of VC company (Limited Partnership): Nine of the Funds adopted this form of organization, the remaining one was a Public VC Fund</i>
<i>A focus on Early Phase investments in Israeli high tech Startup companies</i>
<i>A multiplicity of privately owned Israeli VC Funds (10) each one managed by a local management company and involving a Reputable Foreign Financial Institution (and one important Domestic Financial Institution) – attraction of professional agents to the industry</i>
<i>Government Participation in each Fund \$8M (represented 40% of the capital raised)</i>
<i>A \$20M Government Fund, which directly invested in Israeli High Tech companies-: 'Yozma Venture Fund' (should be distinguished from the Yozma Program). Its aggressive investment policy stimulated investments by Yozma Funds.</i>
<i>Strong Incentive to the "Upside" (there was no downside 'guarantee') - the possibility, within a 5 year period, of purchasing Government's share at cost (all Funds except 2 made use of this option).</i>
<i>Planned 'Privatization' of Yozma Venture Fund: took place in 1998. This previous features assured that the Yozma program was Catalytic Program.</i>
<i>The Yozma Program triggered a strong process of collective learning.</i>

4.4.1 Foreign Partners, "Privatization" of Government's Share, and Incentives to the Upside

Table 9 indicates the 'reputable' foreign (and Israeli) Limited Partners that participated in the Yozma Program (this was a condition for getting Yozma Fund status). This was important since it became an important mechanism for 'learning from others', expanding their international networks and accessing international knowledge related to VC (this was largely tacit knowledge). Moreover these partners, through their international links and reputation, would contribute to the development of the portfolio companies of Yozma Funds. 'VC learning' was also assured by participation of the Yozma Venture Fund manager (Yigal Erlich & other OCS officers who represented the Government) at the board meetings of all Yozma funds (they acted as a node in a vast information network); and through the stimulation of co-investment among Yozma Funds. Culturally speaking the stage was set for a lot of informal advising and interaction among fund managers

The privatization of Yozma Funds was to a large extent considered in Yozma's design. LPs had a call option to purchase the Government of Israel's share approximately at cost anytime during a period of five years. Since the exit market became increasingly favorable till the year 2000 most companies implemented this option. One exception was Medica, a Biotech oriented Yozma Fund, which due to this fact generated lower returns (at the end of its five first years of operation) compared to most of the other ICT oriented VCs. While Medica didn't make use of the buy option it eventually achieved an annual ROR of more than 50%. The other case was Eurofund, which didn't have a foreign PE as a LP investor and achieved a relatively low ROR after its first 5 years of operation.

Note that the option to purchase Government's share in Yozma funds is in effect an 'incentive to the upside' since it will be materialized only when the fund makes more profits than the alternative profits that could be earned with the resources dedicated to this purpose. Note also that this design feature directly flows from the fact that Israel's targeted VC program included a) a Government venture capital contribution; with b) a Fund of Fund function (rather than utilize it to create a Government owned VC company as was common in other countries).

Table 9: 'Yozma Funds'-Foreign Partners and "Privatization"*

VC Name	Foundation Date	"Privatization" Date	Reputable Foreign Investors	Reputable Israeli Investors
Gemini	1993	1998	Advent	DIC
Inventec	1993	1998	Van Lear Group, Docor	Mercator
Pitango	1993	1998	HarbourVest, Chase Capital	Dovrat shrem
Star	1993	1998	TVM, Siemens	PCM
Walden	1993	1998	Walden International	KLA Israel
Concord	1994	1998	AVX	Kardan Technologies
JVP	1994	1998	AXA, Jafco, Bank of Taiwan	HVP Development
Eurofund	1994	2003	Daimler-Benz	Federmann Enterprises
Medica	1995	2004	Buxter, Soros PE, Bank of Japan	Teva
Vertex	1997	2001	Singapore Technologies, Vertex international	
Yozma	1993	1998	The Management company and its assets were sold to The Ofer Brothers	

* For Yozma Funds: Implementation of Call option for Government Shares; for Yozma Venture Fund, Sale of Fund/VC to Achim Ofer

4.5 Causes of System Failure²⁵

The above elements of design were supposed to overcome a number of specific causes of system failure, which blocked the successful emergence of an early SU-oriented VC industry (A&T 2003, 2004b). These included:

- *Difficulties in accessing intelligent & reputable foreign partners*
- *Assembling a Critical Mass of Capabilities*
- *A Critical Mass of Financial Resources*
- *Coordination*
 - *Involving Agents (domestic and foreign) and financial Capital*
 - *With other Policies*
 - *Investment Coordination in early operation of Yozma Funds*
- *Selection of VC strategies consistent with strict definition of VC*
- *Selection of VC Organization (LP)*
- *Assuring Fast Learning*
- *Country/Government Signaling and Cluster Reputation*

Moreover, successful VC emergence depending on overcoming the above causes of System Failure fast. Yozma succeeded in this respect (see 5.2 below) and thereby triggered a successful

²⁵ For further analysis see A&T 2004b

cumulative process of VC growth and impact-- despite the short window of opportunity resulting from the regular cycle of the global VC industry. The result was a new system of innovation and a new 'Silicon Valley' type of high tech cluster.

4.6 Yozma's Impact

The Israeli data show a quantum jump in VC activity after Yozma (see Tables 2, 6). It is likely that the enormous growth of Israel's VC industry in the wake of the Government's successful targeting of that industry had an enormous impact on high tech and more particularly on the growth of the SU segment (Table 3 and A&T 2004a). Also high tech exports quadrupled during the decade of the 1990s (see Table 4); and as part of the enhanced importance of the SU segment of high tech, the share of SU-related 'output' to total high tech output increased considerably during the decade (Teubal & Avnimelech 2003).

This and the insights received and statements made during our interviews (20 interviews) are the basis for our inference that Yozma triggered a cumulative process of VC emergence and High Tech growth. An indication of Yozma Funds' success in triggering growth of the industry is their expansion, which took the form of 'follow up' funds not supported by the Yozma Program (Table 5)²⁶. Total capital under management of VCs who had Yozma Funds approximated 4000 M\$ out of a total of \$10 billion managed by the VC/PE industry between 1991-2003. To this we must add the indirect impact of Yozma in stimulating entry of other non-Yozma, private VCs – which entry was triggered by the handsome profits obtained by Yozma Funds (see Table 6 and explanations in text). In 2000-2002 there were more than 100 VC/PE Israeli management companies in Israel and in Q2 2004 there were 62 VC management companies and about 20 other Israeli PE management companies. A final indication of success in 'industry emergence' is creation of an industry association (IVA) in 1996 with strong leadership of Yozma VCs.²⁷

5. Yozma's Success: Lessons for Other Countries

This paper emphasizes the importance of creation of adequate 'demand' for VC services; of adequate program design (which takes context and timing of policy seriously); and of policy capabilities. The first and last factors have been discussed, albeit briefly, previously; this section will then focus on Yozma Program design and on related aspects.

²⁶ All Yozma funds, except Inventec that was a publicly traded VC, were followed by one or more funds managed by an expanding but related core of managers

²⁷ This contrasts with Inbal funds which in most cases did not raise additional funds after establishment. Moreover there were no additional Inbal-type Public VC Companies that were founded after the original core of four companies.

5.1. Yozma's Design and the Context/Timing of Implementation

For cases like Israel's where VC emergence was a *policy led process*, the existence of favorable demand conditions was *necessary but not sufficient* for the successful VC emergence in phase 3. A *timely and suitably designed targeted policy* was also a requirement. Right timing was important for 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 less the time period available for industry emergence and for a significant high tech impact to materialize.

5.2 How Yozma Overcame the System Failure

A good 'design' of a VC-directed policy would ensure that the *specific causes* for the System Failure (SF), which blocked emergence of the VC industry, are adequately addressed. Yozma's design (and implementation) did in fact do the job: each specific SF cause (SF_j) was addressed by one or more design features and/or implementation solutions.

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 VC agents

SF2: Assembling a Critical Mass of Capabilities

Required participation of professional foreign VC companies in each Yozma funds (as LP)

Required participation of capable local agents (individual and institutions) as general and limited partners

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 privately owned VC management companies (Yozma funds); It leveraged an additional \$150M of private funds (foreign and local); The total of \$250M was sufficient to trigger a cumulative emergence process

SF4: Coordination

Involving Agents (domestic and foreign) and financial Capital

Intensive interactive prior to policy implementation: This involved Government officials, agents from Israel's high tech & financial sectors; and individuals & organizations from abroad.

With other Policies

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

Investment Coordination in early operation of Yozma Funds

Participation of OCS representative in the board of Yozma funds.

SF5: 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 was required)

Yozma/Government representation on Yozma Fund boards monitored implementation of this requirement

SF6: Assuring Fast Learning

Required participation of professional foreign VC agents in Yozma Funds (as limited partners).

Required participation 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.

SF7: Country/Government Signaling

The 100 M\$ 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.

SF8: 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.

5.3 Complementary Policies

It is not surprising that the success of Yozma was dependent on complementary policies. This because SI transformation generally requires a *portfolio of coordinated policies* rather than a single action, program or change in institutions (Section 1.4). One reason for this is the need to continue supporting 'demand' at least for some time, till a virtuous co-evolutionary process involving VC and SU sets in. This function was performed by the regular Grants to BS R&D program (disbursements of which continued to grow at least till the mid 1990s); the Technological Incubators program; and indirectly-by the Magnet program (See Box 2 and Table 8).

5.4 Causes for VC policy Failure

We suggest eight possible VC Emergence/Policy Failures: 1) lack of sufficient R&D/Innovation capabilities in the business sector prior to the implementation of the VC Policy; 2) insufficient 'demand' for VC industry services; 3) inappropriate entrepreneurial culture; 4) lack of other capabilities relevant to the VC-SU model, especially but not only global networks; 5) strong and influential traditional financial institutions which blocked VC industry emergence; 6) a self-reinforcing path-dependence process during early emergence which channeled the VC industry into late and/or non-technological PE activity; 7) weak access to effective Exit markets; 8) unsupportive external environment; and 9) inappropriate program design. In what follows we

analyze some of these especially 1), 2), 3), 6) and 9) (For an extended analysis of VC Emergence/Policy Failures see A&T 2003).

A common cause of VC policy failure was the unfavorable domestic context e.g. inexistent domestic demand for VC services (absence of *deal flow*). There are two causes of this a proximate and a ‘fundamental’ cause. The former is lack of a critical pre-existing mass of SU companies who are the ‘demand agents’ for an early phase VC industry; the latter are other constraints both cultural and institutional. Lack of a prior mass of SU –which Israel avoided through its Grants to BS R&D program in Phase 1 and through other complementary programs of Phase 2- was the situation confronting numerous countries e.g. France, other OECD countries, Chile, etc. Germany and other OECD countries e.g. Italy also suffered from cultural constraints on the emergence of technological entrepreneurship; as well as institutional constraints e.g. unfavorable Bankruptcy Laws (see Becker & Hellmann 2002 and Black & Gilson 1999 for the German case).

In some cases unfavorable domestic background conditions are the result of an excessively early implementation of VC policies i.e. if policies would have been implemented later the required pool of SU and/or the underlying cultural and institutional constraints would have been overcome. This may have been the case of India who implemented VC policies very early (during the late 1980s) –even before the emergence of Bangalore as a center for Software and IT services.

As a general proposition it is important to point out that, at least during the last two decades, VC policies should not have been the initial or main thrust of a policy designed to generate large numbers of SU. Rather they should have come after R&D capabilities were generated in the Business Sector; and after a minimum pool of innovative SU were in place. We view with skepticism the ‘simultaneity perspective’ to VC and SU development, which appeared in the literature (e.g. Black and Gilson 1998). In contrast to this we presented here a sequential or phased perspective where, prior to the onset of a virtuous VC-SU co-evolutionary process, a critical mass of innovative SU is required.

Another frequent cause of VC policy failure was deficiencies in VC policy design. For example the German program of the early 1980s promoted only one ‘intermediary’ (VC) rather than a number of new VC agents, as was the case with Yozma. Moreover, insufficient attention was given to issues of organization, capabilities and strategy of the new institution. These and other design problems seem to have been the result of a ‘VC as pool of money’ perspective, rather than ‘VC as an industry’ perspective.

Finally, it is also important to point out that the implementation of (even well-designed) VC policies may encounter obstacles, some predictable other not. Thus implementation of a program promoting VCs oriented to early phase SU could imperceptibly or not shift to late phase finance. This apparently was the case of the Swedish VC policies of the mid 1990s.

Needless to say, a systematic Typology of VC Policy Failure may have to wait for comparative research in this area. Our feeling however is that we have made a good start.

6. Conclusions

Israel's policy-led experience with VC and high tech cluster re-configuration is unique in terms of the specifics of the context, the timing and the design of the high-impact policies (particularly the targeted VC policy-Yozma) implemented. It seems to have been one of the few policy schemes, which **implicitly** followed a Systems-Evolutionary Perspective; and it was a resounding success in terms of successful venture capital emergence (although consolidation is not yet assured there are very positive recovery signs since Q3, 2003). Moreover both because of the 'fertile soil' for VC, which was created prior to VC emergence and because the targeted policy adopted was well designed and timed, it is not possible to state that the geographical location of the new industries was 'random' (this statement assumes that Israel is 'one region' which seems reasonable given the size of the country).

While other countries cannot copy the Israeli experience, there are a number of analytical lessons flowing from it that may be useful. It is one instance or variant of a more generic three phase model of successful evolution of Innovation and Technology Policy oriented to business sector R&D, VC and high tech industries more generally speaking; and of co-evolution between the business sector and innovation/technology policy. There are strong reasons to believe that an analysis of the Israeli specific variant may clarify the policy options available to other countries aiming at developing VC industries and high tech clusters.

The Systems Evolutionary perspective seems not to have been adopted in several other countries whose policies in this area either failed or had a weak impact. As mentioned, VC policies in Israel were the outcome of a long three-phase, Innovation and Technology Policy Cycle, which started 25 years prior to Yozma. That country's success in VC and high tech depended crucially on a prior set of ITP programs. Moreover the timing of the specific, VC-directed policies was right both from the point of view of 'domestic demand' for VC services and from the point of view of the period of time prior to the capital market down cycle available for consolidation of the industry emergence process and for materialization of its high tech impact.

The objective of Yozma was explicitly ‘creation of a domestic VC industry’, that is VC emergence. This was no simplistic ‘pool of money’ perspective; nor was it a simple ‘additionality’ criterion of success. Moreover the process occurred very fast as if policy makers were aware of the intrinsic dangers and risks of a more gradual approach to the creation of the industry.

Another major conclusion of our analysis is the ‘complexity of the design’ of the targeted VC directed program. It included an explicit Government venture investment component without falling into the trap of a Government VC company (the fund of fund function was crucial); a highly original set of ‘incentives to the upside’ a crucial multidimensional coordination process (particularly related to accessing world class ‘intelligent’ investors in the area); selection processes both of VC company teams and of VC organization and VC strategy; and a government signaling function. Moreover, implementation assured a process of collective learning to take place as well as ‘investment coordination’ among the various VC funds created under the sponsorship of Yozma. The upshot would seem to be that there is a critical mass of effort that should go into the policy making process and that high level capabilities should be developed for this purpose. These requirements might separate those countries who are capable and willing to go through the required lengthy policy process and policy cycle culminating in VC policies from those who are not willing or capable to do so.

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