

October 2003

Preliminary

**GOVERNMENT PROMOTION OF LEARNING AND INNOVATION IN
SMEs OF INDUSTRIALIZING ECONOMIES: SUBSIDIES, VENTURE
CAPITAL AND PRIVATE EQUITY**

Gil Avnimelech

School of Business, The Hebrew University, Jerusalem

gilavn@mscc.huji.ac.il

and

Morris Teubal

Economics, The Hebrew University, Jerusalem

msmorris@mscc.huji.ac.il

Background and Objectives

1. The Israeli Experience in supporting Industrial R&D and Venture Capital(VC)

2. Towards a General Two Phase Innovation and Technology Policy (ITP) Model

2.1 The Model

2.2 Phase 1: Horizontal Support of SME Innovation

2.3 Phase 2: Targeted Support of VC/PE

3. Applicability to Industrializing economies

3.1 Top Tier Industrializing Economies are and should be increasingly interested in Software and IT high tech and therefore in R&D & VC

3.2 Commonalities between a VC industry serving high tech SU companies and a PE industry directed to innovative SMEs

4. Notes on ITP-business/SME co-evolution

Conclusions and Future Challenges

Acronyms

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

VC-Venture Capital, Venture Capital Company; OCS-Office of the Chief Scientist, Ministry of Industry and Commerce (Israel)

ITP-Innovation and Technology Policy; HTP-Horizontal Technology Policy (program)

PE-Private Equity, Private Equity Company

KBE-Knowledge Based Entrepreneurship

SBIC-Small Business Investment Company; SBA-Small Business Administration(USA)

Background and Objectives

This paper traces the main outline of a possible policy effort in industrializing economies whose objective is to simulate SME Learning & Innovation (or KBE more generally-see below) first through Government subsidies, and then through Government support of the Venture Capital (VC) and/or Private Equity (PE) industries¹. Different countries and, for any one country different phases in their development, may require a different policy focus with respect to innovation subsidies on the one hand and the promotion of the venture capital and/or private equity industries on the other.

Subsidies to companies or to particular company activities represent a *direct* form of Government intervention to induce innovation & learning (broadly construed *a la Schumpeter*) in the business sector; whereas policies to promote the creation of an effective Venture Capital (VC) and/or Private Equity (PE) industries, only *indirectly* support SME such activities or functions. Venture Capital and Private Equity represent a *private financial infrastructure* to innovative SMEs/SU.

A main issue is identifying the conditions under which a phase of intensive Government subsidization of SME innovation & learning would create background & pre-emergence conditions for the subsequent emergence of a private VC and/or PE industry. We suggest that these conditions contain three central elements: a) at least reasonable diffusion of innovation and learning throughout the SME segment of the business sector; b) a measure of development of SME 'learning and innovation' capabilities; and c) emergence of 'demand' for finance by an innovative/KBE-based SME segment which was created in the wake of Government subsidization or by new such entrants.

A second issue is characterizing the process of emergence of VC/PE 'industries' and ascertaining their impact on the subsequent growth of the innovative

¹ VC companies are "independently managed dedicated pools of capital that focus on equity or equity-linked investments....." (Gompers and Lerner 1999 p. 349). It can be defined strictly or 'broadly'. The strict definition involves a 'dominant' orientation to the early stage finance of high tech Start Up (SU) companies; while the broad definition which is that of Gompers and Lerner op. cit concerns 'privately held *high growth companies*' that is it is not focused exclusively on high tech. The broad definition also allows for 'other types of equity investments' e.g. leveraged buy-outs, buy ins, consolidations, etc although it is implied that these are not the dominant strategy. If the latter type of equity investments are dominant they would be termed non- VC PE companies (US) or simply PE companies (Europe). The US definition of a PE company thus includes both VCs and other financial institutions whose dominant activity are is an equity based financial institution oriented both the non high tech and to high tech industries (and services). 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.

or SME segment (alternatively, in the transformation of the SME segment of the business sector). Such emergence could be *policy led or market led*. If background conditions are favorable and if the required Government action is forthcoming, then emergence of a VC/PE industry could play important role in the subsequent growth and efficiency of the country's SME segment. Under certain conditions, this segment may begin to grow at a fast rate and possibly co-evolve with the recently emerged VC/PE industry. The outcome would not only be a dynamic and innovative SME segment but gradual substitution of public subsidies by the "market" who will increasingly take over the 'innovation finance' function previously performed by the Government². Moreover, this function will be bundled with *adding value activities* performed by the VC/PE segment in connection with management, production, marketing and international expansion. These additional functions, which may be critical for the rapid growth of an innovative SME segment, are linked with the mode of operation, links and capabilities of VC/PE. 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 specialization- VC/PE companies will represent loci of capabilities, networks and reputation with enormous 'adding value' potential to the emerging innovative SME segment.

As mentioned a necessary condition for this two phase process is that the impact of the Subsidies during the first phase would be enhanced 'innovation' in the SME segment of the business sector; a gradual accretion-through learning- of 'innovation capabilities'; and a strong process of entry of innovative SMEs. As implied above, Innovative SMEs should be linked to the concept of Knowledge Based Entrepreneurship (KBE) which is increasingly relevant for wide swathes of the SME business segment- both in low & mid tech industry, and in the software/IT & high tech industries³. It is a much broader concept than high tech entrepreneurship. The beneficial impact of subsidies will then set the stage for a new phase in the development of the country's business sector one where, in the medium term, a

² This means that Government subsidization was a *catalytic policy* in the sense of having stimulated other market-based sources of finance which can substitute for its own resources.

³ KBE is linked to the increasing importance of knowledge, links and networks in all business sectors or segments: low tech, mid tech and high tech. Knowledge is broadly construed to include knowledge form outside the firm as well as from endogenous R&D or learning; tacit and/or codified knowledge; knowledge accessed through the market or through personal, professional or business links/ networks. Etc.

largely domestic PE industry will cater to the needs of low & mid tech KBE part of the SME segment of the business sector; while (in some contexts) a smaller VC industry—probably linked with the global VC industry- will cater to the software/IT services & high tech segments.

Theoretical Approach

The paper adopts a *policy-oriented focus* based on Evolutionary & Systemic principles (Metcalf 1995, Edquist 1997, Lundvall et al 2002, Teubal 2002 and A&T 2003a,b,c,d,e) both with respect to our understanding of real world processes and with respect to policy (more specifically Innovation & Technology Policy—ITP).⁴ It argues that policy analysis should be explicitly dynamic; and that it should focus on ‘capabilities’ both of the private sector and of Government; and on co-evolutionary processes.

There are four *knowledge modules* which will be integrated into our attempt to create a two phase Innovation and Technology Policy (ITP) model in support of learning and innovation in SMEs: Grants-based Evolutionary Horizontal Programs supporting Innovation (Phase 1); an Industry Life Cycle Perspective to VC and PE & elements of a theory of *targeted infant industry development* policies (Phase 2); and virtuous ITP-Business/SME co-evolution (across both phases). Prior to the analysis of the two-phase model we summarize a very successful special case-Israel’s support of R&D and of VC, a process which took place during almost three decades starting in 1969.

1. The Israeli Experience in supporting Industrial R&D and Venture Capital

In a number of papers (A&T 2003a,b,c; AKT 2003) 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 (1970-89); Pre-Emergence (1989-92); the central VC Industry Emergence phase when the industry got established (1993-2000); Crisis & Restructuring (starting in 2001); and and the final Consolidation phase (in process).⁵ The main event in this

⁴ Needless say that the basis for a policy oriented Systems/Evolutionary perspective lies both in the Evolutionary Perspective to Economic Change (Nelson and Winter 1982, Dosi et al 1988; and in the Systems of Innovation Perspective(Freeman, Nelson, Lundvall among others). In this draft we emphasize much less the ‘justification’ for Government intervention and much more the *structure* or profile of required Government action.

⁵ The five phases of the evolution of VC industries should not be confused with the two phases of our ITP model of support of innovative SMEs although there is a link between the two. Thus the

process is Emergence of the VC industry which took place during 1993-2000. It 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, appearance of a distinct high tech industry, and broad experimentation and learning by both the private sector and Government in connection with the new models of high tech SU and of the specialized institutions associated with their finance and support(VC). Underlying all of these processes was a very successful proactive Government Policy with a strong emphasis on R&D subsidies/grants to business sector R&D. The main incentives program was an Horizontal Program supporting this activity, 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; A&T 2003a) 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(investment banks and NASDAQ).

The grants to R&D program was the backbone of Israel's ITP during more than 20 years during 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.

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 2003c,d). From an evolutionary and Industry Life Cycle (ILC) perspective *VC Emergence* is the process which leads to the 'creation' of a new industry-in this case an *infant* VC industry in Israel. Central to this is the onset of an autocatalytic, cumulative process with positive feedback involving not only VC but SU and the entire high tech cluster. It was a complex process triggered

Background Conditions and Pre-Emergence phases of the development of VC correspond to Phase 1 or 'subsidies' phase of the ITP model; whereas the third VC emergence phase corresponds to Phase 2. Our ITP model will not be linked to the post emergence phases of VC/PE.

by Yozma and involving a number of co-evolutionary and other process such as 1) VC-SU co-evolution; 2) Domestic VC industry- Global capital markets interaction; 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 high tech Startup companies and with Global Capital Markets of technology companies (such as NASDAQ).

Box 1 below summarizes the main events and processes underlying the successful evolution of the US and Israel's VC industries (for further details see ATK 2003). Note that an important background event in the US which both preceded and accompanied the emergence of VC in that country was the Small Business Investment Company (SBIC) program which supported the creation of private companies devoted to SME equity investments (most of them were directed to non-high tech SMEs). There is wide consensus that the SBICs provided both funds and a training ground for future venture capitalists.

Box 1: Main Events/Processes in the Successful Evolution of a VC Industry*

<p>BACKGROUND CONDITIONS PHASE</p>	<ul style="list-style-type: none"> • Creation of High Tech Industry and R&D/ Innovation capabilities; • Concern for the financing of SME not necessarily high tech SU. • Almost no formal VC activity; limited informal VC activity • Growing Acceptance of technological entrepreneurship
<p>PRE-EMERGENCE PHASE</p>	<ul style="list-style-type: none"> • A Technological Revolution which assures a continued stream of new business opportunities for SU • Mechanisms for supporting SME and / or SU • Growth of informal VC e.g. angels; and of VC-related activities • Some formal VC funds • Increasing numbers of SU → excess demand for VC services • Experimentation (variation) & Learning (selection): VCs, SU and Policy makers
<p>EMERGENCE PHASE 'Early' Emergence</p>	<ul style="list-style-type: none"> • High rate of growth of VC activity; large numbers of new funds & new VC companies • Continuation of Experimentation and Learning → Enhanced Selection • Triggering of a Cumulative process ('reproduction') caused by positive feedback and by VC-SU (& others) co-evolution processes within the cluster • Entry of less skilled VC managers/firms. • Excessive competition & eventually overshooting
<p>'Late' Emergence</p>	

CRISIS & RESTRUCTURING	<ul style="list-style-type: none"> • Overshooting leads to a deep crisis characterized by the drying-out of the sources of capital and by a shakeout of companies • A new set of institutions (formal and informal) emerge and a new set of policies are implemented
CONSOLIDATION	<ul style="list-style-type: none"> • The VC industry restructures; the restructuring may be more or less successful. • 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. • The major effect is Sustainability of the VC industry: the enhanced capacity to overcome crises in the future

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

General Comments⁶

The Israeli experience is quite unique in that it probably is the most successful instance of diffusion of the Silicon Valley model (or 'strict definition') of Venture Capital beyond North America (see A&T 2003c p 1-2). This model focuses on VC oriented to *early stage investments in high tech SU*.⁷ It was implemented in the wake of a new era in the Globalization process one characterized by the Globalization of those Capital Markets focusing on IPOs of young technology companies. 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 product markets become a reality.

The possibility of latching into the global IT revolution is probably the main reason why Israel's success in creating a VC industry is important not only for advanced industrialized economies but also for developing economies like India; for top tier developing countries like Taiwan and Singapore; and for an increasing number of developing countries wanting to develop their Software services industries.⁸

⁶ See also 2.2 below

⁷ VC according to this definition should be distinguished from a Private Equity (PE) financial segment where the dominant share of equity investments are not necessarily directed to high tech. A PE may have a significant focus on non high tech SMEs or on well established companies. Large chunks of the European VC industry are in fact PE and so is Taiwan's VC industry(OECD, various reports).

⁸ Moreover the evolutionary perspective adopted in our analysis of VC emergence and of the targeted policies oriented to this objective may be relevant for some categories of *targeted support of infant industries* in developing economies in general. Some of the insights garnered from the Israeli case might be relevant for such policies

2 Towards a General Two Phase Innovation and Technology Policy (ITP)

Model

2.1 The Model

Box 2 schematically outlines the two phase ITP model for the support of innovative SMEs.

Box 2: Two Phases in the Support of Innovative SMEs*

<p><u>PHASE 1</u></p> <p><i>Horizontal Subsidies to Innovative SMEs/SME Innovation</i> (R&D Grants to firms)--→Gradual Transformation of SME sector & creation of a pool of Innovative SMEs(creation of R&D performing companies, beginnings of high tech industry, and increased rate of SU creation)-→</p>
<p>-→Excess Demand of ‘finance’ & ‘support’ by Innovative SME i.e. for PE/VC services(excess demand for ‘services’ of VC)-→</p>
<p><u>PHASE 2:</u> <i>The policy context is one of continued support for innovation at least for some time probably with declining rates of subsidization</i></p> <p>Targeted Support of PE/VC industry (Yozma Program implemented during 1993-7)-→PE/VC industry emergence(Emergence of Israel’s VC industry during 1993-2000)-→</p>
<p>-→Rapid Growth of Innovative/KBE-based SME segment (rapid growth of SU numbers, employment, sales & in IPOs and M&A; VC-SU co-evolution)</p>

*The specific Israeli example is in parenthesis

The model purports to be quite general in the sense that it *allows a number of variants* which reflect the particular conditions prevailing in different industrializing economies. *First some countries may already have a pool of innovative SMEs in which case the only relevant phase may be Phase 2.* The issue here is whether the right policy context is in place including existence of support programs for innovative SMEs (a measure of overlap of direct and indirect SME support is necessary to assure accelerated entry of new innovative SMEs and accelerated transformation of existing

whenever, like frequently is the case in this era of globalization, a successful policy requires accessing sophisticated world class foreign resources and linking them with domestic resources (see Section 3 below).

non-innovative SME). If this is the case and if significant System Failures block the autonomous emergence of a PE/VC industry-the stage is set for implementing a targeted policy directed to that industry. Normally one would expect that the targeted program should be accompanied by other complementary incentives programs (in Israel, over and beyond the regular Grants to R&D program, a more specific Technological Incubators Program was implemented which also promoted new SU entry) and/or by adaptations of the institutional setting.

A second major model variant concerns the nature of Phase 2 where the box represents the policy-led variant. It is important to recognize the possibility that emergence of a PE/VC industry might be a *market led* process (like VC industry emergence in the US which was not the outcome of a VC-directed targeted program).⁹ This is a possibility both for countries where both phases are relevant and for countries where only Phase 2 is relevant. Even then however, while a targeted and deliberate PE/VC emergence policy might not be required, complementary incentives programs and institutional changes may be warranted. For example, US Federal Government support of science and technology in the areas of minicomputers and semiconductors were important policies which supported emergence of a distinctive VC industry during the late 1960s early 1970s (AKT op. cit.).

A third (cluster of) variants concerns the initial structure of the SME sector at the beginning of Phase 1 and the specific functions to be supported by subsidies¹⁰. SME support may take many forms: support of technology transfer, technology adaptation & learning; training of personnel, advisory and consultancy services, equipment modernization, R&D, engineering and product design, introduction of managerial or organizational innovations, etc. A major issue is the effectiveness of the

⁹ It would seem incongruous to state that a market led process in Phase 1 *and* in Phase 2 represents one variant of the two phase ITP model of support of Innovative SMEs. This need not be so since even market led processes (as defined in the text) frequently require complementary incentives programs and institutional changes affecting other elements of the system. Alternatively we also can define 'zero policy' as one particular state of ITP. If this is still not convincing enough then the two phase model should relate to the 'evolution of an innovative SME sector' rather than to the 'evolution of ITP directed to innovative SMEs'

¹⁰ In this paper we focus on subsidies or grants to innovation rather than other tools such as tax benefits which have been found of doubtful value as promoters of R&D (see e.g. Metcalfe 1995 and Stoneman 1987). For our purposes subsidies/grants includes also 'non-refundable loans' (loans which are not returned if the innovation fails commercially) and royalty schemes (where the quid pro quo is royalties on sales from the innovation being subsidized).

various types of innovation-related functional or activity support of SMEs in different contexts.¹¹

2.2 Phase 1: Horizontal Support of SME Innovation¹²

Evolutionary *Horizontal Technology Policy programs*(HTP) supporting company innovation through subsidies have been analyzed in Teubal 1996,7 in the context of Israel's R&D support experience of more than three decades. The program initiated then, which remained dominant thereafter even after VC came into being more than 20 years later, was the "Industrial R&D Fund" (see Box 3). It recognized the importance, during its first sub-period of implementation, of building capabilities in the business sector; and implicitly at least, that this objective required a 'learning approach' to its design and implementation (see below). Moreover at this early sub-period subsidies would tend to be neutral i.e. without strong preferences given to particular branches of industry or technologies¹³. This is not for 'neoclassical reasons' but because of ignorance or lack of information. In this early sub-period neither the location of externalities and spillovers would be known to policy-makers nor would there be strong knowledge about areas of potential competitive advantage.

After the initial sub-period of implementation of such a program (say 5-10 years depending on context) a number of developments will very likely take place: exhaustion of learning opportunities and associated externalities (in certain areas); new opportunities for complex types of R&D projects (based on capabilities generated in simpler projects); and identification of possible areas of competitive advantage. The policy implications of these endogenous changes would include a)

¹¹ This is a big question which we cannot answer at this stage of the research. We are only stating here that there are a number of variants of a successful two phase ITP model oriented to innovative SMEs and that these variants are related to the alternative ways of Phase 1 support depending on context.

¹² This subsection relies extensively on previous work on HTP supporting business sector R&D, particularly the Israeli experience and aspects of that of Mexico and Chile (see Teubal 2002 and A&T 2003a and the references quoted there). While additional work has yet to be done to extend the theory of HTP to other functions and activities (including support of Innovative SMEs in industrializing economies) most of the principles of design and implementation of R&D-based programs are applicable to a significant extent to these other areas as well.

¹³ Purely horizontal/neutral policies support 'random' rather than 'systemic' *variation*-a central aspect of virtuous evolutionary processes (Nelson 1995) and extremely important at an early stage of the SME innovation process where potential competitive advantages are only vaguely known. Whenever policy makers have firm knowledge about areas/sectors of high potential-then support should be selective. This is more likely to occur in the second sub-period of implementation of HTP but it may also occur within the first. Whenever this is the case either the HTP will introduce elements of 'selectivity' in support or alternatively, a separate targeted program should be implemented. Our framework thus supports a *dynamic* mix of policies -horizontal & targeted(see Teubal & Andersen 2000).

likely reductions in average R&D subsidies together with greater selectivity; and b) the implementation of a number of additional programs e.g. targeted programs for specific areas/technologies; or for VC/PE. In Israel only a very limited adaptation did occur before 1990.

As with the support of R&D, an important objective of horizontal subsidies to innovative SMEs is-through policy experience in supporting innovation and through learning- the identification of SME areas with potential competitive advantage. As mentioned above the activity or function focused will not be only and probably not primarily R&D: it will include support of technological modernization, technology transfer and other knowledge creation and adsorption activities.

Israel's 'Backbone' "Industrial R&D Fund"

Box 3: Israel's 'Industrial R&D Fund'

The Israeli Government's ITP directed to the Business Sector began in 1969 with the creation of the "R&D Industrial Fund" at the recently created OCS (the specialized agency in charge of promoting R&D intensive and high tech industry in Israel). This program was, and to some extent continues to be, the backbone of that country's R&D/Innovation/Technology Strategy as far as the Business Sector 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 of individual companies whose objective is the creation of new or improved products (or processes) directed to the export market. This type of R&D could be termed 'regular' or 'classical' R&D to differentiate it from generic, cooperative R&D which is a more infrastructural type of R&D. The latter's objective is to generate knowledge, capabilities and components rather than directly marketable outputs. Its output would facilitate (or become inputs to) a subsequent 'regular' R&D activity directed to new products or processes.

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 significant increases in R&D Grants to Industry.

The "Industrial R&D Fund" is an example of an *Horizontal Technology Policy (HTP) Program* that is a program directed to the Business Sector as a whole and open in principle to all firms in that sector (rather than a *Targeted Program* applicable to a specific industry or technology). These programs embody an important component of 'neutrality in incentives'. In Israel this expressed itself as a 50% subsidy to every R&D project submitted to the OCS, whatever the firms' industrial branch, whatever the product class towards which the proposed R&D was oriented, and whatever the technology underlying such a product class (see Teubal 1982,93). From \$2.5M in the late sixties, the program involved disbursements, which almost reached \$300M in 1996/7

Learning in the HTP Early Sub-Period

The major objective during during the early sub-period is to promote learning about R&D/Innovation¹⁴. Much of this learning 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. The first box below proposes a certain categorization of intra-firm learning processes); while the second box, some specific aspects of 'collective learning' during 1969-90 in Israel.

BOX 5: Learning during HTP implementation

¹⁴ Learning, including experience-based learning triggered by increased R&D in the business sector is the main factor leading to that sector's enhanced R&D/Innovation capabilities.

A: Intra- Firm Learning 'about R&D/Innovation'- early sub-period
1. Learning how to search for Market and Technological Information.
2. Learning to identify, screen, evaluate and choose new projects
3. Learning to generate new projects, including more complex ones
4. Learn to manage the innovation process (linking Design to Production & Marketing; Selection of Personnel; Budgeting; etc)

B: Collective Learning
Firms learned about the importance of marketing (thereby overcoming the previously held view that “my invention is so good that it will sell automatically”)
Officials and experts of the OCS learned, partly through exchange of information within an informal ‘policy network’ a) to better assess the quality and potential of the projects submitted; b) how to help firms configure good projects
Firms acquired capabilities for identifying new projects, including “complex” projects which built upon prior ‘simple’ projects

The Learning Approach to HTP Implementation

A study of Horizontal programs would suggest the following components of a learning approach to HTP implementation

- Assuring a Critical Mass of Projects as early as possible during the Infant Phase of the program
- Creating a Policy Implementation Network—to assure learning by experience on the part of policy makers
- Generating Policy- relevant typologies of R&D/Innovation projects, firms and areas
- Analyzing, codifying and diffusing knowledge about the Learning & Growth Processes of successful companies
- Special Attention to promote *wide diffusion* of R&D (or other relevant activity promoted) during the mature phase of program implementation(including actions to avoid biases against SMEs)
- Explicit attention to developing Policy Capabilities
- Other: flexible budgets, use of grants rather than loans, bottom-up determination of projects, etc

These factors have been analyzed in previous work. None of these factors can be assumed to be given, on the contrary—many would go contrary to the intuitions and to the routines of policymakers.

At the individual program level, proof of success in the adoption of a ‘learning approach’ to implementation, 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.¹⁵ Under favorable conditions take off may happen a few years after initiation of program implementation. Two other indicators of success are ‘*endogenization*’ of the activity supported (e.g. R&D or other functions/activities related to Innovative SMEs); 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 my 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 the ‘return’ would have a qualitative component—wide diffusion of a strategically important activity within the business sector- and a quantitative one- measured rate of return). Achieving all three objectives would be indicative of the cumulative, learning-induced process mentioned above.

2.3 Phase 2: Targeted Support of PE/VC¹⁶

A successful Phase 1 would generate ‘background conditions’ for the targeting of a PE/VC industry which could play a significant role in further promoting the innovative, KBE-based SME segment of the business sector. Both the US and Israel’s experience show the crucial link between Grants to R&D (in Israel this represented a de facto support to SMEs) and support for SMEs more generally speaking (the US’s SBIC program implemented during the 60s and 70s) on the one hand and emergence of a VC industry on the other. A central link in the two phase ITP model is emergence of a demand for the services of the future VC/PE industry. In contexts where Government Subsidies to innovation in SMEs had a strong impact and created a ‘pool’ of innovative SMEs, a significant ‘market’ for the services or the activities of Venture Capital and/or Private Equity industry will be created. Since *System Failures* may still block a purely market-led process of emergence, the implementation of Innovation & Technology Policies (ITP) may be required. As we mentioned, these may take the form of *targeted VC and/or PE emergence policies*. These new ‘finance

¹⁵ This might but need not coincide with the point of inflexion of the S-curve used in Diffusion Studies.

¹⁶ While the analysis focuses on Israel’s successful targeting of the VC industry (A&T 2003d,e) important analytical components are applicable to other VC and PE industries in other countries as well. This because of the evolutionary and ILC perspective adopted which admits numerous ‘variants’ within an overall analytical framework.

infrastructural components' would represent a mixed market & policy led *supply response* to the growing need for VC/PE supporting services which the strong subsidies-triggered learning process of Phase 1 has created.

*Background to Israel's Yozma Program*¹⁷

During the late eighties 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 SMEs whose access to bank finance was limited) this was only part of the problem. A no less important aspect was the perceived weakness in management abilities, business know how and production/marketing capabilities of such companies.

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 growth. 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 identified 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.

A First Attempt at Targeting: 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

¹⁷ For more details of Israel's targeted VC industry program see A&T 2003d,e

problems. More significant was the fact that the program didn't attract any 'adding value' agents or capabilities. The funds did not succeed financially and did not raise additional capital. Eventually all four 'Inbal' funds quit the program (today all of them are 'held' by one holding Company-Green Technology).

The Inbal program not only didn't solve all market failures related to the 'pool of capital' aspect of the VC industry but it didn't target any of the system failures related to VC industry creation/emergence. There was no mechanism for drawing professional VC agents into the program; it did not generate VC companies with adding value capabilities; it didn't promote collective learning; it didn't create links with additional late stage VC pool or a significant IPO market; and it was exposed to 'stock market sickness'. Its model of VC company organization was not imitated, and the 'social impact' of the Inbal Program was very low (A&T2003e). Having said this, it is important to mention that policy makers and businessmen alike learned from Inbal's weak impact particularly 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 for the "upside". Awareness of these favorably influenced the design and implementation of Israel's successful Targeted Policy-The Yozma Program

The Design of Yozma

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

10 private VC funds ('Yozma Funds'-\$80M); and b) direct investments in high tech companies-\$20M (through the Government –owned 'Yozma Venture Fund'). The basic thrust was to promote the establishment of domestic, private LP VC industry that invested in young Israeli high tech SU ('early phase investments') with the support of government and with the involvement of reputable foreign financial institutions (generally a foreign PE or VC company). Such funds must be managed by an independent Israeli VC (Management) Company. Each 'Yozma Fund' would have to engage one such foreign institution together with a well-established Israeli financial institution. This emphasizes the point that the Yozma program favored entry of professional managers or of individuals with VC-related abilities into the infant VC industry. Moreover, the insistence on 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 reputation. In an approved fund that fulfilled these conditions, the Government would invest 40% (up to \$8M) of the funds raised. Thus \$100M of Government Funds would draw \$150M of private sector funds (domestic and foreign)¹⁸.

Yozma did not simply provide capital and risk sharing incentives to investors--as was common in other Government VC support programs¹⁹; its main incentive was in the 'upside'-- each Yozma fund had a call option on Government shares, at cost (plus 5-7% interest) for a period of five years. The program also assured the realization of 'supply side learning' through the compulsory participation of foreign Financial Institutions ('learning from others"-a standard mechanism of infant industry development in developing countries); through participation of the Yozma Venture Fund manager (Yigal Erlich & other OCS officers) at the board meetings of all Yozma funds (they probably acted as a node in a vast information network); and through the stimulation of co-investment among Yozma Funds. Culturally speaking the stage was set for a lot of informal advising and interaction among fund managers. 'Demand side' support was assured not by Yozma itself but by the Backbone 'R&D Subsidies program & by the Technological Incubators Programs (see A&T 2003a,b).

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

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

Another major point was the pursuing of an aggressive investment policy, spearheaded by Yozma Venture Fund.

The Yozma Program created a total of 10 private ‘Yozma funds’²⁰. As mentioned, the program also directly invested 20M\$ through the Government-owned Yozma Venture Fund which started operating in 1993 (it was privatized in 1998). The total capital raised by Yozma funds was about \$250 million and they invested in over 200 startup companies. Box 5 below summarizes the main features of Yozma's design.

Box 5: Critical Dimensions of Yozma Program Design

<i>Fund of Funds & 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) & involving Reputable Foreign Financial Institution.</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 & 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>

The System Failure to be overcome

The above elements of design were supposed to overcome a number of constraints to the successful implementation of a program whose objective was to induce VC emergence (A&T 2003f). Many of these were market/system failures i.e. which *unaided* market forces would not have solved by themselves which the Yozma program overcame. The list of constraints is shown below

- *Difficulties in accessing intelligent & reputable foreign partners*
- *Assembling a Critical Mass of Capabilities*
- *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

20 Six Yozma funds were created in 1993 (Gemini, Star, Concord, Pitango, Walden & Inventec); one in 1994 (JVP); two in 1995 (Medica & EuroFund); and one in 1997 (Vertex). At least two additional VC funds were created as a result of direct interaction with Yozma officers and an additional 30 funds during 1993-5 as a result of the indirect influence of Yozma (12 VC funds and 18 PE funds).

- *Conventional market failures (see learning below)*
- *Selection of VC strategies consistent with strict definition of VC*
- *Assuring Fast Learning*
- *Country/Government Signaling*
- *Selection of VC Characteristics*

Overcoming the above constraints 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.

Yozma Impact

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

Needless to say 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 (see A&T 2003b). For example, high tech exports quadrupled during the decade of the 1990s; there was an enormous increase in numbers of SU; and the share of SU-related 'output' to total high tech output increased considerably during the decade (Teubal & Avnimelech

2003)

Understanding Yozma's Success

In A&T (2003a,b) we provide an 'explanation' why Yozma, through critical mass effects and other factors became the trigger for VC industry emergence and for the onset of a cumulative process of development. Over and beyond favorable background conditions already mentioned and other features of the pre-emergence period we would like to point out here the role of three additional factors which contributed to Yozma's high impact: a) Prior existence of 'unsatisfied demand' for VC services- a consequence of a pre-existent pool of SU which included some high quality firms (e.g. Checkpoint.) who also made a significant direct & indirect contribution to cumulateness & emergence (A&T2003d); b) overlap between the learning & cumulateness process taking place domestically and the rising NASDAQ index (and other favorable conditions)²¹; and c) Yozma's successful design.

Thus as can be expected from a Systems- Evolutionary ITP perspective, Israel's targeted policy directed to the VC industry was successful because its design explicitly (and to some extent implicitly) 'took account' of a) *context* and b) *timing of implementation*. Timing is related to context in the sense that some aspects of the domestic context e.g. assuring a steady flow of innovative SME entrants, may be influenced by other policies prior to implementing the targeted policy itself. Moreover, the timing of implementation should take account of the actual and expected international context (e.g. global high tech product markets and global capital markets for SU companies) which will face the fledging VC and related high tech industry. Also, targeted program design should be adapted to the existing institutional and cultural setting, and frequently some adjustment in the institutional framework (at least the 'formal' one) must take place to enable a good program design to 'fit' well.

A Systems-Evolutionary perspective also will contribute to understanding the sources and types of 'failure' in the implementation of targeted PE/VC policies. In A&T 2003d we identified six types of failure which might beset targeted VC (and by extension –PE) policies. Many of these are linked to issues of timing and context; and others to aspects of design and implementation.

3.Applicability of Two Phase ITP model to Industrializing economies

²¹ Expanding global market for IT- this overlap was not so consistent in other countries where VC-SU co-evolution began operating only after 1996.

The possibility of introducing variants to the basic two phase ITP model explains why it is in principle applicable to other contexts beyond R&D and VC and beyond Israel. Here we focus on two main reasons. We start with the first.

3.1 Top Tier Industrializing Economies may be interested in Software and IT high tech and therefore in R&D & VC

Globalization is creating new opportunities for Software services, Software and IT industries. This takes the form of accelerating the initiation or creation of such industries within the top tier category of industrializing economies; or creating opportunities which –absent globalization-would never have appeared.

Even during the present crisis, there is *increased outsourcing of Software and IT services* by large US corporations to Indian software/software services companies (Nasscom2002, A&T 2003 e). Also *acceleration of the establishment of R&D Labs* of leading MNE in those industrializing economies having highly skilled labor and excellent, low cost engineers and technicians e.g. India & China. The Israeli experience and probably also the Irish and Taiwanese experience show that these trends could set the base for the eventual development of an indigenously based IT industry.

Globalization could-for those countries which are successful in adapting to the new set of circumstances-enable an increasing share of the important elements and critical resources required for the establishment of a high tech cluster to be accessed from abroad (even in the absence of well organized markets) . This could be direct or indirect. Thus, the outsourcing of IT and software services could set the basis for the development of indigenous *product software* in countries like India e.g. many of the indigenous Indian companies in these areas (e.g. Infosys) have generated a reputation and have relatively deep knowledge of the needs of high profile MNE in the US. Moreover, spinoffs and collective learning by engineers and managers employed in R&D labs of foreign MNE will contribute to the founding and growth of indigenous high tech companies. An alternative mechanism is through the larger set of markets in a globalized world which enables peripheral economies to access essential inputs which could not easily be developed indigenously e.g. consultancy services, marketing, technical assistance, markets for technology. Finally the greater possibilities for Mergers & Acquisitions and eventually (after the end of the current crisis) for Initial Public Offerings.

However not every country can benefit from Globalization. Government policies may be critical. But as the Israeli example shows, these policies are possible. One important set of policies concerns the creation of world class indigenous VC/PE industries.

3.2 Points in Common between a VC industry serving high tech SU companies and a PE industry directed to innovative SMEs

The two phase ITP model while initially suggested in connection with R&D support and VC finance of high tech SU is also applicable to support innovation and for PE finance of innovative/KBE-based SMEs. This because of a number of characteristics of the increasingly important KBE-based SME segment in the business sectors of developing economies.

a)Increasing importance of Knowledge: not only technological knowledge but markets/marketing, organization, management, etc and not only in high tech but also in mid/low tech and in services

b)Enhanced management skills, networking and reputation required for global competition (e.g. from China²²): Global competition implies not only that more knowledge will be required for decision making but also that significant management capabilities may be required to make appropriate decisions and to implement them (e.g. collaborations, alliances, FDI, etc). Frequently these capabilities are not existent and cannot be generated within individual SMEs. This will hinder both their transformation into innovative/KBE-based SMEs and materialization of their high growth potential.

d)System Failures in the transformation of the SME segment: The above weaknesses of SMEs in their process of transformation into 'Innovative SMEs' may express a System Failure one reason being that the provision of such inputs requires new types of specialized non SME organizations (rather than SMEs themselves).

²² See Lall & Albaladejo 2003

e)Importance of Equity Based Mechanisms of financial & other Support: In this context there is a strong likelihood that equity-based mechanisms of finance embodied in specialized PE companies will become increasingly important for the above transformation of the SME sector and the subsequent growth of an innovative/KBE-based SME segment. In contrast to traditional means of finance (e.g. bank loans) specialized organizations undertaking equity investments in SMEs could overcome the informational and other market and system failures associated with the provision of finance to SMEs. These include information asymmetries; high market uncertainty and uncertainty about SME management; increasingly high share of non-tangible assets; high transactions costs in the provision of essential services from outside consultants, etc. Many of these failures are similar to the imperfections found in the supply of finance to high tech SU segment (Gompers and Lerner 1999, Chapter 1) which VC has effectively overcome.

f)The nature and operation of PE companies directed to Innovative-KBEbased SMEs low/mid tech and to services will resemble what we know about VC in connection with high tech SU high tech

In a way similar to how VC companies overcome the problems of financing high tech SU, PE companies may overcome the problems affecting the transformation of SMEs into innovative/KBE-based SMEs. Also, like VCs, PE companies may provide adding value services to their portfolio SMEs through capabilities, reputation and networking assets

g)PE when directed to Knowledge Based SMEs is an 'industry' with characteristics of VC

In both instances they are specialized institutions which, unlike banks, are capable of overcoming imperfections or constraints in the markets for SME-finance and SME- support. These include information asymmetries, unknown firm and management, a significant share of intangible assets, and volatility of global markets.

h) A PE financial segment may become an important node in the overlapping networks in which a dynamic SME segment is embedded..

There may be central nodes in the process of collective learning as well

i) Systemic Failures may block the emergence of a PE industry

This statement has yet to be proved although there are sufficient grounds *a priori* to assume that this will be the case in a large segment of industrializing economies. This follows from a double set of arguments raised in this paper. The first is awareness of the problems encountered in the finance of high tech SU in advanced countries; and the emergence of an (and desirability of furthering the) Innovative SME segment which is increasingly knowledge based and therefore increasingly similar in numerous respects with the former group of companies. Second that there is a strong likelihood that there are special problems in the finance of such companies which existing financial institutions cannot overcome; and that *successful emergence* of a specialized financial segment dealing with such problems requires overcoming simultaneously a large number of constraints (see 2.3 above).

4. Notes on ITP-business/SME co-evolution

A major remaining issue concerns *policy capabilities*. The Israeli example with the two phase ITP model suggests that these could develop *pari passu* with the implementation of the policy. By this we are stating that policy capabilities cannot be considered as being or not being in place (rather than this -they should be developed and actually they co-evolve with the business sector itself). Thus phase 2 capabilities may be crucially dependent on the evolution of phase 1 capabilities-despite the enormous differences in the challenges facing policy makers.

A strong initial policy capabilities base need not be required to implement the horizontal SME-innovation support programs of phase 1 although policy makers of this phase must be *fast learners* (see 2.3 p. 15). Strong capabilities though are required for phase 2's *targeted* program (targeted programs are inherently more risky and fraught with pitfalls compared to horizontal programs) and also for the post VC/PE emergence period (A&T 2003d).

A first requirement is a tradition for continuously assessing the 'needs' of the emerging innovative SME segment of the business sector; and experience in problem solving i.e. addressing such need. This could be the outcome of a successful policy-business co-evolutionary process during phase 1. To this must be added what may be termed 'strategic policy capabilities' in particular a capacity to identify the emerging

system failure that could block to further development of the fledging Innovative SME segment induced in phase 1. In Israel both policy institutions and personalities played crucial roles in assuring a virtuous ITP-high tech/SU co-evolutionary process which covered *both* phases. The OCS which is a specialized institution devoted to supporting business sector R&D and to the creation and support of high tech industries was specifically created to implement the R&D grants program; and through time it became the locus of new experienced-based capabilities. Moreover, the last Chief Scientist of phase 1 who identified the new system requirements enabling high tech SU to exploit the new opportunities opened up by globalization was also the main actor behind the design of the Yozma Program. His success in identifying the new ‘system failures’ would be impossible without the accumulated experience and knowledge of the OCS. This was the second policy capabilities requirement of the Israeli profile of success in the two phase ITP model. Undoubtedly there are other substitute requirements in other contexts²³.

5. Conclusions and Future Challenges

We have presented the outline of what may be an important category of policy initiatives for industrializing economies in the area of SME support, particularly the transition to KBE, even and especially in traditional areas. A full paper still requires the completion of each one of the three theoretical modules mentioned above. From these it *would also have to assemble a small set of profiles of the two phase ITP model which takes into account the varying contexts facing industrializing economies*. For module 1 we need to access existing research and knowledge about types of SME sectors and the specific contexts into which they are embedded; and related to this-on types of innovation support to SMEs and their impact both in the short and in the medium term (e.g. in connection with the generation of an increasingly important

²³ By a virtuous ITP-High Tech co-evolutionary process we mean a chain of complex dynamic links where Government not only responds successfully to ‘current’ System Failures (SF) but indirectly (maybe somewhat unintentionally) is also instrumental in creating a ‘future’ SF to which it also responds successfully. The link between SF today and SF in the future is the process of business sector (in most cases, high tech) restructuring induced by the policy response, generally a new ITP program, to the current SF. A *virtuous* ITP-High Tech co-evolutionary process requires that the Government identify SF and craft an adequate policy response; and that business/high tech (and other components of the system) adapt, thus effectively cancelling the constraint to growth represented by the original SF. It also requires that the new, restructured & more sophisticated high tech sector which emerges from this first round of policy making and policy impact be capable of exploiting a new set of opportunities that exogenously makes its appearance-- provided a suitable policy response is found to a new System Failure that stands in its way. Israel’s experience suggests that a virtuous co-evolutionary process may require i) a specialized policy institution in charge of national ITP (like Israel’s OCS); ii) strong accumulation of ‘policy capabilities’ through time; and iii) a political process such that the aforementioned agency not be captured by private interests and lobbies

segment of KBE). Concerning module 2 we need evidence about the structure of the PE sector in industrializing countries and about the role they play or could play (side by side with traditional financing institutions) in the financing of & impact on innovation through the purchase of equity stakes and the provision of added value to 'portfolio companies'. Finally concerning module 3-we need to access knowledge about the suitability of various types of Government Agencies involved in designing and implementing ITP.

The tasks are heavy, but the expected outcome could be quite valuable. A *relatively complete and well integrated paper will not be available soon*. It is also conceivable that what we are talking about is not one paper but a 'project' involving several researchers and several papers.

BIBLIOGRAPHY

- Abernathy, W.J. and Utterback, J.M. (1978) *Patterns of Industrial Innovation*, **Technology Review**, June-July, 40-47
- Avnimelech, G. (2002). *Exploring VC Added Value: A Study of the Israeli VC Industry*, **MA Degree Paper**, Tel-Aviv University.
- Avnimelech, G. (2003) Strategic groups in the Israeli VC industry, STE 2003 (in process)
- Avnimelech, G. and M. Teubal, (2003a). Israel's Venture Capital Industry: Emergence, Operation and Impact, in D. Citendamar (ed) ***The Growth of Venture Capital: A Cross Cultural Analysis***. Praeger, Westport CT.
- Avnimelech, G. and M. Teubal, (2003b). *Venture Capital – Start Up Co-evolution and the Emergence and Development of Israel's New High Tech Cluster—Part 1: Macroeconomic & Industry Analysis*, **Economics of Innovation and New Technology**, pp. 1-28.
- Avnimelech, G. and M. Teubal, (2003c) "Venture Capital Policy in Israel: A Comparative Analysis and Lessons for Other Countries. To be published in the Proceeding in ***Financial Systems, Corporate Investment in Innovation and Venture Capital***, Mani S. & Bartzokas, A. (eds), Cheltenham, UK: Edward Elgar, 2003
- Avnimelech, G. and M. Teubal 2003 d."Evolutionary Venture Capital Policies: Insights from a Product Life Cycle Analysis of Israel's Venture Capital Industry", typescript
- Avnimelech, G. and Teubal, M. (2003e): *Strength of Market Forces and the Successful Emergence of Israel's Venture Capital Industry: Insights from a Policy-led Case of Structural Change*. To be revised for publication in **Revue Economique**
- Avnimelech, G. and M. Teubal, (2003e): *The Indian Software Industry from an Israeli Perspective: A Systems/Evolutionary and Policy View*, forthcoming in E. Sridharan & A. D'Costa (eds) **The Context of Innovation in India**, Palgrave, London.
- Avnimelech, G., Kenney, M. and M. Teubal, (2003): "Building Venture Capital Industries: Understanding the U.S. and Israeli Experience" typescript (in process).
- CBS 2001: ***Development of Information and Communications Technologies in the last Decade***, March
- Coriat, B and G. Dosi 1998: "The institutional embeddedness of economic change: an appraisal of the "evolutionary" and "regulationist" research programmes", in Klaus Nielsen and Bjorn Johnson(eds): *Institutions, and Economic Change: New Perspectives on Markets, Firms and Technology*, Cheltenham: Edgar Elgar, pp 3-32
- Dossani, R. and M. Kenney 2002: "*Creating an Environment for Venture Capital in India*" **World Development**, 30 (2):227-253.
- Erlich, Yigal. 1998 and 2000. "Interview by Morris Teubal and Gil Avnimelech."
- Florida, R. and Kenney, M. (1988) "Venture capital-financing innovation and Technological Change in the U.S", **Research Policy**, 17, 119-137.

- Freeman, C. and C. Perez (1988) Structural Crises of Adjustment: Business Cycles and Investment Behavior, in Dosi et al (eds), pp. 38-66.
- Gelvan D. and Teubal M. (1997). *Emergence and Development of a Venture Capital Industry in Israel: and Evolutionary and Policy Approach*, paper presented in Symposium in Honor of Alexander Volta, Como, Italy.
- Gompers P. and Lerner, J. 2001:"The Venture Capital Revolution", **Journal of Economic Perspectives**, **15(2):145-168**
- Gompers, P. and Lerner, J. (1999) *The Venture Capital Cycle*, The MIT Press, Cambridge, Massachusetts, London, England.
- Gort, M and S. Klepper 1982: "Time Paths in the Diffusion of Product Innovations", **Economic Journal (92):** 630-653
- IVA 1997-2003 Yearbooks**, A survey of Venture Capital and Private equity in Israel, edited by IVC
- Jerusalem Institute of Management (JIM) 1986: report to the Office of the Chief Scientist.
- Lall, S and M. Albadalejo 2003: "China's Competitive Performance: a threat to East Asian Manufactured Exports?", typescript, Queen Elizabeth House, Oxford.
- Lerner, J. (1998) Angel Financing and Public Policy: An Overview. *Journal of Banking and Finance*, Vol. 22, pp. 773-783.
- Lerner, J. (1999) The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program, **Journal of Business**, 72 (3), 285-318.
- Lerner, J. (2002) When Bureaucrats Meet Entrepreneurs: The Design of Effective 'Public Venture Capital' Program. *The Economic Journal*, 112 (February) pp. 73-84.
- Lerner, J. (2003): " Boom and Bust in the Venture Capital Industry and the Impact on Innovation", typescript
- Maggioni, M. 2003: **Clustering Dynamics and the Location of High-Tech Firms**, Heidelberg & New Yor: Physica Verlag
- Malerba 1993:"The National System of Innovation: Italy", Chapter 7 in R. Nelson (ed) **National Innovation Systems: A Comparative Analsys**, New York-Oxford: Oxford University Press
- Metcalfe, S. 1995: "The economics foundations of technology policy: equilibrium and evolutionary perspective", Ch. 11 in Stoneman, P. (ed) **Handbook of economics of innovation and technological change**, Blackwell: Oxford UK and Cambridge USA.
- Nelson, R. 1994: "The Co-evolution of Technology, Industrial Structure and Supporting Institutions" **Industrial and Corporate Change**
- Nelson, R. 1995:"Recent Evolutionary Theorizing about Economic Change" **Journal of Economic Literature**, 33, 48-90
- Nelson, R. and Winter, S.G. (1982). *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge, Massachusetts, and London, England.
- OECD 1996:** Venture Capital and Innovation, OCDE/GD(96)168, Paris
- OECD 1997:** Government Venture Capital for Technology Based Firms, OCDE/GD(97)201, Paris
- OECD 2000:** The Internationalization of Venture Capital Activity in OECD Countries: Implications for Measurement and Policy, DSTI/DOC(2000), December
- OECD 2003a:** Venture Capital Policy Review: United Kingdom, DSTI/DOC(2003)1 (STI Working Paper 2003/1, Industry Issues)
- OECD 2003b:** Venture Capital Policy Review: Korea, DSTI/DOC(2003)2 (STI Working Paper 2003/2, Industry Issues)
- OECD 2003c:** Venture Capital Policy Review: Canada. DSTI/DOC(2003)4 (STI Working Paper 2003/4, Industry Issues)
- OECD 2003d:** Venture Capital Policy Review: Israel. DSTI/DOC(2003)3 (STI Working Paper 2003/3, Industry Issues)
- Perez, C. 2003: *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*, Edgar Elgar, Cheltenham, UK.
- Saxenian 1998: *Regional Development: Silicon Valley and Route 128*, Harvard University Press
- Stoneman 1987; *The Economic Analysis of Technology Polic*, Clarendon Press, Oxford.
- Teubal 1997

Teubal, M 2002:" What is the Systems of Innovation (SI) Perspective to Innovation and Technology Policy (ITP) and how can we apply it to developing and industrialized economies?", **Journal of Evolutionary Economics** 12:233-257

Teubal, M. (1999). Towards an R&D Strategy for Israel, *The Economic Quarterly* (Hebrew), 46(2), 359-383.

Teubal, M. 1998: "Policies for promoting enterprise restructuring in National System of Innovation: Triggering Cumulative Learning and Generating System Effects", in STI Review (22), Special issue on "new rationale and approaches in technology and innovation policy", OECD 1998.

Teubal, M. and Andersen E. (2000). Enterprise Restructuring and Embeddedness: A Policy and Systems Perspective, *Industrial and Corporate Change*, 9 (1), 87-111.

Teubal and Avnimelech 2003: "Foreign Acquisitions and R&D Leverage in High Tech Industries of peripheral economies: Lessons and Policy issues from the Israeli experience", **International Journal Technology Management**, Vol 26, Nos 2/3/4, pp.362-385.