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Microeconomic Insights from Israel's Venture Capital Emergence:

Towards a Theory of Evolutionary Targeting of Infant Industries

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Abstract

The development of Venture Capital in Israel during 1993-2000 is an example of *policy-led industry emergence*. The Israeli targeted policy adapted to trigger Venture Capital emergence is an example of *successful infant industry policy* implemented at the prime of the *Globalization* process of capital markets for startup firms. This policy stands on its own as a separate class, due to its non-conventional configuration and high impact. This paper both specifies why this policy succeeded and what lessons could be drawn for other countries attempting to develop a new Venture Capital Industry. Moreover, some of the insights gained from the Israeli case could be relevant for general targeted infant industry policies in the current phase of *Globalization*. That experience could be relevant whenever success in creating a new industry depends on a) generating a *critical mass* of resources and activities; b) accessing *sophisticated foreign agents* and coordinating them with domestic ones; and c) triggering a *self-sustained emergence process*, within a reasonably short period of time.

This paper introduces a *microeconomic dimension* to the study of Israel's VC Industry development during the 1990s. This analysis focuses on building indices of *Private Performance* and *Social Impact* for 40 Israeli VC companies. Our analysis suggests that the emergence process of the Israeli VC industry was characterized by very strong positive correlation between VCs *private performance* and their *social impact.* Companies in our sample founded in the *pre* and *early* emergence of the new VC industry not only generated, on average, strong *'social impacts'*, they where also highly profitable. This condition has been termed *Class A market conditions.* We stress that *Class A conditions* are the base of effective collective learning and other agglomeration effects. Prevalence of such conditions explains the extremely rapid process of growth during VC emergence. We suggest that the *Class A* phenomena might not be unique to the Israeli case or to VC industries and that its existence has significant policy implication to the field of infant industry promotion.

Key Words: Venture Capital, Emergence, Infant Industry, Targeted Policy, Innovation and Technological Policy, New Industrial Policy, High Tech Cluster.

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Non-technical Summary

The Yozma Program triggered the development of Venture Capital in Israel during 1993-2000. This targeted policy is an example of *successful infant industry policy*, which stands on its own as a separate class, due to its non-conventional configuration and high impact. This paper both specifies why this policy succeeded and what lessons could be drawn for other countries attempting to develop a successful Venture Capital Industry.

This paper introduces a *microeconomic dimension* to a wider study of Israel's Venture Capital Industry development during the 1990s. It complements prior research conducted at the *industry level* of analysis (A&T 2006a) and emphasizes the significant role of the pre-emergence events in enabling the VC emergence process. Our microeconomic analysis suggests that the emergence process of the Israeli Venture Capital industry was characterized by strong positive correlation between Venture Capital firms *private performance* and their *social impact* (indirect impact on the subsequent development of the industry) and high level of both. We stress that this was the base of the extremely rapid process of growth during the Venture Capital emergence. We also suggest that this phenomenon might not be unique to the Israeli case or to Venture Capital industries and that its existence has significant policy implication to the field of infant industry promotion.

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Acronyms

VC-Venture Capital; PE-Private Equity; LP-Limited Partnership;
ITP-Innovation and Technology Policy; ICT-Information and Communications Technologies
ROR: Rate of Return; Pp: Private Performance; Ps: Social Impact;
ILC-Industry Life Cycle;
A&T-Avnimelech and Teubal;

1. Introduction

This paper outlines a new perspective to *Infant Industry* promotion, particularly for Industrializing Economies, which emerged from Israel's successful experience with Venture Capital (VC) industry targeting during the 1990s. The motivation is the increasing recognition of the importance of (i) innovation-based structural change for economic growth; (ii) policy-led industry emergence processes; and (iii) adopting a Systems-Evolutionary perspective both in the framing and in the implementation of such policies.

The paper comprises an empirical and an analytical part. It is a new addition to A&T (2004b), which extend the empirical part (from 20 companies to 40) and present a more comprehensive analytical part. The empirical part (section 3) is a microeconomic *analysis of 40 companies* active in Israel's VC industry aimed at integrating a firm-level dimension to the industry-level analysis of VC Emergence (A&T 2004a, 2006a). The focus is the notion of '*Class A Market Conditions'*, an indicator of the capabilities and impact of early entrants to a new industry, and its importance for infant industry emergence. Our analysis shows that Israel's VC industry was '*Class A*' prior to the government VC targeting program.

The analytical part of the paper (section 4) argues that (i) the *emergence* of the new industry should be the objective of infant industry development policy, and contrary to much of prevailing *Industry Life Cycle* analysis should be considered as an endogenous phenomenon; (ii) under the *new global context* and for certain classes of industry (including VC), existence of *Class A* market conditions might be a necessary condition for successful infant industry *targeting*; (iii) beyond *Class A*, a number of other pre-emergence factors should be taken into account prior to a decision to select a particular infant industry for *targeting such as potential supply/demand and timing*; and (iv) beyond offering appropriate incentives, the design and implementation of infant industry *targeting* should, for certain industries, assure that governments perform a multi-dimensional coordination function both at a point of time (simultaneity) and through time (sequencing), aimed at assuring a critical mass of domestic and foreign resources (both financial and other) as well as assuring a strong process of collective learning.

The papers makes extensive reference to the Systems-Evolutionary literature including Jacobsson's (2005) functional requirements for the formative phase of new industries; Rodrik's (2004) 'new industrial policy' framework; and Innovation and Technology Policy (ITP) Cycle models (A&T, 2006b).

1.1 The Structuralist and Evolutionary Perspective to Economic Growth

Structuralist Perspective

The Structural Perspective to economic growth contends that periods of deep structural change particularly *knowledge based structural change* not only accompany but also *cause* rapid economic growth. This view underlies Kuznets's (1971) characterization of *Modern Economic Growth*. Compared to the pre-modern growth models, Modern Economic Growth involves on the one hand-a higher rate of growth of output per capita and on the other- both a higher rate of change in the structure of output and a higher rates of accumulation of production's relevant knowledge. The latter two are interrelated and are causes of the higher rate of growth of output. Kuznets illustrated these propositions in detail by analyzing the economic growth implications of the rise of the automobile-related industries in the U.S. during 1880–1920. His interpretation of the relevant links is clearly a 'structuralist' perspective.

In some respects this perspective fits very well with the experience of Israel during the 1990's where the relatively high rate of growth of 'high tech output' not only accompanied but also to some extent 'caused' the relatively high rate of growth of the economy as a whole. Moreover, there is some evidence that the engine of high tech transformation and rapid growth in Israel during the 1990's was the VC industry emergence (A&T 2004a).

Justman and Teubal (1991) presented an analysis and survey of the structural perspective to economic growth and development up to the end of 1980's. The authors conclude that at nodes of structural change the "growth process may be punctuated by periods of discrete shifts in resource allocation (creative destruction) and growth acceleration rather than being smooth throughout". Also, "market failures may be pervasive due to problems of human capital accumulation, critical mass and discrete choice among alternative paths growth". Thus "… successful growth may require an adequate industrial and technological policy, particularly at nodes of structural change"[1]. The large numbers of failures in infant industry promotion in industrializing economies (Bell et al., 1984) seems to confirm the point that structural change based economic growth was neither automatic nor assured[2].

[1] Some elements of this approach are common to some variants of 'Modern Growth Theory' (see Roemer 1986).

[2] The structuralist perspective contrasts with the 'early' neoclassical perspective, which either abstract from structural change or considers it an *outcome* rather than a cause of growth. In such models, the rising *per capita* income associated with growth ('demand' effect) and the capital accumulation effects on the comparative advantage of the country ('supply' effect) induces changes in the relative weights of different industries in overall output.

The Evolutionary Perspectives

An early exponent of the reverse link between Economic Growth and Structural Change was Schmookler (1966) in his analysis of the sector determinants of invention. He argued that through the effect of changing 'demand' patterns on the investment patterns, economic growth would affect the pattern of 'demand' for innovation. This represents an important mechanism of structural change. However, the structuralist perspective does not consider a full co-evolutionary process between structural change and economic growth. This is central to the Evolutionary perspective, which explicitly considers micro-meso economic links and co-evolution between technology and institutions (Nelson, 1994).

The Evolutionary Perspective emphasizes agent heterogeneity and dynamic processes involving variation, selection, reproduction and diffusion of inventions, firms, resources, strategies, etc. (Nelson & Winter, 1982; Saviotti, 1997; Coriat & Dosi, 1998; Metcalfe et al., 2003). At another level, economic development can be analyzed in terms of two processes- *division of labor* and *coordination* (increases in the *former* increases the *coordination problems*- Saviotti & Pyka 2004). New institutions and long periods of adjustment are always needed to solve the coordination problems resulting from innovation and other qualitative change e.g. the emergence of new sectors and new markets. It follows that a *continued* process of qualitative change requires a virtuous co-evolutionary process between technologies and institutions (Nelson 1994).

This perspective suggests other mechanisms linking economic growth to structural change. For example, Israel's adaptation to the ICT Revolution took the form of creation of a new industry i.e. VC, which also represents a new type of financial institutions appropriate for the economic exploitation of the new opportunities. Its emergence was the main vector in the transformation of that country's *National Innovation System* during the 1990s and the central driver of economic growth. The new financial institution did not emerge out of thin air. It was the result of a successful government policy - the Yozma program implemented during 1993-97 - which acted upon very favorable Background and Pre-Emergence conditions[3] generated during 1969-1992. These conditions could be grouped into supply, demand and institutional factors e.g. emergence of a demand for VC services during the early 1990s-the result of prior growth of high tech startups; generation of

[3] These conditions, where themselves, the result of another government policy (see A&T 2006b).

'market agents' who later became the 'market forces' who created and developed the new VC industry; liberalization of foreign exchange and capital markets, and an intensive policy process, which led to the targeting of the VC industry (A&T 2006a). Many of these were induced by economic growth and by past structural changes. They are *more specific* than those suggested by neoclassical analysis as affecting structural change.

The Saviotti-Pyka Model and Rodrik's New Industrial Policy

While there are a number of important representatives of the *Evolutionary Perspective to Economic Growth* we will focus on Saviotti & Pyka (2004), which starts with the observation that since the industrial revolution, economic development involved the creation of new products and services, the activities required to produce these new objects and the required institutions. "Thus economic development cannot be reduced to the simple growth in efficiency of all existing activities, that is to a purely quantitative growth, as it was often implicitly assumed in a number of previous growth models... the new goods and services are often not substitutes of pre-existing ones, but provide users with functions hitherto unavailable in the economic system... development is a process of transformation and not simply one of quantitative growth" (Saviotti & Pyka, 2004, pp.1023-4).

The authors proceed to build a stylized formal model of growth characterized by a relatively small number of equations and assumptions. They focus on the dynamics of firm's exit and entry in new industries. Entry of new firms is dependent directly on financial availability, which involves both financial resources and other requirements such as new capabilities and organizational forms. These should be embodied in new financial institutions, which are not automatically available. The upshot is that sustainable economic growth requires that financial institutions co-evolve with technologies.

From their definition of *variety* ('the number of actors, activities and objects required to describe the economic system') the authors derive the following hypotheses: *Hypothesis 1: Growth of variety is a necessary requirement for long-term economic development. Hypothesis 2: Variety growth (new sectors) and efficiency growth (in existing sectors) are complementary and not independent aspects of economic development.* Their paper aims at providing supporting evidence in favor of the two hypotheses. In line with this objective the authors undertake simulations of patterns of

development spurred by the exogenous emergence of new sectors. In their model, the *creation of new sectors is the fundamental force that sustains economic development in the long run*. Even under growing productivity, a constant composition of sectors will sooner or later lead to a bottleneck or stagnation.

Rodrik (2004) focuses on the economic growth of developing countries and on the 'new industrial policy' required sustaining it. In line with Saviotti-Pyka's Model, Economic Growth of both advanced and industrializing economies can only be sustained with the continued creation of new sectors. Moreover, historically this process-certainly in industrializing economies- has overwhelmingly been stimulated by government policies. This leads Rodrik to a particular perspective on 'infant industry promotion' for developing countries and on the required industrial policy. Rather than being neutral across new and old sectors and activities, the 'new industrial policy' should focus on 'differential support' of new industries and new activities.

1.2 The Infant Industries Argument

The original Infant Industry Argument (Hamilton, 1791; List, 1904; Mill, 1909) claims that support might be justified for new firms active in infant industries, especially in less developed countries. The infant industry support aim is to assist new firms in gaining production, management and other expertise that will enable them to compete head to head with firms at similar industries in developed countries. For the support to be justified the infant industry must possess a *potential* comparative advantage to be materialized after a period of production in which industry's efficiency will grow through learning by doing. In addition, the future earnings of the industry must cover the cost of support over the infant phase.

Temporary protection of an infant industry can only be justified in the presence of one out of two possible market failures: *inefficient capital markets* in which young firms find it hard to borrow against potential future earnings; and *existence of positive externalities* from the activity of the early entrances to infant industry such as external economics of scale, knowledge spillovers and inter-industry complementarities[4].

The development of a VC industry could be a major mechanism for reducing capital market inefficiencies in potential high impact infant industries. The successful experience of Israel in developing a VC industry during the 1990s (A&T 2006a) raises

[4] When the Scope of the externalities generated remains constant over time the activities that create them should be subsidized at a constant rate. If these externalities decrease over time a temporary subsidy could be justified.

hopes that the VC industry could increasingly play a role in the economic development of industrializing economies. This fact does not reduce the scope for explicit infant industry 'targeting' since policies may still be required to overcome market failures connected with 'positive externalities' and because the development of VC itself might, in most cases, be dependent on appropriate policies being implemented to this effect (A&T 2006b).

The 'positive externalities' argument for infant industry promotion could be criticized not because it is not an important source of market failure, but because as it stands it is a too general statement with little focus provided to policymakers (Dahlman, 1979). First, many activities can generate positive externalities, not only R&D or other forms of technological development. Second, whether an activity at time *t* generates or not an externality will depend on the behavior of existing and future agents of the economy[5]. This may be extremely difficult to predict without a clearer distinction between the *'generation of a potential positive externality'* and its *'economic impact'* i.e. its transformation into an actual 'externality'. Additional focus in the analysis of infant industry development can be achieved through the notion of *industry emergence* conceived as a cumulative process of growth with positive feedbacks. We suggest that policymakers should aim at triggering and enhancing industry emergence rather than addressing individual externalities one at a time.

As mentioned before, the large numbers of failures in infant industry promotion in industrializing economies (Bell et al., 1984) suggests that infant industry emergence is neither automatic nor assured. In its implementation to the real world there are two additional problems. First, how to *identify the targeted industries*[6]; second, how to assure that the policy process will be appropriate *designed*.

We argue that Israel's VC industry emergence process and the related government support program i.e. Yozma Program, are unique examples of both a potential design for an *Infant Industry* support program and for the pre-conditions that justifies its implementation. As analyzed in previous papers (A&T 2006b) the Yozma program is an example of a successful infant industry promotion program, which triggered the emergence of the Israeli VC industry. This support program contained elements of risk sharing and of upside incentives in the investment in the VC industry, aiming at

[5] Thus if activity X is 'knowledge spillovers' it may be that the economic exploitation (positive externality) of Xt at t+n, may depend on whether or not a new set of agents makes there appearance before t+n.

[6] Two types of error are possible: support of an industry that will stay uncompetitive even after the learning period; and support of an industry that could have become competitive without any government intervention.

overcoming the capital market imperfections related to the infant industry and to attract high-quality agents (including foreign) to partner with the domestic VC agents. This contributed to the capabilities of the domestic industry, enhanced spillovers, and accelerated the industry emergence process. Moreover, explicit mechanisms enhancing collective learning and other positive externalities were implemented through Yozma's design and political process.

To summarize, the Israeli experience give raise to a number of important normative points, which could be important in the new global environment. Some refer to the conditions for and implications of VC industry emergence e.g. the likelihood that successful emergence may require policies including explicit targeting policies; and the importance of such a private infrastructure i.e. VC, as part of the process of generating a *generic capability* for the development of other new infant industries. Other normative points that derived from the successful targeting of VC in Israel are: *First*, the main objective of an infant industry development policy should be 'industry emergence'; *Second*, the goals of policy should be to achieve a 'critical mass' of capabilities and activity that triggers self-reinforcing emergence process within a reasonable period of time; *Third*, infant industry policy design should focus on enhancing collective learning and other elements generating positive externalities by private agents including enhancing coordination among market agents and selection of a common cognitive structure (Nooteboom, 2000a) and technology trajectory (Dosi, 1984), which will enhance collective learning; and *Fourth*, the timing of such policies and the overall context of their application should be carefully assessed and chosen. All of these aspects have been present in the Israeli VC industry case; and they will be highlighted in this paper.

The New Global Environment

The notion of evolutionary targeting in this paper differs from the failed 'picking winners' of Western economies in the post war period; and from the successful Japanese, Korean and Taiwan's infant industry targeting during the 1960's and 1970's. The reason for the difference is the context prevailing then-including fewer competitors and the possibility of protecting domestic markets, compared with the current context characterized by the spread of globalization and increasingly harsh selection environment confronting both advanced and developing countries. The increasing importance of 'global markets' (implying potential high returns to innovation) and

'global competition' (implying high risks) introduce new conditions for *Sustainable Competitive Advantage* **(**Porter, 1998), particularly in those industries with *'winner takes all'* situations. Today the selection of industries is more difficult due to more competition and to more uncertainty, and the process of emergence, for it to be successful, should proceed at a rapid pace.

These new conditions are quite similar to those facing Israel when it targeted the VC industry during the early 1990s. We will see how that experience could be relevant whenever success in creating a new industry depends on a) generating a critical mass of resources, both financial and other; b) accessing sophisticated world class foreign agents and linking them with domestic ones; and c) triggering a self-sustained (and endogenous) cumulative emergence process, within a reasonably short period of time.

1.3 Israel's Experience with Venture Capital

Previous work (A&T 2006a) has analyzed the process of emergence and development of Israel's *Venture Capital (VC)* Industry in terms of an ***Industry Life Cycle (ILC)*** perspective comprising five phases: Background conditions (1969-85); Pre-Emergence (1986-92); ***VC Industry Emergence Process*** (1993-2000); Restructuring Process (2001-2004); and the Consolidation phase. The main event in this process is the successful 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 and Innovation into Israel's business sector and appearance of a distinct high tech industry. The "new" high tech cluster involved *a new set of specialized agents* (i.e. VC) with strong connections with *high tech Startup companies* and with global technological and capital markets.

VC emergence in Israel was a *policy-led process* in the sense that a deliberate and targeted policy directed to this objective (Yozma Program) was implemented. Throughout, VC has been analyzed as co-evolving with high tech, mainly the startup segment. Thus accompanying the process of VC emergence was the transformation of Israel's high tech industry from a military dominated industry toward a 'Silicon Valley' type of high tech cluster involving considerable entrepreneurial related activities. Some of the major events in the above processes were:

- *Background Phase **(1969-85)**:* Generating R&D/Innovation capabilities in the business sector; leveraging R&D to acquire complementary assets for export market penetration; and adopting high tech business models to the new opportunities in the ICT sectors;
- *Pre-Emergence (**1986-92**):* Creation of early links with global product/technological and capital markets; strong business experimentation and policy learning; creation of Demand for VC services; experimentation with the new born Global SU model; and identification of the Israeli high tech cluster specific system failures.
- *VC Emergence phase **(1993-2000)**:* A cumulative processes with positive feedback, which involved a number sub-processes such as 1) Structural change within the High Tech cluster; 2) VC-SU co-evolution; 3) Domestic VC Industry-Global capital markets interaction; 4) Building the cluster's infrastructure e.g. generating reputation, expending networks and appearance of a wide spectrum of services such as consultancies, accountants, legal experts, business services etc.; 5) extensive collective learning and spillovers; 6) Economies of Scale in Entrepreneurship (Gompers, Lerner and Scharfstein 2002). These sub-processes both comprised and amplified the above-mentioned cumulative process and made it self-sustaining.
- *Restructuring Process **(2001-2004)**:* Confronting with market downturn and other new elements of the competitive environment, which leads to an expansion in variety of content (new strategies implemented by existing market agents).

The Israeli experience is unique in that it probably is the most successful instance of diffusion of the Silicon Valley model of VC beyond North America (Bresnahan et al., 2001, Carmell and de Fontenay, 2003, OECD, 2003). This model focuses on VC oriented to *early stage investments in high tech startups* (A&T 2006a); and its diffusion to Israel took place in the context of Globalization of those capital markets focusing on *Public Offerings* of young technology companies.

While in principle any startup in any country during the 1990s could float in NASDAQ, the possibility of building a new high tech cluster, which exploits the ICT revolution, may well have depended on the emergence of a capable VC industry. Only then would the possibility of connecting large numbers of innovative startups to global capital and product markets could become a reality.

Table 1: Capital Raised by PE Organization in Israel (in Million Dollars)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
LP VCs	27	172	112	135	299	580	608	1548	3711	1323	52	84	724	1340
Public VCs	54	22	0	0	0	29	8	45	191	6	0	0	4	0
Other PE	79	168	262	31	104	190	260	257	742	83	110	440	626	1980
Total PE	**160**	**372**	**374**	**166**	**403**	**799**	**876**	**1850**	**4644**	**1412**	**162**	**524**	**1354**	**3320**

1.4 Objectives

Our previous research on Israel's VC industry emergence process (with the exception of A&T 2004b) focused at the *industry level* of analysis. On the empirical side this paper will undertake a *microeconomic analysis* of VC *companies* particularly those active during the pre- and early emergence. This will provide additional insights on the nature of the emergence process and on why Yozma succeeded. The focus is to identify in a robust way the state of 'market forces' just prior to and during early emergence. These are the agents, which would or would not enable the cumulative process of VC emergence to take place. Following A&T (2004b) we define *Class A market conditions* as a set of conditions that *potentially* could support a successful cumulative process of emergence once achieving critical mass of resources and activities. *Class A market forces* on the other hand are those specific market agents, which *de facto* enhance industry emergence.

The specific objectives of this paper are:

- Extend the empirical analysis of VC Company *Private* Performance (Pp) and *Social* Impact (Ps) undertaken in A&T (2004b) to cover 40 VC companies;
- Establish with higher confidence than in A&T (2004b) whether *Class A market forces* prevailed during the pre- and early emergence phases in Israel and the implications of this for the emergence of a VC industry and for the success of Yozma;
- Analyze possible implications of the Israeli experience with VC for *Infant Industry* promotion in industrializing economies - toward a theory of *Evolutionary Targeting, and l*ink those implications with the relevant literature;

2. Theoretical Background: The Emergence of New Industries/Clusters

2.1 Jacobbson's 'Functional Requirements' for New Industries

Jacobsson (2005) summarizes a particular formulation of the *pre-emergence conditions for the creation of new industries* and associated *Sectoral Innovation Systems* especially in top-tier industrializing economies. The basic approach is to identify functions, which must exist or be created in the *formative phase* of new industries. These include 1) knowledge development and diffusion; 2) search for new opportunities; 3) entrepreneurial experimentation; 4) market formation; 5) political legitimization; 6) resource mobilization; and 7) development of positive externalities.

Jacobsson's analysis is not explicit enough either about *the dynamics* of cluster emergence and related-policies or about profiles of emergence. Moreover, the presumption seems to be that once a minimum set of such functional requirements are in place, creation

of the industry will occur almost automatically (i.e. there is little analysis of non-emergence)[7]. We, on the other hand, would also be interested in analyzing the conditions and policies, which precede and stimulate the potentials for new sectors; and in sector-specific policies and particularly the targeting of such sectors. The latter, are crucial given the widespread system failures for the successful emergence of new sectors (see Rodrik 2004 and section 4 below). Successful sector emergence policies might have to impart a strong momentum and speedy emergence of new sectors i.e. rapid building of capacity and global market share. This in turn may require critical mass both of financial resources and capabilities- sufficient to spark a self-sustained emergence process.

Another point is that Jacobsson assumes that it is known in which sectors the country has a potential *Competitive Advantage*. While sometimes it may be the case, frequently it need not be so. Moreover, the relevant unit of analysis is much more dis-aggregate than our usual definition of sectors (and this fact has implicitly been recognized by Jacobsson). *Competitive Advantage* refers not necessarily to aggregate sectors but to more specific product classes within aggregate sectors. The need for greater dis-aggregation reinforces the need of identifying a set of potentially relevant new *product classes* for a particular country. While some product classes may look pretty obvious this will not be the case in the majority of cases. Moreover, one should not exclude the need for a set of public policies oriented to generate new product class options. This conforms to the *Evolutionary* view of the importance of generating sufficient 'variation' prior to the selection/development of a subset of specific variants.

Jacobsson's perspective should be expanded to consider explicitly events and policies of the formative phase. It should also be more explicit about the subsequent emergence process and emergence profiles, and on the conditions for non-emergence. Even more important, Jacobsson's discussion of the dynamics of sector/product class emergence is too simplistic and is almost completely devoid of policy considerations. It is importance to realize that an *emergence of new sectors/product classes* may frequently escape the un-aided actions of even very able firms already operating during pre-emergence. Too frequently the actions of existing market forces (even *Class A*) will be too little and too late. The result may be sub-critical mass leading to truncated development and early decline i.e. a low economic impact. In these cases there might be a justification for government intervention including targeting by the government.

[7] Nor is it explicit enough about the additional requirements for the *rapid emergence* of new sectors-a major issue in the

2.2 Industry Life Cycle (ILC) Models and Cluster Emergence Process

A new industry is more than a set of firms supplying a new class of products or services. Rather it is a *'social institution'* embedded in the country's National Innovation System and oriented towards the supply of new products/services. It involves firms, non-firm supporting organizations (e.g. Universities and Technological Institutes); and networks, interactions and links (e.g. among firms, between firms on the one hand and customers, suppliers and non-firm organizations on the other, etc). An industry embodies what can be termed *sustainable variety* i.e. a relatively stable product/service class that is sustainable at least during a non-insignificant time period. A final characterization of many industries is the existence of *scale effects* at the industry level. From all of this it is clear that we cannot identify 'creation' of an industry with the first firm supplying the relevant product/service class[8].

For our present purposes '*a new industry will come into being as a result of a cumulative process of emergence.* An example is the creation of the VC industry in Israel: this took place sometime during the VC emergence process (1993-2000). During this period we observe (i) acceleration of growth of VC activity; (ii) entry of large numbers of players both on the supply side (VCs) and on the demand side (startups); (iii) 'selection and reproduction' of critical features of the industry, and (iv) achieving critical mass that facilitated agglomeration effects (A&T, 2006a)

The emergence process is characterized by *dynamic* economies of scale and it involves creation of externalities. Moreover, different industries (and different contexts) will lead to different 'profiles of industry emergence'. These profiles are a result of dynamic sequences involving complex sets of interactions among firms and other agents. Successful emergence requires favorable background and pre-emergence conditions. This is ignored in most ILC work; and it constitutes one of its major weaknesses since it means that ILC theory cannot analyze the *timing of emergence of new industries.* Neither can it deepen our understanding of non-emergence of new industries- a major aspect of any reasonably complete theory of industry emergence.

new global environment.

[8] Most Industry Life Cycle Models (Abernathy & Utterback, 1978; Klepper, 1996; Malerba and Orsenigo, 1996) implicitly assume that a new industry is created with the first firm and that it traverses the full set of ILC phases.

Emergence of Clusters

A related problem arises in the analysis of emergence of high tech clusters. The literature has identified some of the pre-requisites and some phases in the development of clusters (Brenner, 2001; Bresnahan et al., 2001). Much less, however, has there been a thorough analysis of the real obstacles to cluster emergence (Porter, 1998; Feldman, 2001). Like with the ILC perspective the main gap in cluster analysis is in understanding the specific emergence process that will transform a "cluster candidate" into a well defined, operating cluster. Fornahl and Menzel (2004) define the first stage of a candidate cluster development as "Emerging Cluster", which is quite similar to our background condition phase. While they stress that the "Emerging Cluster" position does not ensure entering the next stage, they skip over our pre-emergence phase[9] and define the next stage as “Growing Cluster” (quite similar to our emergence phase). In our opinion, ignoring the crucial pre-emergence phase significantly reduces the theoretical understanding of the triggers and processes related to cluster emergence (or growth[10] as they define it). We argued before and will further reinforce this view later, that the process of emergence of a cluster requires attaining a critical mass and other elements that create a self-reinforcing process of growth.

While many sub-processes are involved in the emergence process, often the crucial push toward cluster emergence stem from single events and a sudden change in some exogenous factors including government policy (Feldman et al. 2005). This was probably also the case in Israel in which Yozma program triggered the VC industry emergence. When the background conditions are appropriate the triggering force may lead to an emergence process. The cluster, once established, acts as a selection device (Nooteboom, 2000b), attracting specific kinds of economic activities comparable with the clusters' core and reducing the ambiguity and costs facing local entrepreneurs when keeping close to these core activities and context (Maskell, 2001). Therefore, once established the cluster enhance self-reinforcement processes.

[9] They mention this transition phase in 1-2 short paragraphs.

[10] We argue that the differences in the terminology between us are related not only to semantic differences but also to differences in the understanding of the phenomenon itself. They call the major phase- cluster growth while we call it- cluster emergence. We believe that growth in activities is not the only significant elements of this phase. Similarly, while they call the first stage ‘emerging cluster’ we view it only as the creation of background condition.

2.3 Dynamics of VC Emergence in Israel

During the pre-emergence (1985-92) and early VC Emergence (1993-95), significant experimentation and collective learning took place both with respect to VC strategies and with respect to VC organization. Many strategies, routines and organizational forms did not survive; some did and were adopted by varying numbers of VCs. The VC industry also began experimenting with 'institutions' and with collective organizations. In addition from competing with each other, VCs also cooperated (a distinctive feature of young markets). At some point we observe an accelerated entry of new VC companies fed by a cumulative process with positive feedback effects. It is then that the industry attains a size, which enabled it to sustain a large number of supporting services (e.g. the VC association, specialized attorneys and lawyers, investment banks, etc.), while also converging to a relatively stable distribution of strategies (in Israel, a strong focus on 'early phase' investment), routines and organization forms (Limited Partnerships). As long as external and internal conditions remained unchanged, the VC industry supported the creation and growth of large numbers of new startups.

Multi-component Cumulative Effects

During early VC emergence where strong ‘selection’ and ‘reproduction’ processes were operating, *a significant self-reinforcement acceleration process was in action.* Moreover, in Israel this acceleration was associated with a major re-configuration of the high tech cluster towards a ‘Silicon Valley’ model. Yozma Fund and its 10 affiliated funds triggered this cumulative emergence process. It comprised a number of *linked sub-processe*s, which are listed in Box 1, most of which are largely non-conventional. Overall, the first ones in the box started operating before the later ones; and at least for a time, each new sub-process increased those already in operation. A central motivation for the operation of these sub-processes is *expected profitability* although *strategic considerations* where also important (as the reputation of the cluster grew many global ICT players sought for a presence in Israel). Expected profitability was driven initially by existing profits; and after a certain point by beliefs driven by the revealed actions of other agents (a herd-effect’). Some of these sub-processes jointly acted to determine a process of VC-SU co-evolution (A&T 2006a)- a major distinctive feature of the re-configuration of Israel’s high tech cluster during the 1990s.

BOX 1: Sub-processes contributing to the cumulativeness of VC & HT emergence.

1. Yozma Funds and other LP VCs founded prior to 1995- *created follow- up funds*
2. *Entry of non-Yozma LP VCs* during 95-97 which *created follow- up funds*
3. *Successful Exits of the early entrants enhanced* their reputation and the *reputation of Israel's VC and high tech industries*. This led to more (particularly foreign) investment in Israeli VCs and directly in Israeli SUs
4. Among these we have *new Strategic Partners* e.g. IBM, Cisco, Intel, Nokia, AOL, etc. as Limited Partners of Israeli VCs. This in turn led to further *Reputation and Networking* of portfolio SU that further strengthened their activity and performance. It also led, in some cases, to *enhanced direct investments* by such partners and to enhanced reputation and networking benefiting the VC industry/ high tech cluster as a whole
5. During the process, *foreign investment banks set up offices in Israel*. This *further facilitates the creation and growth of high tech SU*
6. *Collective Learning* of the VC industry and VC-SU *Interactive Learning*
7. *Cluster Effects* from the higher scale of activity which enhanced the local production of services for the VC/high tech sector (e.g. accounting, consulting, legal, etc)
8. Significant direct foreign VC activity in Israel, starting in 1997. They represent 40%-60% of the VC investments in Israel. Some foreign VCs established domestic offices is Israel, starting in 1999
9. The boundaries of Israel's ICT cluster became more explicit with the VC industry becoming one of its focal points.

2.4 Collective Learning, Critical Mass, and Coordination Issues

We have suggested that successful emergence is linked to collective learning, critical mass and coordination issues. We now link with these themes specific literature.

Collective Learning

There is a growing awareness that knowledge and the capability to learn are critical elements of firms and clusters competitive advantage. Lundvall (1988) argues that firms learn by interaction with other firms or organizations. Moreover, he stress that innovations are often the result of interaction within firms (e.g., between R&D and marketing), between firms (e.g., buyer-suppliers relationships and other cooperation between firms), and between firms and other organizations (such as universities). In addition, the institutional context may also shape the pattern of interaction and its intensity within a cluster and therefore influence collective learning. The relations between learning, innovation and regions have been subject to extensive discussion in the regional economics literature (Boschma, 2005; Capello, 1999; Cooke, 2001; Keeble et al., 1999; Lawson & Lorenz, 1999; Maskell, 2001, Storper, 1993). Regions matter

because differences in the social capital and in the institutional context influence the nature and intensity of interaction and collective learning. Moreover, due to the tacit nature of knowledge geographical, cultural, and institutional dimensions of proximity may enhance interactive learning.

Evolutionary economists generally define interactive learning as 'a social process of cumulative knowledge, based on a set of shared rules and procedures which allow individuals to coordinate their actions in search for problem solutions' (Dosi, 1982; Nelson and Winter, 1982). Cohen and Levinthal (1990) presented the concept of absorptive capacity, which is the organization's capability to absorb new knowledge efficiently and to transform it into valuable knowledge. They argue that conducting R&D has two goals first to develop innovations and second to strength the organization's absorptive capacity. In recent years, this concept has been adopted also to the meso-level (i.e. clusters or regions) – the absorptive capacity of a cluster depends on the cluster's previous R&D and innovation experience and on the common technological trajectories in the cluster as well as on common cognitive structures (Nooteboom, 1999).

Critical Mass

A major element in overcoming the transition phase between the background phase, where we can observe sporadic activity in same technology field with low level of collective action, to the emergence phase is the creation of critical mass of resources, skills, and activities[11]. Overcoming this minimum critical mass is dependent not only on the growth of the activities of related agents but also on the *establishment of a dominant trajectory* and *common cognitive framework* in aspects of technology, organizations structure and strategy. The critical mass should include direct quantitative measures such as number of companies created, number of skilled employees, and industry turnover (Brenaham et al., 2001); direct qualitative measures such as knowledge and competencies (Fornahl and Menzel, 2004); indirect quantitative measures such as economics of scale and of scope of the cluster (Fornahl and Menzel, 2004) and indirect qualitative measures such cluster's reputation (Crone, 2003), and enhance collective learning between agents though the strengthening the cluster's absorptive capacity. These in turn will strength the linkages between private agent's assets, capabilities and reputation to cluster's assets, capabilities and reputation.

11 For example, Fornahl and Menzel (2004) defined cluster as "a geographical concentration of interconnected organizations and institutions in a particular field beyond a critical mass".

Coordination Problems

At the background phase there are no clear boundaries of the cluster's related technologies, organizational structures and strategies; and the 'cognitive gap' (Nooteboom, 1999) between different agents is too wide. Therefore the level of interconnections, spillovers and collective learning among different agent in the cluster will be quite low. At this point of time, while success stories of a few startups may exist, they are isolated from the cluster and don't create mach reputation or demonstration effects within the regional institutional environment (Fornahl and Menzel, 2004). In order to progress toward emergence some coordination between new entrant activities should be created. This creates a paradox: on the one hand there is a requirement for collective action (to solve the coordination issues); on the other, the cluster is still too young to act collectively. In same cases coordination will appear by chance e.g. same agents will become focal points in a number of dimensions; and this will determine the particular trajectory of development. But in most cases coordination issues should be addressed directly, usually by public or semi-public authorities, in ordered to be solved. Once a critical mass is created the cluster's collective learning activities will determine the development trajectory and therefore a self-reinforcement of boundaries will occur (Fornahl and Menzel, 2004). Moreover, usually when new coordination problems emerged in mature cluster collective actions would be effective in overcoming them[12].

3. Microeconomic Analysis: Data, Methodology and VC Pp and Ps

3.1 The Sample

The Sample includes 40 Israeli VC management companies and their funds, including (9) of the (10) 'Yozma VCs', 19 other LP VCs, all Inbal Funds and other Publicly Traded VCs (8 VCs), and 4 other non-LP VCs. These VCs managed 89 VC funds with total capital under management of more then $9.9 billion (out of $16.3 billion capital under management in Israel's PE industry at December 2005).

This data is used in order to build VC Company Private Performance and Social Impact indexes and to group them into performances groups according to these indexes. In the analysis of these indices we use only data on funds initiated prior to 1999, these included 57 funds that managed an aggregate amount of more than $3 billion (95% of total capital under management in Israel's PE industry at December 1998). The sample includes 8 VCs (20%) established in the pre-emergence phase of

the Israeli VC industry (1986-1992); 11 VCs (27.5%) established in the early-emergence sub-phase (1993-1994); 11 VCs (27.5%) established in the mid-emergence sub-phase (1995-1996); and 10 VCs (25%) established in the late-emergence sub-phase (1997-1998)[13]. Most of 'Yozma VCs' were created in the two first phases (77%) as well as most of the Publicly traded VCs (63%), while all other non-LP VCs and most other LP VC (63%) were created in two last phases. Tables 2a and 2b present basic codified data on the VC Companies and their funds.

3.2 Methodology and Variables

Assembly of information for this research project was done during 1999-2005. As mentioned above a main objective was to explain VC industry emergence and this made us select a sample with a large proportion of VC companies managing Yozma Funds and other VCs who were founded relatively early. We undertook in-depth interviews with 20 VC Companies and gathered extensive information on them and on additional 20 VC Companies from other private and public sources (mostly from IVC, VC websites and newspapers). With this data we generated measures of VC private performance and social impact; and we subsequently grouped VC companies into *Categories of Success* both with respect to *Private Performance* and to *Social Impact*.

According to Table 2a the VC Companies in the sample have on average 2.2 funds (Median- 3 funds), these funds were usually established every 3-4 years. At December 1998 the VC Companies in the sample had on average 1.4 funds each and had $74M capital under management on average (and $247M at December 2005). Table 2b show that the VC Companies in the sample have on average 32 portfolio companies, 7 exits (4.1 IPOs and 2.9 M&As) and additional 2.7 Fire Sales (acquisitions whose value represents return on the VC investments of less than 5% annually). This represents a 22% exit ratio and additional 8% of Fire Sales. The average total Exits' value of the VC companies in the sample is $1.4 Billion (this number take into account the portfolio companies exit value and not the VC share in the company during the exit, which is usually within the range of 5%-25%).

VC Performance Indicators

[12] This effective indigenous collective action is part of our definition of the consolidation phase.

[13] In the microanalysis we distinguish between four sub-phases, which are not exactly those presented in the macro analysis. This is made to emphasize the different between very early emergence (93-94) entrants to other early emergence (95-96) entrans (mid emergence).

The private nature of VC investments means that there is a generalized absence of publicly available information. Write & Robbie (1998) also mention that there is little rigorous analysis of VC performance out of the U.S. due to the newness of markets (where VC portfolios have not yet reached maturity), problems of access to adequate data and the non-transparency of the calculations undertaken by national VC associations (Write and Robbie 1998, pp. 553-4; 563). These observations apply to the situation in Israel where the industry is about 12 years old. Given the approximately 7-10 years VC cycle only the first Funds raised by VC companies during 1989-95 would have completed the "exiting" process while other funds would only complete it in the future. Thus only a subset of VC companies and funds could be included in a full analysis of 'VC Performance'; and, even within this group, a *Rate of Return (ROR)* calculation for each VC was not possible. Under these conditions, Write and Robbie suggest the use of in-depth 'qualitative' research methods.

Problems of information are only one reason for searching for *indicators* of VC performance rather than relying exclusively on ROR measures. In this paper we will use a mix of qualitative and quantitative methods, which will enable us to rank VC Companies according to *performance indicators*. We tried to identify and use both 'absolute' success indicators, which capture some scale effects but are sensitive to random events (such as a very successful exit), as well as 'relative' indicators which are less sensitive to luck[14]. In addition we calculated *Social Impact indicators*, which will be specified in the next section.

After calculating these indicators for each VC, we end up classifying the 40 VC Companies into five 'private performance' groups and five 'social impact' groups. Each group belongs to one of the following categories: *Very High Performance, High Performance, Moderate Performance, Low Performance and Very Low Performance.* We then determine the correlation between VC *companies' private performance (Pp)* and their *social impact (Ps)* and analyze implications for the emergence process and for the role of policy.

[14] The VC private performance indicators used in this paper are: absolute number of exits; exit success ratio and Exit value, each indicator is calculated both for the VC company and for each fund separately.

Table 2a: VC Companies' Sample: Descriptive Statistics

VC Company	Foundation Date	Number of Funds (Date of Initiation)	Total Capital (M$) at 09/05 (Capital in each Fund)	Total Capital at 12/98 (# of Funds at 12/98)
VC-01	1989	5 (89, 93, 96, 98, 00)*	987 (19, 38, 120, 170, 640)*	347 (4)
VC-02	1991	3 (91, 97, 01)	96 (50, 5, 41)	55 (2)
VC-03	1992	3 (92, 97, 00)**	140 (24, 44, 72)**	68 (2)
VC-04	1992	4 (92, 98, 00, 04)	466 (45, 60, 211, 150)	105 (2)
VC-05	1992	2 (92, 96)**	42 (22, 20)**	42 (2)
VC-06	1992	2 (92, 97)**	60 (10, 50)**	60 (2)
VC-07	1992	5 (92, 94, 97, 99, 02)	654 (12, 37, 72, 90, 210, 233)	121 (3)
VC-08	1992	1 (92)	22 (22)	22 (1)
VC-09	1993	2 (93, 98, 00)	184 (33, 61, 90)	94 (2)
VC-10	1993	1 (93)	20 (20)	20 (1)
VC-11	1993	3 (93, 98, 01)	150 (20, 80, 50)	100 (2)
VC-12	1993	1 (93)	25 (25)	25 (1)
VC-13	1993	1 (93)	25 (25)	25 (1)
VC-14	1993	3 (93, 96, 00)	280 (20, 75, 185)	95 (2)
VC-15	1993	1 (93)	33 (33)	33 (1)
VC-16	1993	4 (93, 97, 00, 04)	546 (36, 110, 200, 200)	146 (2)
VC-17	1993	4 (93, 96, 00, 04)*	945 (20, 125, 500, 300)*	145 (2)
VC-18	1994	4 (94, 97, 99, 01)	683 (20, 75, 183, 405)	95 (2)
VC-19	1994	4 (94, 99, 01, 05)	1340 (40, 100, 600, 600)	140 (2)
VC-20	1995	3 (95, 98, 00)	262 (18, 44, 200)	62 (2)
VC-21	1995	1 (95)	40 (40)	40 (1)
VC-22	1995	2 (95, 00)	72 (20, 52)	20 (1)
VC-23	1995	2 (95, 99)	246 (86, 160)	86 (1)
VC-24	1996	1 (96)	80 (80)	80 (1)
VC-25	1996	3 (96, 01, 05)	416 (86, 210, 120)	86 (1)
VC-26	1996	1 (96)	25 (25)	25 (1)
VC-27	1996	1 (96)	25 (25)	25 (1)
VC-28	1996	2 (96, 00)*	353 (90, 263)*	90 (1)
VC-29	1996	1 (96)	40 (40)	40 (1)
VC-30	1996	2 (96, 00)	72 (12, 60)	12 (1)
VC-31	1997	1 (97)	150 (150)	150 (1)
VC-32	1997	1 (97)	20 (20)	20 (1)
VC-33	1997	1 (97)	20 (20)	20 (1)
VC-34	1997	2 (97, 00)	205 (55, 150)	55 (1)
VC-35	1997	2 (97, 00)	353 (100, 253)	100 (1)
VC-36	1997	1 (97)	50 (50)	50 (1)
VC-37	1997	1 (97)	90 (90)	90 (1)
VC-38	1998	3 (98, 00, 01)	270 (80, 90, 100)	80 (1)
VC-39	1998	2 (98, 00)	83 (43, 40)	43 (1)
VC-40	1998	3 (98, 01, 04)*	190 (90, 80, 20)*	90 (1)
Total	**89-98**	**89**	**9,875**	**2,976 (57)**
Ave.		**2.2**	**247**	**74 (1.4)**

* We bunched VC Company's funds according to VC industry sub- phases: 89-92, 93-94, 95-96, 97-98, 99-00, 01-02, and 03-05. In the cases of VC funds with an extension-funding round or few funds in the same sub-phase we bunched all rounds/funds and assigned the total value to the data of the first round/fund.

** In the case of public VCs, which renewal their capital we made a distinction between total investment before 1996 and total investment after 1996.

Table 2b: VC Exits and Investments (funds initiated till 12/1998)

VC	*Date of Funds* Initiation*	# Exits	# IPOs	# M&As***	# Firesales	# Portfolio Companies**	Total Exits' Value (M$)
VC-01	89, - , 96	30 (18, -, 12)	22 (15, -, 7)	8 (3, -, 5)	6 (2, - ,4)	123 (68,-, 55)	5,400
VC-02	91, - , - ,	7 (7, - , -)	4 (4, -, -)	3 (3, -, -)	2 (2, - ,-)	30 (30, - , -)	1,600
VC-03	92, - , 97	15 (10, -, 5)	7 (6, -, 1)	8 (4, -, 4)	5 (2, -, 3)	44 (17, -, 27)	2,800
VC-04	92, - , 98	10 (4, -, 6)	4 (2, -, 2)	6 (2, -, 4)	2 (1, -, 1)	34 (11, -, 23)	2,400
VC-05	92, 96 ,-,	3 (2, 1, -)	1 (1, 0, -)	2 (1, 1, -)	1 (1, 0, -)	14 (10, 4, -)	350
VC-06	92, - , 97	4 (3, -, 1)	3 (2, -, 1)	1 (1, -, 0)	1 (1, -, 0)	30 (12, -, 18)	320
VC-07	92, - , 97	20 (14, -, 6)	14 (10, -, 4)	6 (4, -, 2)	8 (-, 4, 4)	60 (40, -, 20)	5,600
VC-08	92 , - , -,	4 (4, -, -)	3 (3, -, -)	1 (1, -, -)	1 (1, -, -)	16 (16, -, -)	2300
VC-09	- , 93, 98	4 (- , 4, 0)	2 (-, 2, 0)	2 (-, 2, 0)	4 (-, 3, 1)	36 (-, 22, 14)	900
VC-10	- , 93 , -,	7 (-, 7, -)	5 (-, 5, -)	2 (-, 2, -)	0 (-, 0, -)	14 (-, 14, -)	950
VC-11	- , 93, 98	12 (-, 7, 5)	4 (-, 2, 2)	8 (-, 5, 3)	6 (-, 2, 4)	46 (-, 18, 28)	1,800
VC-12	- , 93 , -,	5 (-, 5, -)	2 (-, 2, -)	3 (-, 3, -)	1 (-, 1, -)	36 (-, 36, -)	400
VC-13	- , 93 , -,	10 (-, 10, -)	8 (-, 8, -)	2 (-, 2, -)	2 (-, 2, -)	27 (-, 27, -)	1350
VC-14	- , 93, 96	13 (-, 9, 4)	10 (-, 6, 4)	3 (-, 3, 0)	2 (0, -, 2)	41 (-, 14, 27)	3,800
VC-15	- , 93, - ,	5 (- , 5, -)	3 (-, 3, -)	2 (-, 2, -)	2 (-, 2, -)	24 (- , 24 -)	800
VC-16	- , 93, 97	21 (-, 15, 6)	12 (-, 10, 2)	9 (-, 5, 4)	7 (-, 4, 3)	60 (-, 36, 24)	3,300
VC-17	- , 93, 96	15 (-, 11, 4)	11 (-, 7, 4)	4 (-, 4, 0)	4 (-, 1, 3)	52 (-, 18, 34)	3,000
VC-18	- , 94, 97	13 (-, 9, 4)	8 (-, 7, 1)	5 (-, 2, 3)	0 (-, 0, 0)	26 (-, 14, 12)	3,000
VC-19	- , 94, - ,	6 (-, 6, -)	5 (-, 5, -)	1 (-, 1, -)	1 (-, 1, -)	14 (-, 14, 10)	1,000
VC-20	- , 95, 98	3 (- , 2, 1)	1 (-, 1, 0)	2 (-, 1, 1)	6 (-, 4, 2)	38 (-, 23, 15)	900
VC-21	- , 95 , -,	6 (-, 6, -)	5 (-, 5, -)	1 (-, 1, -)	3 (-, 3, -)	25 (-, 25, -)	1650
VC-22	- , 95, - ,	4 (- , 4, -)	1 (-, 1, -)	3 (-, 3, -)	1 (-, 1, -)	29 (- , 21, -)	400
VC-23	- , 95 , -,	8 (-, 8, -)	5 (-, 5, -)	3 (-, 3, -)	8 (-, 8, -)	4 (-, 4, -)	1700
VC-24	- , 96 , -,	2 (-, 2, -)	1 (-, 1, -)	1 (-, 1, -)	0 (-, 0, -)	50 (-, 50, -)	350
VC-25	- , 96, - ,	10 (-, 10, -)	3 (-, 3, -)	7 (-, 7, -)	4 (-, 4, -)	43 (- , 43 , -)	3,400
VC-26	- , 96 , -,	0 (-, 0, -)	0 (-, 0, -)	0 (-, 0, -)	0 (-, 0, -)	11 (-, 11, -)	0
VC-27	- , 96 , -,	0 (-, 0, -)	0 (-, 0, -)	0 (-, 0, -)	0 (-, 0, -)	11 (-, 11, -)	0
VC-28	- , 96 , -,	11 (- , 4, -)	5 (-, 5, -)	6 (-, 6, -)	1 (-, 1, -)	26 (- , 26 , -)	1,300
VC-29	- , 96 , -,	1 (-, 1, -)	1 (-, 1, -)	0 (-, 0, -)	1 (-, 1, -)	11 (-, 11, -)	70
VC-30	- , 96 , -,	1 (-, 1, -)	1 (-, 1, -)	0 (-, 0, -)	2 (-, 2, -)	7 (-, 7, -)	350
VC-31	- , - , 97	6 (- , -, 6)	2 (-, -, 2)	4 (-, -, 4)	7 (-, -, 7)	49 (- , - , 49)	1200
VC-32	- , - , 97	1 (- , -, 1)	1 (-, -, 1)	0 (-, -, 2)	3 (-, -, 3)	10 (- , - , 10)	180
VC-33	- , - , 97	1 (- , -, 1)	1 (-, -, 1)	0 (-, -, 0)	1 (-, -, 1)	17 (- , - , 17)	75
VC-34	- , -, 97	3 (- , -, 3)	1 (-, -, 1)	2 (-, -, 2)	2 (-, -, 2)	16 (- , - , 16)	2,100
VC-35	- , - , 97	3 (- , -, 3)	3 (-, -, 2)	0 (-, -, 1)	0 (-, -, 0)	28 (- , - , 28)	800
VC-36	- , - , 97	2 (- , -, 2)	0 (-, -, 0)	2 (-, -, 2)	2 (-, -, 2)	49 (- , - , 49)	60
VC-37	- , - , 97	4 (- , -, 4)	2 (-, -, 2)	2 (-, -, 2)	3 (-, -, 3)	64 (- , - , 64)	750
VC-38	- , - , 98	3 (- , -, 3)	2 (-, -, 2)	1 (-, -, 1)	5 (-, -, 5)	24 (- , - , 24)	500
VC-39	- , - , 98	3 (- , -, 3)	2 (-, -, 2)	1 (-, -, 1)	1 (-, -, 1)	18 (- , - , 18)	500
VC-40	- , - , 98	0 (- , -, 0)	0 (-, -, 0)	0 (-, -, 0)	2 (-, -, 2)	20 (- , - , 20)	10
Average	6, 24, 23	7	4.1	2.9	2.7	32	1439

* We distinguished VC Company's funds according to initiation date in relation to the following VC industry phase or sub-phases 89-92, 93-4, 95-6; 97-8.

** A portfolio company is counted only for the First Fund within a VC company that invested in it. Frequently several VC funds managed by the same management company would have invested in the same startup; this may lead to under-estimation of second and third VC fund portfolio companies with implications for the estimation of their performance.

*** For our purposes an M&A exit must fulfill two conditions: a) have a valuation higher than $10M, and b) have a valuation which is at least 50% higher than total investment in the relevant portfolio company prior to the M&A. M&As not fulfilling these conditions are regarded as Fire-Sales in this paper.

3.3 VC Private Performance (Pp)[15]

Table 2b indicates investment and exit data for the 40 VC Companies. The data in parenthesis in columns 3-7 indicate the figures corresponding to individual funds of the VC companies, whose date of initial operation are shown in column 3.

"Absolute" VC Private Performance (Pp) Categories

Younger VC companies have fewer exits in part because their activity is still in the pipeline and therefore a simple ranking will be misleading. To overcome this problem we define *Exit Threshold Levels* (for VC companies and funds) for each category of Private Performance. These threshold levels are higher the earlier the company foundation or fund initiation date. The computed indicators enable us to group each VC Company into the five VC private performance categories.

Box 2: Absolute VC Company Private Performance

Performance Category	VC Companies
Very High (7)	VC-01; VC-11; VC-16; VC-17; VC-25; VC-28; VC-31;
High (9)	VC-03; VC-07; VC-13; VC-14; VC-18; VC-19; VC-21; VC-37; VC-38;
Mid (8)	VC-04; VC-10; VC-20; VC-23; VC-34; VC-35; VC-36; VC-39;
Low (9)	VC-02; VC-09; VC-12; VC-15; VC-22; VC-24; VC-32; VC-33; VC-40;
Very Low (7)	VC-05; VC-06; VC-08; VC-26; VC-27; VC-29; VC-30;

* Based on the data from table 2b

"Relative" Private Performance Categories

A simple *relative* indicator of VC *Company* performance is the *Success Ratio* defined as number of Exits over number of Portfolio Companies. These ratios can be calculated from the data in Table 2b. Since the average number of Portfolio Companies per VC Company approximates 32 and that of exits is 7, the Success Ratio for the sample of VC companies, as a whole is 22%. Needless to say that the Success Ratio is only a rough indicator of VC company performance since each exit has a different ROR. As with numbers of exits, important differences can be found in the Success Ratio between the first and the subsequent funds of a VC company.

We also calculated another relative ratio, which is the total *value* of the VC Company's exits divided by the total *capital* under management. This ratio is not an ROR- it refers to the capital multiple i.e. $200M investment that achieve $1,450M will

[15] Due to the length and complexity of the ranking measures and analysis we didn't add them to this paper. For details on the measures and calculations (which there outcomes are reported in this section) see A&T 2004b.

be presented as 7.25 (the average in the sample)[16]. As with absolute exits, there are threshold levels of the success ratio for each category (the earlier the initiation date is the higher the threshold level is).

Box 3: "Relative" VC Private Performance

Performance Category	VC Companies
Very High (9)	VC-03; VC-04; VC-07; VC-10; VC-14; VC-16; VC-18; VC-25; VC-34;
High (7)	VC-01; VC-11; VC-13; VC-19, VC-20; VC-21; VC-28;
Mid (8)	VC-02; VC-08; VC-15; VC-17; VC-22; VC-23; VC-30; VC-39;
Low (9)	VC-05; VC-12; VC-31; VC-32; VC-33; VC-35; VC-37; VC-38; VC-40;
Very Low (7)	VC-06; VC-09; VC-24; VC-26; VC-27; VC-29; VC-36;

* Based on the data from table 2b

Overall VC Private Performance

The computed data on the two *Success Ratios* for each VC fund and VC Company enable us to assign VC Companies into the five overall VC Private Performance Categories (Box 4 is based on a simple average of the two indices).

Box 4: Overall VC Private Performance Groups

Performance Category	VC Companies
Very High (9)	VC-01; VC-03; VC-07; VC-11; VC-14; VC-16; VC-18; VC-25; VC-28;
High (7)	VC-04; VC-10; VC-13; VC-17; VC-19; VC-21; VC-34;
Mid (9)	VC-02; VC-15; VC-20; VC-22; VC-23; VC-31; VC-35; VC-38; VC-39;
Low (8)	VC-08; VC-09; VC-12; VC-30; VC-33; VC-36; VC-37; VC-40;
Very Low (7)	VC-05; VC-06; VC-24; VC-26; VC-27; VC-29; VC-32

Box 5: Overall VC Private Performance according to Phases of Foundation

	89-92 (8 VCs)	93-94 (11 VCs)	95-96 (11 VCs)	97-98 (10 VCs)
Very High Impact (VCs 9)	**3 VCs** (1 'Yozma' VC) (1 Public Traded VC)	**4 VCs** (4 'Yozma' VCs)	**2 VC** (1 'Yozma' VC)	
High Impact (VCs 7)	**1 VC**	**4 VCs** (1 'Yozma' VCs)	**1 VC**	**1 VC** (1 Public Traded VC)
Mid Impact (VCs 9)	**1 VC**	**1 VC** (1 Public Traded VC)	**3 VCs** (1 'Yozma' VC)	**4 VCs** (1 Public Traded VC)
Low Impact (VCs 8)	**1 VC** (1 Public Traded VC)	**2 VCs** (1 'Yozma' VC)	**1 VC**	**4 VCs** (1 Public Traded VC)
Very Low Impact (VCs 7)	**2 VCs** (2 Public Traded VCs)		**4 VCs**	**1 VC**

[16] In order to get the funds ROR we need to know the actual VC share in those portfolio companies during exit; and the accurate dates both of the VC investment rounds and of liquation of shares.

3.4 VC Social Impact (Ps)

A central concern of the paper is to assess the *Social Impact* of VC companies. This is a distinctive aspect, which to our knowledge has not yet been considered in the literature. It follows directly from our striving to understand VC emergence in which, early entrants could generate knowledge and other spillovers that contribute to the industry collective learning and benefit subsequent entrants. A major component of the *social* impact of VC companies is their *Private Performance*, which we have discussed in the previous section. Our focus here is on the additional, non-private performance aspects of social VC Company impact (*externalities*- Ps*)*. For our purposes we define four *Specific Social Impacts: 'Reputation effects'; 'Networking effects'; 'Creation and Diffusion of New Variety'; and 'Contribution to Critical Mass'* (this last social impact indicator has partial ex-ante/internal correlation with the private performance).

The sources or variables affecting each one of these impacts are varied and our intention is neither to list all of them nor to fully trace the mechanisms linking sources to impacts. As with private performance we first build four 'simple' indicators of the social impact of VC companies- one for each specific impact- and then aggregate them to get an *overall* social impact indicator for each VC Company.

'Reputation' and 'Networking' Effects

We define 'Reputation effects' for our purpose as VC activities that increase the reputation of the entire VC industry. The relevant 'source' variable of 'reputation effects' for each VC Company is *Best Company Exits* - measured by Exit Value and its ongoing contribution to the high tech cluster (such as firms post IPO growth and success). We define 'Networking effects' for our purpose as networks of a local VC that enabled easier access to complementary assets by other local VC and startup agents. The relevant 'source' variables of 'networking effects' is *Participation of Reputable value added Investors* (e.g. well known Strategic Investors such as AOL or Intel which act as Limited Partner of local VC Companies). Since a VC is a central node in the overlapping networks of the high tech cluster (Florida & Kenney 1988) adding a new added value investor to a VC's network may facilitate other agents' access to that investor. Thus the new limited partner may become a strategic partner/investor of companies in the VC's portfolio or of other startups in the cluster; he may develop links with other VCs that co-invest with the VC in question; and,

through these and other cumulative effects he may decide to establish a local branch (usually an R&D facility or an investment arm).

Box 6: VC 'Reputation & Networking' Effects

Performance Category	***VC Companies***
Very High (8)	**VC-01; VC-04; VC-07; VC-14; VC-16; VC-17; VC-18; VC-25;**
High (7)	**VC-02; VC-03; VC-09; VC-11; VC-19; VC-37; VC-40;**
Mid (8)	**VC-10; VC-15; VC-21; VC-22; VC-28; VC-30; VC-31; VC-34;**
Low (8)	**VC-05; VC-13; VC-20; VC-23; VC-24; VC-35; VC-38; VC-39;**
Very Low (9)	**VC-06; VC-08; VC-12; VC-26; VC-27; VC-29; VC-32; VC-33; VC-36;**

* Based on the data from the interviews and from other sources (see A&T2004b)

Creation and Diffusion of New Variety

We define 'Creation and diffusion of new variety' for our purpose as pioneering activities leading to selection and diffusion of new functionally tested features into the VC industry and high tech cluster. This social impact derives from a broad category of actions or events leading to the introduction of new important information into the system or a new model of organization, strategy, behavior, etc. (such as first instance of world class Strategic Investor in the industry or first instance of opening a global office of a local VC). These pioneering activities generate new behavioral options, which could be selected by, and widely diffused in the VC industry and high tech cluster[17]. Based on the 'total score' for each VC Company (which aggregates the various pioneering events with appropriate weights).

Box 7: Creation and Diffusion of New Variety

Performance Category	***VC companies***
Very High (6)	**VC-01, VC-02, VC-04, VC-07, VC-16, VC-17;**
High (4)	**VC-03, VC-11, VC-14, VC-18;**
Mid (10)	**VC-05, VC-06, VC-08, VC-09, VC-10, VC-12, VC-13, VC-19, VC-25, VC-34**
Low (10)	**VC-15, VC-20, VC-21, VC-23, VC-24, VC-28, VC-35, VC-36, VC-38, VC-39;**
Very Low (10)	**VC-22, VC-26, VC-27, VC-29, VC-30, VC-31, VC-32, VC-33, VC-37, VC-40;**

* Based on the data from the interviews and from other sources (see A&T2004b)

[17] The list of the relevant pioneering activities and their weights can be found in A&T2004b

VC Contribution to Critical Mass

We define 'VC contribution to the critical mass' for our purpose as increase in accumulated VC investments and exits which reduces cost in the VC industry (such as underwriting costs, fund raising cost and contracting costs) through different aspect of economics of scale and scope. This component of social impact concerns VCs' contribution to critical mass of the industry, which is the main factor triggering VC emergence. The relevant 'source' variables for each VC are: total capital under management, number of portfolio companies, number of Exits and number of Exits leading to Entry of important MNE (through M&As). A major factor in calculating the social impact of each variable is calendar time. Thus, the weights given to the early exits will be much greater than that given to the later ones or weights given to capital raised in downturns periods is greater than those given in bubble periods. This rational is similarly with all other 'source' variables' weights.

Box 8: 'Contribution to Critical Mass': Capital & Exits

Performance Categories	***VC companies***
Very High (8)	VC-01, VC-03, VC-04, VC-07, VC-14, VC-16, VC-17, VC-18;
High (8)	VC-02, VC-10; VC-11, VC-13, VC-19, VC-23, VC-25, VC-28;
Mid High (6)	VC-09, VC-12, VC-21, VC-31, VC-37, VC-40;
Low (9)	VC-05, VC-06, VC-08, VC-15, VC-20, VC-22, VC-24, VC-34, VC-38;
Very Low (9)	VC-26, VC-27, VC-29, VC-30, VC-32, VC-33, VC-35, VC-36, VC-39;

Overall VC Company Social Impact

Box 9 below summarizes the overall VC Company Social Impact and Box 10 present this overall Social Impact grouping according to phases of VC foundation.

Box 9: Overall VC Social Impact Groups

Performance Categories	***VC companies***
Very High (7)	VC-01, VC-04, VC-07, VC-14, VC-16, VC-17, VC-18;
High (8)	VC-02, VC-03, VC-09, VC-10, VC-11, VC-19, VC-25, VC-28;
Mid High (10)	VC-05, VC-12, VC-13, VC-15, VC-21, VC-23, VC-31, VC-34, VC-37, VC-40;
Low (8)	VC-06, VC-08, VC-20, VC-22, VC-24, VC-35, VC-38, VC-39;
Very Low (7)	VC-26, VC-27, VC-29, VC-30, VC-32, VC-33, VC-36;

Box 10: Overall VC Social Impact Groups according to Phases of Foundation

	89-92 (8 VCs)	93-94 (11 VCs)	95-96 (11 VCs)	97-98 (10 VCs)
Very High Impact (VCs 7)	**3 VCs** (1 'Yozma' VC)	**4 VCs** (4 'Yozma' VCs)		
High Impact (VCs 8)	**2 VCs** (1 Public Traded VC)	**4 VCs** (2 'Yozma' VCs)	**2 VCs** (1 'Yozma' VC)	
Mid Impact (VCs 10)	**1 VC** (1 Public Traded VC)	**3 VCs** (1 Public Traded VC)	**2 VCs**	**4 VCs** (1 Public Traded VC)
Low Impact (VCs 8)	**2 VCs** (2 Public Traded VCs)		**3 VCs** (1 'Yozma' VC)	**3 VCs** (1 Public Traded VC)
Very Low Impact (VCs 7)			**4 VCs**	**3 VCs** (1 Public Traded VC)

4. Analytical Implications: Class A Market Forces and Industry Emergence

4.1 The High Pp-Ps Levels and Correlation of Early VC Entrants

Israel's VC industry emerged during 1993-2000 under very favorable conditions. The pre-emergence experimentation and learning by the business sector reported in previous research (A&T 2006a) suggests that market agents existing then acquired significant capabilities and their activities had significant externalities. This could now, at least indirectly, be confirmed or disconfirmed through the indexes of private VC performance and social impact developed in the previous section.

In what follows the term 'pre entrants' will refer to VCs established during 1989-92 period, the term 'early entrants' will refer to VCs established during 1993-94 period; the term 'mid entrants' will refer to VCs established during 1995-96, and the term 'late entrants' will refer to VCs established during 1997-98 period. Boxes 5 and 10 place the 40 VC companies in Pp and Ps space respectively (by categories of success). It also shows that total pre entrants are 8; total early entrants are 11; total mid entrants are 11; and total late entrants 10. This means a total ***early/late*** entrant's ratio of ***1.1;*** a total ***early/mid*** ratio of ***1;*** a total ***early/pre*** ratio of ***1.4***, and a total ***early/(mid+late)*** ratio of ***0.5***.

Box 11 place the 40 VC companies in the ***Pp-Ps space*** it shows that 15 VC companies out of the sample of 40 VC (37.5%) are characterized by full ***Pp-Ps*** correlation (i.e. the diagonal line in the box). Out of these 3 are pre entrants, 6 are early entrants, 4 are mid entrants and 2 are late entrants. This is a high early/late ratio

(3), which is ***2.7 multiple*** of the *total* early/late ratio; a high early/mid ratio (1.5), which is ***1.5 multiple*** of the *total* early/mid ratio; and a high early/pre ratio (2), which is ***1.4 multiple*** of the *total* early/pre ratio. Therefore, we argue that during early emergence the relation between Pp and Ps is more significant than in any other sub-phase, while in the pre and mid emergence the strength of Pp-Ps relation is moderate and in the late emergence it is by far weaker.

Let us define ***'high Pp-Ps'*** as levels of both Pp and Ps being at least *high performance***.** A total of 13 VC companies have '*high Pp-Ps'* (32.5% of the sample). Out of these 4 are pre, 7 are early, 2 are mid and none are late entrants this is a high early/(mid+late) ratio (3.5), which is ***7 multiple*** of the *total* early/(mid+late) ratio and **3.*5 multiple*** of the *total* early/mid ratio; and a high early/pre ratio (1.75), which is ***1.25 multiple*** of the *total* early/pre ratio. These suggest that early entrants had the best private and social performances, followed be the 'pre' entrants and both have by far high performances of the mid and late entrants. Finally, there are 7 VC companies having both full **Pp-Ps** correlation and high **Pp, Ps** levels – 2 are 'pre' entrants and 5 *are 'early' entrants.*

The high ***Pp-Ps*** levels and very strong ***Pp-Ps*** correlation of those VC companies founded and active during the pre- and early emergence strongly suggests that ***Class A*** conditions prevailed then in the VC industry. This might be surprising since many firms with positive social impacts could as easily have been making negative profits i.e. the typical 'market failure' situation of young markets described by early neoclassical analysis (Arrow, 1962) seemed not to have been present in this case.

However, the fact that early entrants had higher ***Pp-Ps*** levels and stronger ***Pp-Ps*** correlation than pre-emergence entrants may suggest that despite ***Class A*** conditions, system failures blocked the autonomous creation of the VC industry during the early 1990s; and that these conditions both justified Yozma and were a main factor explaining the high impact of this program (see section 4.3).

In addition, we can learn more on the role of 'Yozma Funds' in the emergence process and on the better fitness of LP VC form of organization in the Israeli cluster. As mentioned before, in our sample there are 9 'Yozma Funds' (22%), 19 other LP VCs (48%), 8 Publicly Traded Funds (20%), 4 other non-LP form of organization VCs (10%). Out of the 13 VC companies with **'high Pp-Ps':** 7 are 'Yozma Funds' (54%), 5 are other LP VCs (38%), 1 is Publicly Traded VC (8%) and none are other non-LP VCs (0%) that is a very high 'Yozma Funds' ratio and very low Publicly Traded and

other non-LP ratio. On the other hand, out of the 10 VC companies with **'low Pp-Ps':** 3 are Publicly Traded VC (30%), 2 are other non-LP VCs (20%), 5 are other LP VCs (50%), and none are 'Yozma Funds' (0%), that is a very low 'Yozma Funds' ratio and very high Publicly Traded and other non-LP ratio. To sum up, we can see that 'Yozma Funds' tend to have high private performance and strong social impact, Publicly Traded and other non-LP VCs tend to have weak private performance and limited social impact, and other LP VCs tend to have moderate private performance and moderate social impact.

Box 11: VC Groups according to Private Performance and Social Impact

	Very High Performance	**High Performance**	**Mid Performance**	**Low Performance**	**Very Low Performance**
Very High Social Impact	**5 VCs** *(5 Early Phase) (4 Yozma)*	**2 VCs** *(2 Early Phase) (1 Yozma)*			
High Social Impact	**4 VCs** *(2 Early Phase) (2 Yozma) (1 Public)*	**2 VCs** *(2 Early Phase)*	**1 VC** *(1 Early Phase)*	**1 VC** *(1 Early Phase) (1 Yozma)*	
Mid Social Impact		**3 VCs** *(1 Early Phase) (1 Public)*	**3 VCs** *(1 Early Phase) (1 Late Phase) (1 Public)*	**3 VCs** *(1 Early Phase) (2 Late Phase) (1 non-LP)*	**1 VC** *(1 Early Phase) (1 Public)*
Low Social Impact			**5 VCs** *(3 Late Phase) (1 Yozma) (1 Public) (1 non-LP)*	**1 VCs** *(1 Early Phase) (1 Public)*	**2 VCs** *(1 Early Phase) (1 Late Phase) (1 Public) (1 non-LP)*
Very Low Social Impact				**3 VCs** *(2 Latey Phase) (1 Public)*	**4 VCs** *(1 Late Phase) (1 non-LP)*

We are now in a position to characterize *Israel's profile of Emergence of a VC industry and startup-intensive high tech cluster* in terms of three main characteristics:

- *Class A market* conditions and forces prevailed - VC activities in the early emergence phase are characterized with *high Pp-Ps levels and strong Pp-Ps correlation*
- A very *rapid process of VC Emergence* took place fueled by a cumulative growth process with significant positive feedbacks.
- *VC emergence was policy-led* - Yozma was a deliberate response to *system failures* and with a high probability its implementation was critical for the success of the VC emergence process.

4.2 Class A Market Forces and Industry Emergence

The strength of our empirical conclusion is that in Israel's infant VC industry *Class A market conditions* prevailed; and the undeniable link of this state to the strength and impact of the subsequent VC emergence suggests that *Class A* should be considered as *key pre-emergence conditions* for infant industry development. We have argued that under the uncertain and harsh global selection environment, existence of sophisticated and even profitable *domestic* market forces operating prior to the emergence of the formal industry or in related areas may actually enhance rather than diminish both the justification for implementing targeted policies and the probability that such policies will lead to industry emergence. This is due to our observation that in order to translate efficiently private firm success into public benefits and cluster emergence, a certain critical mass that will promote collective learning should be reached (A&T 2006a,b; Bresnaham et al., 2001; Fornahl and Menzel, 2004). On the face of it this would contradict both the theory of support of infant industries – where the prior existence of 'strong' market forces would seem to pre-empt the need for policy (Stoneman, 1987; Bell at el., 1984; Krueger and Tuncer, 1982) and the underpinnings of a simple 'market failure' justification for policy e.g. relevance of the "R&D additionally" criterion.

The role of government could be different when early entrants to an infant VC industry are Class B (with low private profitability levels or low Pp-Ps correlation)- particularly when the cumulative process triggered by policy is expected either to be non-existent or weak. Rather than targeting the industry itself the role of government under these conditions could be directed to stimulate favorable *pre-emergence* conditions such as fostering high tech startups or innovative SMEs, supporting business experiments, ascertaining the future sector's or product class's growth potential, or other 'functional requirements' (see Jacobsson, 2005 and 2.1 above)[18]. The upshot is that targeting should be withheld, at least for the time being, or should focus on other industries where Class A conditions prevail.

[18] These Phase 2 policies could be termed *pre-selection* of the industry rather than targeting the industry, which would be a Phase 3 policy (see A&T 2006b).

4.3 A Policy-Market Forces Paradox?

One implication is the possibility that, within a certain range of domestic capabilities, *Class A* conditions could enhance both the justification for a targeted Industry emergence policy and the probability that such a policy will be successful. Why could it be that, *Class A* market conditions may underpin a stronger justification and a stronger economic impact from the targeting of new industries? At first sight this would seem paradoxical since it would go against the proposition that governments should not intervene when market forces are capable or strong. The answer pertains to the strength of the emergence process triggered by the policy, namely, that it could be stronger, and consequently, industry emergence would be faster and would have more economic impact. On the other hand, the unaided operation of (even) *Class A* market forces, might generate a cumulative process which is 'too little and too late'.

To further explain let us return to our VC example as experienced by Israel. While *Class A* conditions imply existence of *some* capable *VC companies* they do not assure VC reputation for the aggregate of firms active in the new industry. Thus, while some world-class foreign partners did link to high quality new domestic entrants- the momentum engendered would probably not be enough to trigger an auto-catalytic cumulative process of growth. Under these conditions the *System Failures* preventing initiation of a sufficiently strong cumulative VC emergence process comprise: i) Low rate of entry of highly skilled and experienced domestic VC agents; ii) 'Failure' of existing domestic market agents to partner with a sufficiently large number of world class foreign agents due to lack of reputation; iii) 'Failures' in exploiting static and dynamic economies of scale.

The upshot is that *Class A* conditions may still justify a targeted policy directed to VC emergence. Moreover, within a certain range, an increase in the sophistication of local VC capabilities could, by reducing the 'gaps' in foreign resources required for triggering VC emergence, enhance the justification and expected impact from implementing a targeted policy. Therefore, there is no *Policy-Market Forces Paradox.* However, beyond a certain level of domestic capabilities policy would not be justified since a high impact VC emergence would occur without government intervention. Similarly when conditions are *not Class A* policy may not be justified since even the best policy design might not trigger VC emergence.[19]

4.4 How Targeting can Overcome System Failures? The Role of Yozma's Design

Could we state that despite the presence of *Class A* conditions effective VC emergence processes *depended* on a targeted program like Yozma? There are a number of reasons for believing that this was so and that Yozma was critical for Israel's successful VC emergence[20]. Our previous research and the empirical work reported here suggests that (in addition to Class A) *VC emergence required:*

- *Accessing capable and reputable foreign partners and investors, which were difficult due to the inherent lack of market-tested reputation at the level of the VC proto industry and the high tech industry as a whole.*
- *Assuring that a significant part of the domestic VC agents adopt an early phase investment strategy and accelerating selection of the LP form of organization and of other aspects of VC activities – creating a common cognitive framework.*
- *A complex coordination process linking the above mentioned foreign agents with highly skilled domestic VC entrants and with financial resources and assuring the critical mass for each one of the above resources (see also Gilson, 2003)*
- *Exploitation of increasing returns to scale in the supply of inputs and of dynamic economies of scale (including collective learning).*
- *Assuring that a cumulative process with positive feedback be initiated and completed within a short period of time.*
- *Country/Government signaling concerning the excellent opportunities in the country and the resolve of government to overcome all obstacles to VC emergence. Substituting for lack of VC industry reputation, which would be acquired only during VC emergence, with sophisticated government support.*

In our opinion most of the above were *System Failures* that unaided market forces by themselves (even if they were *Class A*) could not overcome[21]. There is also sufficient evidence to support our view that the design and mode of implementation of Yozma succeeded in overcoming each one of the above specific system failures causes (see below). Therefore, *Yozma* by creating a 'critical mass' and strengthening collective learning *assured the onset of a successful cumulative emergence process and a strong economic impact despite the short window of opportunity.*

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[19] Formal modeling is required to make these points more precise.

[20] The failure of the Inbal Program, which began operating only one year before Yozma strengthens our argument that Yozma was critical for the emergence of Israel's VC industry. The requirements below and the associated System Failures should be dated at 1993. For additional details of Yozma and Inbal Programs see A&T 2006b.

[21] Ascertaining that these were *system* rather than *market* failures also meant that simply providing incentives would not assure the overcoming of such failures.

How Yozma overcome the specific causes of System failure

Difficulties in accessing intelligent & reputable foreign partners

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

Assembling a Critical Mass of Capabilities

- Required participation of world-class foreign VC companies and investors in each Yozma funds (as limited partners) and 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 (having a S&T background and experience in high tech were important criteria)

Critical Mass of Financial Resources

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

Coordination

- Intensive interactive in the planning and in the implementation process of Yozma between the government officials and the private sector agents (domestic and foreign)
- Participation of OCS representative in the board of Yozma funds.
- Parallel implementation of complementary ITPs- Continues and expended support to R&D performing firms through the Regular R&D grant program, MAGNET program and Technological Incubator program (see A&T 2006b)

Selection of VC strategies consistent with early stage investments in high tech firms

- Early stage investments in high tech firms and also the adoption of a LP form were requirements for Yozma Fund status. Government representation on Yozma Fund boards monitored implementation of this requirement.

Assuring Fast Learning

- Required participation of professional foreign VC companies as GPs and LPs and of capable local agents (individual and institutions) and the requirement that Yozma funds involve a newly created formal VC company enhanced the fast learning.

Country/Government Signaling

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

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.

Specific Characteristics of VC industry Emergence

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

There are additional *idiosyncratic aspects* of the VC industry that reinforce this view. One could say that once 'basic' capabilities and other factors were in place the critical input for VC industry emergence was availability of capital and accessing reputable financial institutions and strategic partners from abroad. Absent a strong reputation of the VC industry the probability of prompt and extensive partnering with such sophisticated foreign agents must have been low. Our interviews showed that the fact that, through Yozma, the Government of Israel was willing to invest *directly* and *indirectly* in startups[22] was an important profitability confidence signal to such investors[23].

No less important was the fact that a seemingly necessary condition for the first VC funds created under the backing of Yozma to trigger entry of subsequent funds is that the former be highly profitable. Such a performance would generate what we termed *market-tested reputation,* which would considerably facilitate the raising of additional capital and the participation of a wider set of foreign partners. Strong early profitability was due to very good exits (during 96-97) from early investments; and this led immediately to Venture Capitalists worldwide to

[22] Directly since a portion of the Yozma Program budget (20M$) was earmarked for direct investment in startups - Yozma Fund; and also since the Regular R&D subsidies by the OCS were increased between 1993-2000.

[23] Lerner (1999) in his study of the U.S. SBIR program (which supported 'early stage' R&D of startups) found a similar phenomenon that operated at the level of individual companies—the 'certification effect'. Startups backed by this program had superior performance mostly due to a signaling effect.

consider investing in Israeli VCs and startups, hence the onset of cumulativeness[24]. The Israeli experience shows that, once several Yozma funds had such high returns early, the individual reputation effects spilled-over to the VC industry/high tech cluster as a whole; and that this led not only to expansion of existing VCs but also to entry of new VCs.

By the same token, early funds and early investments, which are not *highly profitable,* risk truncating the subsequent process of VC industry emergence[25]. This pattern of "early success leads to initial reputation that leads to additional capital and added value networks/partners" may lead to a self-sustained cumulative process of growth. In addition, the early reputation enhanced new high potential entrepreneurs to establish startups, which increase the potential deal flow and therefore lead to additional increase in potential future success/profitability.

Yozma's Success: Accelerating or Causing VC Emergence?

We now summarize and complete our argument concerning the role of Yozma. *First, Class A* Market Forces in the VC area were necessary but probably not sufficient for VC industry emergence - additional capabilities and other elements were also required; *Second*, these would not automatically be generated to the extent and the speed required*; Third, either* Yozma *caused emergence* or it *accelerated* what market forces would have accomplished anyway. Our assessment is that in either case Yozma was a successful policy with a significant impact. Due to the narrow window of opportunity even if Yozma only accelerated emergence the economic value of the resulting high tech transformation would have increased considerably i.e. unaided market forces might have under performed compared to a Yozma-driven process[26]. In all likelihood they would have created a smaller VC sector, and an associated shorter period of expansion and growth of high tech cluster as a whole.

[24] This effect has been analyzed by Gompers (1996) who focuses on how early 'exit' successes of young, unknown VCs enhanced the flow of capital to follow up funds of these organizations.
[25] A weak Reputation effect could lock–in VC into a low-level 'equilibrium' trap.
[26] Paul David (2001) has emphasized that effective policies implemented under conditions of strong 'path dependence' enjoy only *a narrow window of opportunity* a statement which fits our view of the impact of Yozma. We also believe that if the timing is correct as in Yozma's case, a strong policy impact could be linked with it having generated a *functionally desirable* path dependent process—emergence of the VC industry.

SUMMARY AND CONCLUSIONS

The objective of this paper is to underpin the emerging field of *Evolutionary Targeting*. The analysis is based on prior work by the authors on emergence and non-emergence of VC industries (with a particular although not exclusive focus on the successful Israeli case) and the conditions for the successful targeting of such industries in a wide variety of contexts (A&T 2006a). It is also based on recent developments in the literature particularly in the high tech Cluster Dynamics (Breshnahan et al., 2001; Feldman et al., 2005; Fornhal & Menzel, 2004;) and other Evolutionary Economics areas (e.g. coordination and critical mass). Finally and no less important, our theme links centrally with certain strands in the Economics Development literature such as the 'functional requirements for new industries' (Jacobsson, 2005), 'New Industrial Policies' (Rodirk, 2004) and Innovation and Technology Policy Cycles (A&T 2006b).

An important motivation was the growing realization of the importance of high impact, innovation based structural change i.e. development of new industries (Saviotti & Pyka, 2004) for sustainable economic growth and increasing empirical and theoretical justification for government intervention in the process (Rodrik, 1996; A&T 2006b). These reflect the changing global environment one characterized by enhanced uncertainty and competition, increasing 'winner take all' situations, and the difficulties in identifying new sectors/product classes for targeting.

Needless to say these factors entail a significant re-orientation of the traditional *Infant Industry Argument*: rather than ascertaining whether capital market imperfections and positive externalities exist the focus shifts towards (i) development of VC/PE industries or markets (a generic social technology which could eliminate market/system failures in a number of areas); (ii) creating 'background conditions' in the R&D/innovation capabilities areas– both in the business sector and in supporting institutions; (iii) pre-selecting new industries and identifying the set of pre-emergence requirements that may have to be fulfilled prior or during emergence; (iv) assuring a fast and efficient new industry emergence process, one that may require evolutionary targeting.

A major pre-emergence condition suggested by the empirical side of this paper is existence, within those industries that were pre-selected, of *Class A* market forces. This means that during the pre- and early-emergence phase there exist a group of highly capable market agents who a) are or will be profitable during the emergence process; b) have a strong impact on the emergence process itself. We argue that *class A* conditions,

which characterized Israel's VC industry, should increasingly be considered a pre-condition for targeting; and that this does not entail a *Strength of Market Forces—Industrial Policy Paradox*, rather under the new set of global competitive conditions, the opposite is true.

Our extensive analysis of the Israeli case strongly suggests that the design and implementation of a targeted policy to promote VC emergence in other countries could be quite complex. This because the central emergence process might require foreign inputs which, are difficult to access due to lack of market-tested reputation; the requirement of enlisting a critical mass of highly capable domestic resources; and the need for sequencing and simultaneous coordination of agents and resources.

The upshot is that VC emergence policies are considerably more sophisticated than the conventional set of measures recommended for increasing the flow of financial VC[27]. We have emphasized some of the *virtues of direct government investments in VC*; but the use of these either alone or in conjunction with tax benefits, equity guarantees, and regulatory changes though necessary may not sufficient for successful emergence of a sophisticated, early phase and high tech oriented VC industry. To be successful governments must also be able to assess and even to influence the context under which the VC emergence policies will be implemented. These will affect *the timing of VC emergence policies* and other government action, particularly when background conditions have not yet matured and when external conditions are not right.

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

[27] This is the normative counterpart to the statement that "…evolutionary theory identifies a more complex 'economic problem' than the orthodox theory, and we think this is an advantage. Evolutionary models tend to be more complicated than orthodox ones."(Nelson & Winter 1982, p. 402)

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