

EVOLUTIONARY TARGETING OF INFANT INDUSTRIES IN INDUSTRIALIZING ECONOMIES

**Lessons from the Emergence of Venture
Capital in Israel**

*Gil Avnimelech and Morris Teubal**

ACRONYMS

VC-Venture Capital, SU-high tech start up
ITP-Innovation and Technology Policy
S/E-Systems Evolutionary, SI-System of Innovat.
STE-Science, Technology & Higher Education
LC-Life Cycle; ILC-Industry Life Cycle
II-Infant Industry, C/B-Cost/Benefit
EHTC-Entrepreneurial High Tech Cluster
BS-Business Sector; SS-Supporting Structure (e.g
Universities, Gov. Labs, Technology Centers)

FORWARD

The paper outlines the beginning of a new perspective to Infant Industry (II) Promotion for industrializing economies

The term we chose is Evolutionary Targeting - something very different both from the traditional infant industry argument and from the (largely failed) 'picking winners' policies of the past

Forward-2

It emerged from our analysis of Israel's successful targeting of Venture Capital (VC) emergence during the 1990s (about 10 joint publications during the last 5 years)

It is also relevant for the 2nd, post 2000 phase of 'Policy Targeting' in Israel -the first being the targeting of VC during 1993-7.

From a S/E perspective, this is Israel's 4th. Innovation and Technology Policy (ITP) phase

A. MOTIVATION-1

Increased Recognition of Importance of new industries/product classes & technologies for successful knowledge based growth

In Saviotti-Pyka 2004, 2005: the creation of new sectors is the fundamental force that sustains economic development in the long run--/Infant Industry promotion could be more important than in the past

Early entry of firms in new sectors depends on financial availability and on new financial institutions-Venture Capital→potential importance of Israel's experience which created a new VC industry and VC market during the 1990s

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- *Similarly, Rodrik 2004 has argued the need for industrializing economies to promote structural change-based economic growth*
- *He has also argues that policy may be required; and that such such countries should develop a ‘generic capability for targeting’*
- *Also the World Bank and other institutions are (presumably favorably) re-evaluating their view of ‘targeting’*

A. MOTIVATION-3

Need to re-formulate the traditional Infant Industry (II)Argument

Major problems: how to select II; and how to take into account the specifics of the (changing) domestic context and global competitive environment (e.g. cannot protect domestic markets; harsh selection environment i.e. Strong competition, actual or potential)

A Systems-Evolutionary (S/E)Perspective of the II Argument is required both for analysis of the ‘real world’ and for ‘policy’ e.g to analyze how to create options for future II ; how to ‘pre-selection’ a small number of industries/product classes; and how to select one or more for II for promotion; etc

Evolutionary (Policy) Targeting, is largely a “Bottom-Up Process of Determination of ITP Options”. It also involves ‘nested’ Variation/Selection/Development processes

MOTIVATION-4

A S/E approach implicitly underlies Israel's successful experience with targeting VC

VC was created after 25 years of direct Government support of business sector (BS) R&D (starting in 1969)

Success in Targeting VC was linked to the context created by past policies e.g about 300 high tech Start Up companies existed by 1992/3 when 'Yozma' was implemented (changes in the external environment were also important)

The timing of the policy (1993-97) was crucial; so were complementary policies; and finally, program design.

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More generally, frequently the decision at time t concerning promotion of ‘good II candidate’-X- might have to be delayed (rather than accepted or rejected).

Policy may have to be directed to ‘search’ and to further promote favorable pre-emergence conditions (for X and/or possibly other industries)

B. SPECIFIC OBJECTIVES

1. *Identify possible implications of Israel's experience with the targeting of VC*
2. *Outline an emerging theory of 'Evolutionary Targeting' of Infant Industries, with an important focus on Pre-Emerging Conditions*
3. *Link the insights arrived at with the literature*
 - **Infant Industry Promotion**
 - **Functional analysis of new industries (Jacobsson 2005)**
 - **Rodrik's New Industrial Policy (Rodrik 2004)**
 - **The emergence of Clusters (e.g Breshnahan et al 2001)**

C.THEORETICAL BACKGROUND

- 1. *Analysis of Israel's Experience with Venture Capital*-a private infrastructure for many II-
including the ITP component(this section C)**
- 2. *The Traditional Infant Industry Argument* (D, E)**
- 3. *Jacobsson's Functional Requirements for New Industries* (F)**
- 4. *The Dynamics of Clusters* (G)**

C1: Phases in Israel's VC and EHTC Life Cycle-1

- ***Background Conditions (Phase 1, 1969-85)***
- ***Pre-Emergence Phase (Phase 2, 1985-92)***
- ***Emergence Phase (Phase 3, 1993-2000)***
- ***Crisis and Restructuring (Phase 4, 2001-2003)***
- ***Consolidation (Phase 5, starting in 2004)***

C1-1': Phases in Innovation and Technology Policy

The VC/EHTC Life Cycle phases (more or less) overlap with Phases in Innovation & Technology Policy (ITP) broadly conceived for the economy as a whole increasingly focused on the 'System of Innovation'.

Thus Phases 1,2,3 are both phases of the VC/EHTC and of the ITP "Life Cycle"

C1-2

Cumulative Process of Emergence

Favorable Pre-emergence conditions and Government action (see Yozma Program below) sparked the cumulative process of emergence-of VC and of the EHTC

This involved several subprocesses some of them conventional others not so. They included: entry of new VC organizations and expansion of existing ones; reputation effects, entry of new foreign agents (strategic partners and MNE; investment banks, foreign VC organizations, etc); “cluster” effects.

C1-3

Co-evolutionary processes e.g. VC \leftrightarrow SU contributed even more to reinforce the process.

Foreign agents, foreign capabilities and foreign capital played crucial roles- a crucial contextual factor, the result of Globalization.

Their contribution was both quantitative and qualitative e.g. entry of a high profile agent signalled to others their belief that Israel was a good place for high tech investments. Their participation in the process opened up new possibilities for creating new companies and for accessing global product and global capital markets

C2: A THREE PHASE ITP MODEL-1

The successful targeting of VC (and EHTC) in the 1990s did not arise from thin air.

Rather it resulted from a long process of implementing ITP since the end of the 1960s

Till the year 2000, Israel's ITP process can be divided into three phases. They correspond to Phases 1-3 (up to and including Emergence) of the VC/EHTC Life Cycle.

A 4th phase focusing on Evolutionary Targeting started in 2000. It should be further re-inforced by a new set of specific actions, programs and institutional changes

C2-2:Phase 1(1969-84/5)

Strategic Priorities

Diffusion of BS R&D/Innovation; creation of R&D/Innovation Capabilities; promotion of 'Innovative Entrepreneurship', and contributing to identification of areas (product classes/industries/markets/clusters) with Sustainable Competitive Advantage (SCA)

Innovation/Technology Policies

Horizontal Grants to BS R&D program (which included a strong component of support of SU) → led to a high tech industry of the 1980s (not to the EHTC)

Bottom Up & Market Driven Program with an important component of Neutral Incentives

C2-3: Phase 3(1993-2000)

Strategic Priorities

Emergence of VC & EHTC; and Accelerated growth & “endogenization” of BS R&D and High Tech

Innovation and Technology Policies

Targeted VC directed (and indirectly EHTC emergence) programs—the successful Yozma Program.

Also there was continued growth of ITP programs e.g. R&D grants (peak in 2000) and other Phase 2 policies. An issue is complementarity/substitution between VC and direct BS R&D grants.

C2-4: Getting Stalled

- *The transition was not automatic-critical events and conditions occurred in the intermediate period (1985-1992)-Phase 2*
- *Many countries get 'stalled' in Phase 2 (did not manage to generate 'favorable pre-emergence conditions) or even in Phase 1. The result was that the transition to VC and EHTC did not take place*
- *Several industrializing economies got 'stalled' in Phase 1 e.g. in Latin America, Chile being an exception; and VC/cluster policies were both weak and 'too early'*

C2-6: Phase 2 (1985-1992), Priorities/Action Areas

These are Pre-Emergence (necessary) conditions for success in Targeting Venture Capital during Phase 3.

Central was identification of SU foundations and SU development as a new priority, and linked to this

Creation of a domestic VC industry/market (‘Selection’)

There still were System Failures blocking the autonomous emergence of Venture Capital (dealt with in Phase 3)

Appropriate policies to overcome such failures were still required (Yozma Program in Phase 3).

C2-7

Other Priorities

- ***Selected components of the SS*** such as stronger focus on training and research on specific technologies or technological areas including those underlying 'candidate areas with SCA'
- ***Greater BS orientation of Universities*** and facilitation of University spin-offs
- ***Promoting SU and VC experiments- →Identifying a new intermediation form, suitable to the local context, linking VC to SU –a precursor conditions for a new industry/market***

C2-8

- *a critical mass of SU**
- *Strengthening of BS R&D*
- *stablishing international (including capital market) links*
- *liberalization of capital markets and foreign exchange*

* This priority was not necessarily explicit at the time

C2-9: Some Phase 2 Policies

Policies and Policy Actions

Identification of System Failures (weak impact of Grants program) and new Priorities(SU promotion)

Sharp Increase in R&D Grants

New Programs (Generic R&D, Incubators)

A Failed precursor VC-directed program (Inbal)

Promoting (or promoting an environment conducive to) Business Experiments with VC and SU

Policy Learning/Capabilities' Creation: from Inbal, from Business Experiments and from explicit search of new SU-oriented intermediation forms

Identifying New Strategic Priority (VC industry) and associated System Failures for Phase 3

C2-9: Criticality of Phase 2

A central issue is:

- ***When will Phase 2 policies create conditions for the successful transition to Phase 3 that is for targeting a VC industry/market***
- **This was a first step in policy targeting (1990s) in Israel. Subsequent targeting of other high impact new infant industries requires other (pre-emergence) conditions and policies (Phase 4 of Israel's ITP)**
- **Other top tier industrializing & advanced countries may already target other II during Phase 3 (in addition to a VC industry/market)**

C3-1:Israel's Targeted Program, Yozma (93-97)

Design Aspects

- *100 M\$ Government Venture Contribution*
- *Fund of Funds (80%) and Direct equity investments in high tech SU (20%)*
- *Target Capital aimed at: 250 M\$*
- *Focused on Limited Partnerships (LP)*
- *Seeding of 10 private LP funds (mostly) of 20M\$ (Government contribution-80M\$)*

C3-2: Yozma(93-97)

- *Required involvement of reputable foreign partner (& of reputable domestic partner and VC mgt co.)*
- *Incentives to the Upside*
- *Catalytic Program*

C3-3: Yozma

Aspects of Implementation

Selection of Limited Partnership form of organization

**Teams with very capable and experienced individuals
were selected**

Timing was appropriate (partly result of luck)

**Promoted Collective learning (experience, foreign
partners, VC-SU interaction)**

Triggered Cumulative Process of Emergence

Privatized towards the end of the decade

D: The Traditional Infant Industry

(II) Argument (General)

Temporary support is justified only if one or both of the following market failures hold:

- *Inefficient capital markets e.g in funding of early II entrants*
- *Existence of positive externalities*

Preliminary comments

- *Many industries could, in principle, satisfy the above conditions If we may have to choose, how to do it?*
- *Little analysis neither of generation of ‘choices’ nor of ‘selection’ of II for promotion (particularly for a high risk, high return ‘globalized’ environment)*

D continuation-2

- *VC (industry and/or market) may reduce capital market inefficiencies for a number of potential II → raises issues concerning II promotion sequencing (Phases 3: VC, a non-traded private infrastructure; and Phase 4: other sectors)*
- *Externalities could be pervasive, the statement ‘support creation of positive externalities’ does not help policymakers very much (even in the context of a single industry!)*
- *Major issue: how to build ‘policy targeting’ capabilities (Rodrik’s ‘generic capability’; or, based on the Israeli case-the Strategic Level of Innovation/Technology Policy. There may be System Failures to the building of such a capability)*

D-continuation:3

From a Focus on Externalities to a focus on Cumulative Emergence Processes

Assume the II being analyzed is already given

- Many activities can generate them (R&D, first entrants, etc)
- Should make a distinction between *generation of 'potential externalities'* (e.g a knowledge spillover) and their *'economic impact'*-, depends on future events and future policies → difficult to predict
- There is a large number of trajectories for a particular industry's development, each one generating externalities. The objective is to select the one with the highest social/economy-wide return!

D-continuation:4

How can we provide additional focus to Policy Makers?

- **Rather than focusing on ‘externalities’ individually we *focus on the II’s emergence* process-understood as a cumulative, auto-catalytic process (with posit. Feedb.)**
- **There are many such cumulative processes- each one involving various mixes of externalities-generating, and externalities’-using events. Subset of these are combined at a moment of time; others are combined through time**

D- continuation: 5

- **The process involves ‘dynamic increasing returns’ i.e at least for a period of time, an increase in activity & profits at time t \rightarrow even more activity and profits at $t+1$**
- **This process has been analyzed both in the Cluster Dynamics literature (Bresnahan et al 2001) and in our study of VC emergence in Israel (Avnimelech and Teubal 2004a,b; 2006a,b)**
- **It also underlies the acceleration of activity in any new industry that is being created i.e that ‘emerges’.**

D-continuation:6

In Israel's VC/EHTC case the cumulative emergence process involves a number of sub-processes

- *Expansion of early VC entrants (second & third funds)*
- *New entrants to the industry*
- *Reputation effects (from early very profitable exits)*
- *Cluster effects e.g specialized services (lawyers, etc)*
- *Collective and Interactive Learning (many dimensions)*
- *New agent types become active e.g. Strategic Partners, Investment Banks, Foreign VCs*
- *VC-SU co-evolution*
- *Massive participation of highly qualified labor*

D-continuation: 7

- **Only a subset of such cumulative processes will lead to a sufficiently fast process of industry emergence(due to the ‘harsh selection environment’, speed is of the essence in successful infant industry development i.e necessary conditions for positive social benefit)**
- **Ideally some sort of identification of such a subset is required. We use the term ‘emergence profile’ to identify such a subset**

D-continuation: 9

- In Israel the emergence of the new Entrepreneurial High Tech Cluster (EHTC) was *policy led & driven by VC* (we also think that this was the case in Silicon Valley during the 1970s). That is by focusing first and foremost on VC emergence we got-the cumulative processes triggered- a new high tech cluster
- It is important to note some *pre-emergence* conditions e.g. there was an *unsatisfied demand* for the services of the future VC industry.
- Also the *outcome* was an *early phase oriented* support and finance system for high tech start ups-a central backbone of the new Entrepreneurial High Tech Cluster

D-continuation:10

- **The general issue then is how to *spark* and how to *sustain* a cumulative process which responds to the appropriate ‘emergence profile’-appropriate to the the ‘industry’ and ‘context’.**
- **Alternatively, the issue is identifying System Failures blocking such a profile of emergence e.g in the Israeli case, the System Failure blocking emergence of the EHTC was related to VC, namely absence of a sufficiently vigorous, unaided emergence of that industry**
- **There is no simple answer and, frequently, few possibilities to undertake a conventional C/B analysis. We support attempts to do so but should also be very careful not to rely exclusively on the outcome of such attempts.**

D-continuation:11

Ideally we should have an understanding of the dominant emergence profile characteristic of the industry; and of the variants relevant to particular contexts-including knowledge about what could spark the process.

For VC this would mean analyzing VC/high tech cluster emergence and non-emergence in other contexts e.g. Finland, Ireland, etc including failed (non-emergence) cases e.g. Germany in the 1980s, Chile in the early 2000's.

We would then try to infer(still, approximately) on the basis of our country's specific internal/external context, which profile would be suitable to that country, and infer which if any System Failure should be overcome in order to spark the process

D-continuation:12

**In most cases this knowledge is not available
[there is an opportunity for research to build up these
new types of required, policy-relevant knowledge].**

***One implication is that we have to pay a lot
of attention to identify pre-emergence
conditions which might be of general
relevance (see E below).***

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Short Summary of Pre-Emergence Requirements

- *existence of promising and capable market forces* already operating in what yet is a proto industry [this is an advantage in the present global environment]
- *promotion of experiments* concerning the types/bundling of goods and services involved and modes/types of producer & user organizations that might operate both on the demand and on the supply side of the new II

D-continuation:13

- *Identifying critical components of the “sectoral” systems of innovation pertaining to the II selected*, and promoting some common ones which seem to be relevant for a wide spectrum of industries
- *Hints about the dynamics of creation of such components*
–which are exogenous, and which will be the endogenous outcomes of the cumulative process of emergence
 - what sort of ‘coordination problems’ might have to be solved e.g Rodrik referred to coordination among entrants of new industries in order to exploit (industry level) economies of scale. In most cases coordination issues are much more complex (see E below)

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- ***The emergence process required for successful II promotion today should consider***
 - Critical mass of resources/capabilities***
 - linking with potential foreign partners : either directly or through broader networks which might contact a variety of critical foreign partners in the future e.g. Investment banks, diaspora networks; etc***
 - How to promote Collective Learning processes, including ‘learning from foreigners’***
 - ***Creating adequate Regulatory frameworks for the new Iis***
(Katz 2005)
 - Complex coordination problems (domestic-foreign agents; across Ministries; BS and SS; within the policy portfolio at a moment of time & between policies through time, etc)***

D-continuation:14

- *Underpinning the above is creating a generic capabilities for targeting.*

The above is only one reason for adopting a Systems-Evolutionary (S/E) Perspective to II promotion.

More generally, the S/E perspective is important for:

- *the process of creation of options for II development;*
- *pre-selection of a subset; and selection (and phasing) of even a smaller subset;*
- *design and implementation of a targeted II emergence policy*

E-On Choosing Infant Industries for Promotion

Many II industries can generate positive externalities: *how to choose the one (or more) II's with highest (high) 'social/economy wide' impact?*

No simple answer; limitations of C/B analysis

A related issue: the timing of targeting of such industry

Two major issues: *what are the Background and Pre-emergence conditions relevant to II promotion?*; and related to the latter-*what are the Pre-selection & selection mechanisms?*

SUMMARY AND CONCLUSIONS-1

The main objective was to underpin the emerging theory of 'Evolutionary Targeting', a point of departure being the traditional Infant Industry (II) Argument and Israel's experience with Targeting a domestic VC industry and market during the 1990s.

The II argument was criticized from various angles: the notion of market failure and externalities; no analysis of which infant industries to promote; no embeddedness of the theory into a wider, dynamic perspective

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- *Our analysis suggests that II promotion should focusing on Emergence processes rather than on ‘creating positive extenalties’ which has been usual in the literature, even the recent literature.*
- *Emergence processes are dynamic economies of scale associated with a number of interconnected and co-evolutionary events, phased through time, which are both creators and beneficiaries of external economies.*

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- *Such processes should be identified [there may be typical profiles of emergence for different Infant Industries and different institutional contexts], and the conditions for sparking/triggering them ascertained.*
- *Market/System Failures which the policy targeting of II should aim at overcoming, relate to such (sparking, and other, sustaining) conditions*

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- *In the case of Israel, achieving a critical mass of financial resources and capabilities [particularly linking with high profile, reputable global players in the industry] was required to start the VC emergence process. This was achieved by the Yozma program*
- *In addition, due to co-evolutionary and other processes related to emergence of the new (entrepreneurial) high tech cluster of the 1990s, VC emergence was the central driver of the process of emergence of such cluster (yet another entity which evolutionary targeting should aim at)*

-5: Specific Conclusions

- 1) Creation of a VC/PE industry and/or market could become a central axis in ‘Evolutionary Targeting’ both for advanced and for industrializing economies.**

VC/PE is a ‘social technology’ private infrastructure which potentially could support a large number of II [for which it solves the capital market imperfections problem]

Only in a few countries would VC/PE industries be created but even then, strong links with the global industry should exist.

Most countries would have to develop a domestic VC/PE market where a group of domestic agents would play important roles such as ‘intermediary’ agents for foreign VC/PE firms or domestic partners.

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2. *It may be important to create ‘generic’ Background Conditions (mostly in Phase 1 of a country’s ITP Cycle) from which a set of II promotion options [candidate areas with potential SCA] might be generated.*

Central components would be the promotion of innovation & innovation capabilities; of innovative SMEs and SU with an eye of identifying those with SCA; a measure of liberalization and other institutional changes, and depending on case, a basic set of STE institutions

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3. Successful II development would also necessitate favorable Pre-emergence conditions. Most of these would appear in Phase 2 (prior to emergence of VC/PE industry or market) or at Phase 4 (after).

They would depend very much on the specific II and on the context/environment facing the country

- *They would enable to Preselect a number of II entities for subsequent Selection of a subset.*
- *Thes would be the subject of Policy Targeting.*

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4. The process is a bottom up/top-down process involving both Government actions and policies and Business Sector actions and experiments. No profiles for such process exists in the literature yet.

- ***For Venture Capital (ideally to be selected in Phase 2 for targeting in Phase 3) the pre-emergence conditions for creating an industry include***
 - **continued promotion of innovation and BS R&D;**

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- **promotion of innovative SMEs/SU and alternative mechanisms of financing and supporting them;**
- **promotion of search, analysis and experiments with VC and SU organization and strategy;**
- **a critical mass of high tech SU & Class A Market Forces**
- **liberalization and other institutional changes; and**
- **the forging of international links and networks**

The more frequent objective would be the creation of a domestic market for VC/PE services. The set of pre-conditions for this would be somewhat different. So would be the pre-emergence conditions for other II (more empirical evidence on actual cases is required here)

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5. *Policy Targeting of II and other higher level organizations (markets, product classes, clusters, etc) should aim at a 'rapid' process of emergence.*

This is a reason why the existence of capable market forces operating in the prior, proto-industry is frequently considered a justification for choosing such an industry for II promotion (rather than, what frequently is the case, a situation for non-intervention).

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6. Infant Industry Program Design

The previous point also justifies why linking with high profile foreign partners may also become a crucial aspect of II promotion design

This means that country signalling, the incentive package offered such partners, and coordination by policy makers is crucial

Broadly speaking the coordination function of policy makers/Government involves both financial resources and capabilities-where critical masses of both would be required.

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The coordination problem is likely to be more complex than the frequied coordination of producers in a new industry for exploiting scale economies(Rodrik); and more complex than a one based on filling the gaps required for the new sectoral systems of innovation (linked with Carlsson & Jacobsson)

In some cases Government may have to contribute to the financing requirements of the II; in others it may have to have a say in the 'selection' of those agents [capabilities and networking will be crucial] entering or participating in the new industry under the aegies of the II promotion policy

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7. *The upshot is desirability that targeting II should be conducted following a S/E Perspective.*

Consideration should be given to background & pre-emergence conditions; of pre-selecting a potential a set of such industries; and other conditions for successful (and rapid) emergence of such industries (e.g targeted program design; and timing of implementation)

The S/E perspective should also be applied to Innovation and Technology Policy. The Phases model proposed here is one expression of such a perspective

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8. Within the above Governments should begin worrying about a formal, Strategic Level of ITP already during Phase 2. A full fledged capability might be aimed at for Phase 4