

**COEVOLUTIONARY PROCESSES AND INNOVATION & STRUCTURAL
CHANGE- LED ECONOMIC GROWTH:
Reflections on the Emergence of an Entrepreneurial High Tech
Cluster in Israel during the 1990s**

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Acronyms

I-(commercial) Innovation; SC-Structural Change

STE-Science, Technology and Higher Education

GERD-Gross Expenditure in R&D

BS-Sector

HLO-Higher Level Organization e.g a cluster, market,
sector,etc

VC-Venture Capital; SU-Start Up company

EHTC-Entrepreneurial (ICT-oriented) High Tech Cluster

***OCS-Office of the Chief Scientist, Ministry of Industry
and Trade (Israel)***

I. MOTIVATION AND SPECIFIC OBJECTIVES

Israel successfully made a transition from an underdeveloped economy whose main exports during the 1960s were oranges and textiles to a high tech powerhouse based on an ICT-oriented Entrepreneurial High Tech Cluster (EHTC) which emerged during 1993-2000.

Israel's EHTC was one of the most successful ICT-oriented, entrepreneurial high tech clusters beyond the US, with over 3000 start up companies (SUs)-up from 300 during 1992- and over 100 VC (VC organizations)-up from 2 or 3.

A strong VC industry emerged and co-evolved with the new wave of SUs during the 1990s, it being one of the major factors underlying Israel's success

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Other co-evolutionary processes involving (Commercial) Innovation (I), Innovation Policy and Innovation Finance were important, starting in 1969, with the creation of a specialized agency in charge of promoting business innovation (the Office of the Chief Scientist, OCS) in what was a multivariable and multidimensional process which started several decades prior to the EHTC emergence process of the 1990s.

An important facilitating factor was the strength of that country's Science, Technology and Higher Education (STE) infrastructure, which began in 1925-during the pre-State period- with the creation of two of Israel's most important Universities: The Hebrew University of Jerusalem; and the Technion (Israel Institute of Technology in Haifa-The Engineering University) of Haifa.

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The process of accumulation of STE capabilities continued after creation of the State in 1948, at least till the end of the 1990s. The motivation was a mix between 'economic' and other reasons e.g cultural reasons, the 'absorption of immigrants' and defense

For this reason our analysis here of Innovation- related co-evolutionary processes and their impact will consider the STE infrastructure as 'exogenous' (in other countries-and for post 2000 period in Israel- it may be necessary also to consider a STE-I co-evolutionary process)

-3: Objectives

Present a broad co-evolutionary framework of analysis linking Innovation, Innovation Policy and Innovation Finance, focused on the Israeli experience during 1969-2000

Link the above with the emergence of a high impact VC industry and market and, related to this, emergence of an EHTC between 1993-6/7

Suggest some implications of the analysis, both analytical as regards the processes of I & SC-led Economic Growth and more specific Innovation Policy implications

I first present the two co-evolutionary processes analyzed; and then I consider how they operated in each of the of the three evolutionary phases which led to the EHTC during the 1990s.

My analysis makes use of the method and results of previous research, including joint research with G. Avnimelech and G. Dutrenit

-4. Summary Presentation of Co-evolutionary Processes

Two co-evolutionary processes are considered:

a) Innovation Policy*-Innovation* co-evolution

b) Innovation*-Innovation Finance* co-evolution

Innovation*: *Innovation broadly defined to include capabilities and innovation performing organizations in ICT areas e.g. SU companies*

Innovation Policy*: *Innovation Policy broadly defined but excluding policies directed to the STE infrastructure (excepting joint BS-STE projects).*

The focus is on Direct Support instruments such as R&D subsidies/grants or tax concessions. It will also include Government Policies or other actions of Government which facilitate the creation or generation of private sources of finance to R&D/Innovation in firms & which represent alternatives to Government funding of Innovaton*

Innovation Finance*: *Private sources of finance of innovation and innovative firms like SUs e.g VC, angels, Private Equity funds, etc. It excludes in house company sources for financing innovation*

-5: Evolutionary Phases leading to Israel's EHTC

Phase (1), Background Conditions (1969-1984)

Phase (2), Pre-Emergence Phase(1985-92)

*Phase (3), EHTC Emergence Phase (1993-
2000)*

II. PHASE 1 (1969-84): *Background Conditions*

Strong STE infrastructure for historical reasons ***and continued support till after 2000***

• ***Clear ‘market/system’ failure regarding BS R&D/Innovation*** exports of textiles & oranges, almost no BS R&D and no R&D intensive sectors ***despite very strong STE*** (possible exception: Agriculture whose R&D at the time was performed not by firms but by a specialized Research Center- The Vulcani Institute)

➤ ***Creation of the OCS as a specialized agency (part of Ministry of Industry/Trade) in charge of promoting BS R&D***

➤ ***Backbone Policy or “Regular R&D Support Program”***: A ***Successful Grants to BS R&D program which Directly supported projects at firms (50% grant to R&D projects of individual firms).***

➤ ***This program is widely regarded as being successful in promoting BS R&D (see below), in stimulating exports resulting from R&D, and in contributing to the creation of a group of ‘medium sized’ R&D performing firms during the 1980s***

-2

- *Initially the share of BS R&D in GERD was low (< than 20%). During this phase we see strong growth in BS R&D, in Innovation and in numbers of R&D performing companies*
- *OCS grants to BS R&D increased from 2.5 M\$ in 1969, to 39 M\$ in 1980 (and in Phase II, to 133M\$ in 1990s; and in Phase III, to 337\$ in 2000)*
- *The OCS's proactive policy promoted 'demand' for R&D by firms, both through a collective learning process and through enhanced awareness of the commercial potential of in house R&D[Teubal 1997, 2001].*

OCS policies resulted in the dominance (first half of the 1970s) of direct support of R&D in firms over support to the public research institutes created during the 1950s and early 1960s

II-3

.The dominant Chief Scientist at the time, Prof. Yitzhak Yaakov, moved on 5 fronts (Pugatch et al 2010; Breznits 2008)

- *Setting explicit goals for the OCS (e.g Horizontal support-open to all firms; Neutral support-non discriminatory across sectors e.g. no sector targeting; sharing risk; promoting exports of science-based products & and bottom-up determination of projects)*
- *Sharp increase in direct, grant-based support of R&D in firms*
- *A Program of National Projects (which allowed the OCS to give 80% grants to up to eight projects) (after Yaakov, the BIRD program, 1981--)*
- *Adjudicating the status of “approved factory” to R&D performing firms(giving them all the benefits provided under the law for the encouragement of capital investment in Israel’s “developing towns”)*

II-4

Eventually the OCS became a quasi-independent agency with many of its provisions incorporated into the 1985 Law for the Encouragement of R&D

The Outcome was a significant strengthening of Innovation Policy in Israel. Israel also became the first or one of the few countries to adopt as a mainstay of its innovation policy a set of instruments which where both Neutral (non-discriminatory) and Horizontal (open to all firms in the BS)

II-5

In this phase a number of critical events took place with important implications for our co-evolutionary phenomena and for the future emergence of the EHTC. These included:

- **Development and Diffusion of R&D/Innovation Capabilities in the BS**
- **the beginnings of global product and capital market links**
- **Creation of a favorable environment for foreign investment**
- **The beginning of involvement of business sector agents such as banks in the financing of high tech**
- **First steps in SU entrepreneurship activity (early 1980s)**

II-6. PHASE 1 (1969-84)

Co-evolutionary Processes

In response to collective learning by firms and to changed circumstances, the OCS adjusted the Grants to R&D in firms program and was also instrumental in creating two additional incentives programs (Programs of National Importance and BIRD)

A.Examples or events implying *Innovation Policy-*Innovation** co-evolution**

***(1)Enhanced R&D/Innovation capabilities in firms- →
implementation of the Projects of National Importance
Program which***

Supported complex R&D projects involving both a firm and a University, for which the firm received an 80% subsidy (rather than the standard 50% for the regular program)

II-7

By promoting a higher degree of sophistication and complexity of R&D/innovation projects and therefore facilitating future company growth and diversification, this program benefited those companies who had accumulated substantial innovation capabilities during the first years of OCS support

(one such company was Elscint, the flagship of Israel's Electronic Industry in the 1970s, where the program financed development of a CAT scanner, a quantum jump in complexity relative to the regular nuclear medicine gamma cameras developed up to then by the company).

Through its success and by considerably enhancing the demand for R&D support by firms it also indirectly spurred not only the growth of the OCS budget but also the search for alternative sources of support of BS R&D/Innovation during the 1980s (e.g the "Elscint Law", tax concessions on R&D)

II-8

(2) Implementation of the BIRD program starting in 1981 which supported joint innovation programs between an Israeli company (usually performing the R&D part) and a US company (focusing on production and marketing, mostly for the US market).

This program helped Israeli companies to 'access' those complementary assets required for export marketing, a critical deficiency of many domestic companies at the time [it was also *an outcome of domestic companies having learned about the importance of marketing for commercial success of in house R&D efforts*].

It also helped those companies who developed significant R&D capabilities and who therefore could aspire to partner with a US company from continued OCS support during the latter's first decade of operations (e.g Elscint, who partnered with GE).

This program had an enormous indirect effect on Phase III cluster emergence, particularly due to the very significant networking effects linking local entrepreneurs with their US counterparts.

II-9. Phase 1

B. Innovation*-Innovation Finance* co-evolution

The background was the strong rise in demand for Government Grants to R&D due to initial successes and collective learning about innovation spurred in the early years of operation of the OCS.

An excellent example of this was Elscint, who exerted strong demand for such Grants and who also –as a consequence of its agreement with GE (BIRD program)- managed to access two private sources of innovation finance: a loan from Israel Discount Bank, and an IPO in Nasdaq in 1972 where 4 M\$ were obtained. These operations contributed to opening these and other private sources of funding for innovation. In the meantime the demand for such funding increased further since very fast Elscint's problem became a problem of the whole R&D performing sector.

II-10. Phase 1

Another event or situation involving such co-evolution took place in the early 1980s where the first examples of domestic SU companies were founded, in response, to exogenous developments (appearance of a Software industry) and to the capabilities accumulated during the first decade + of OCS support. The OCS actively searched for alternative private sources of support for these companies, the result being a highly idiosyncratic and primitive form of Angel Investment which flowed from the US to Israel (in contrast to present angel investment or VC investments, the support then was to projects or groups of projects rather than to firms)

The OCS was proactive, no less than in directly financing these SU, as in acting to identify other sources of funding. The above was an important precursor to the massive development of paradigmatic VC a decade plus later. The Israeli Government (beyond the OCS itself) contributed by extending loans to foreign investors which enabled them to take advantage of tax breaks in the US)

III. Phase 2: Pre-Emergence Phase(85-92)- *General Features*

A number of factors favorable to BS R&D and to the creation and development of SU took place during Phase 2

- **New opportunities in the global environment (globalization and technological revolution)**

Beginnings of Software industry, de-regulation of communications markets, liberalization of trade and investment, globalization of NASDAQ (→ first IPO of a non-profitable Israeli SU in 1991)

- **R&D Grants to BS R&D continued to increase, especially after the 1984 Law which also provided a measure of autonomy of the OCS (viz a viz The Ministry of Industry and Trade)**
- **A new OCS priority- promoting the creation and growth of SU**

III-2. Phase 2, General

- **Restructuring of Defense Industries in the mid 1980s**

Led to a transfer of existing highly qualified human resources and an increase in the share of yearly flows of resources going to the BS

- **Consolidation of External Networks and Links**

With Nasdaq, business links from the BIRD program, Defense links, Israeli Diaspora and returning Israelis, Academic Links

- **Liberalization of Capital and Foreign Exchange Markets**

Critical for future flows of foreign capital to VCs and SUs

III-3. Phase 2, General

- **‘Qualitative’ Changes in organization and strategy of both SU and VC, a result of Business Experiments**

A new innovative organization (SU) ‘model’

- i) oriented no less to **global capital & knowledge markets** than to global product markets; and in order to exploit the new opportunities in the ‘non-product’ markets e.g. CFO became an important function in SU companies prior to IPO
- ii) The strategy of SU became **‘born global’** towards the end of the Phase

The SU Supporting Structure: VC

There was not yet a VC industry, only about 2-3 formal organizations (Atena, Star).

Some individuals (also from abroad) searched for investment opportunities, and performed part of the functions a VC industry would perform e.g providing links with foreign agents. At least one subsequently created a successful VC company

‘Selection’ (both by the market & by Policy makers, the latter in later Phase 2 and in connection with the Yozma program of 1993) of the **Limited Partnership (LP)** form of VC organization; and an ICT oriented, ***early SU phase investment focus***

III-4. Phase 2, General

Main impacts of the above factors:

- Increase in BS R&D and beginnings of a *civilian-oriented* high tech industry
- Birth and/or growth of SUs, entrepreneurs and Business Groups including the largest ICT companies of the 1990s e.g the RAD group, Formula, Comverse, Amdox
- A number of IPOs in NASDAQ by incumbent companies during the mid 1980s Scitex, Tadiran, Teva → new links with global capital markets; and a number by IPOs by as yet non-profitable SUs in the early 1990s Lannet, The Third Dimension, etc
- A critical mass of (about 300) SU by 1993
→ Demand for the services of a future VC industry -a precondition for Yozma's success

III-5. Pre-Emergence Phase 2 (1985-92)- Co-evolutionary Processes

Innovation Policy*-Innovation* co-evolution

It resulted from a sequence of adaptations of (primarily OCS) policies on the one hand and business innovation* on the other to the changing global environment.

Innovation Policy* included a significant search & learning process in the latter part of Phase 2 oriented to identify an adequate design for policy targeting of a private VC industry/market (Yozma Program) -the perceived requirement for supporting large numbers of SUs

Together with other factors (e.g. qualitative adaptations of SU & VC organization/strategy, & the creation of very favorable pre-emergence conditions favoring a new VC industry/market and an EHTC) *this process contributed both to a good design of Yozma, and to the subsequent emergence of an EHTC*

III -6. Phase 2-Co-evolutionary Processes

Innovation Policies*

Qualitative Aspects

- new strategic priority: support of high tech SUs*
- concluded that a private, domestic, internationally linked VC industry/market was the critical financial and added value support mechanism required; and that this financial infrastructure for SU should be supported by a special or targeted Government Program*
- contribute, through search, to identify adequate forms of SU & VC organization and strategy* thereby complementing private efforts in this direction
- Work leading to the design of Yozma, a new Innovation Finance* mechanism which would operate during the subsequent Emergence Phase 3 (1993-2000)*

Quantitative Dimension

- continued growth of OCS budgets*

III -7. Phase 2-Co-evolutionary Processes

Innovation*

Qualitative

- New type of innovation organization (SU)***
- Gradual Identification of desirable SU organizational and strategic features***
- New Innovation Capabilities especially in the Software and Communications areas***

Quantitative

- Moderate quantitative growth of SUs and other R&D performing organizations***
- Strong increase in BS R&D and in its share of GERD***

III -8. Phase 2-Co-evolutionary Processes

Innovation Finance*

- *Capital raised through IPOs of medium sized Israeli companies during the mid 1980s (Scitex, Tadiran, Orbotec, Ormat, etc)*
- *Capital raised through IPOs by SU companies (largely still unprofitable) during the early 1990s (Lannet, The Third Dimension, Magic, etc)*
- *→ strengthening of links with key underwriters in the US (→ facilitating subsequent IPOs and stimulating additional SU foundations, especially in Phase 3)*
- *Creation of 2-3 new VC funds (Atena, Star) & private equity company (Giza)*
- *Some Angel finance (*
- *Some innovation finance from Industrial Groups (Clal, IDB) and from Investment Banks (Oppenheim?)*

III -9. Phase 2-Co-evolutionary Processes

Conclusions

Both co-evolutionary processes were present in Phase 2 as they were in Phase 1. They were ignited by a number of endogenous and exogenous factors.

A major difference with Phase 1, however, was the narrowing down of Innovation*-Innovation Finance* co-evolution to a qualitative, early form of co-evolution which focuses on processes of Mutual Adaptation of VC and SU (and to some extent the institutional environment). This process sets the stage for the subsequent largely quantitative and more synchronous Phase 3 SU-VC co-evolution process, one associated with VC/EHTC emergence

III-9', Phase II, Co-Evolutionary Processes: Conclusions

The existence of Qualitative Phase 2 co-evolution links with one of the central objectives of Evolutionary Perspectives, namely explain the introduction of new 'qualities' into the Innovation System (Saviotti & Pyka, various papers). These include first and foremost 'innovations' and at the individual 'agents' level, new types of innovative organizations (e.g concerning SU, VC)

The subsequent Phase 3 quantitative VC-SU co-evolutionary process which build upon the above Phase 2 qualitative process, set the base or led to the new VC market/Industry and to the more complex HLO as represented by the new EHTC. They represent a higher level form of Qualitative Change.

III-10. Phase 2, Co-Evolutionary Processes: *Conclusions*

Another analytical point pertaining to both phases is the link between Innovation-I Policy* and Innovation-I Finance* co-evolution*

The former's success will lead to significant increases in Innovation, and the possibility that 'Demand for Innovation Policy Support' outstrip the capacity of Governments to comply

A virtuous situation will occur if, at this point, I Policy makers may make it their mission to search for private sources of finance who could satisfy this need. In this way they would actively help ignite a virtuous Innovation*-I Finance* co-evolutionary process.*

III-11. Phase 2, Co-Evolutionary Processes, Conclusions

This might then ignite or re-ignite Innovation-Innovation Finance* co-evolution as happened in Israel during Phase 1*

In both cases and as a result of success in Innovation Policy-Innovation* co-evolution, Innovation Policy* makers switched their attention both towards the identification of the new 'need' (Excess Demand for OCS Grants) and towards finding a solution or a mechanism to overcome such excess demand.*

A 'private' finance (VC-related in both cases) solution was found, a non-standard one in Phase 1 (early 1980s); and a standard one in Phase 2 (early 1990s). Concerning the latter, the OCS was involved in identifying elements of the VC policy 'knowledge package' required for designing the Yozma program which preceded the actual implementation of Yozma during 1993-1996/7(Phase 3)

III-12. Phase 2, Co-Evolutionary Processes, Conclusions

The example of Yozma including its antecedents in Phase 2 and its implementation in Phase 3, exemplifies a situation where Innovation Policy oriented to the design and implementation of public measures supporting private Innovation Finance* is that which ignites or triggers a virtuous Innovation Finance*-Innovation* co-evolutionary process.*

Phase 2 antecedents (a so-called 'pre-emergence' condition) involved a process of mutual *qualitative*, VC-SU *adaptations* with-contrary to other countries- relatively few complementary institutional changes. For example, unlike in Finland, a LP form of VC organization was already possible under Israeli Commercial Law

Yozma also exemplifies the case where a continuation of this process (Phase 3) would increasingly be based on actions directly coming from the BS, be they qualitative (relatively less important) or quantitative (more important), with an increasingly diminishing innovation or general public policy component

IV: VC/EHTC Emergence(Phase 3, 1993-2000)

The rapid growth of VC and SU during Phase 3 led to a well defined VC industry & market and to a EHTC cluster. These were Higher Organizational Forms (HLOs), induced by processes of innovation and linked to deep structural changes (SC) that took place during this decade (see Table 1).

These correspond to the notion of Development/Qualitative Transformation & Structural Change put forward by Foster and Metcalfe (Foster & Metcalfe 2001, p.6).

HLOs embody both qualitative changes in the economy/society and National Innovation System (e.g. types of innovation, the new BS agents, etc) as well as a scaling up, quantitative process that underpinned these changes.

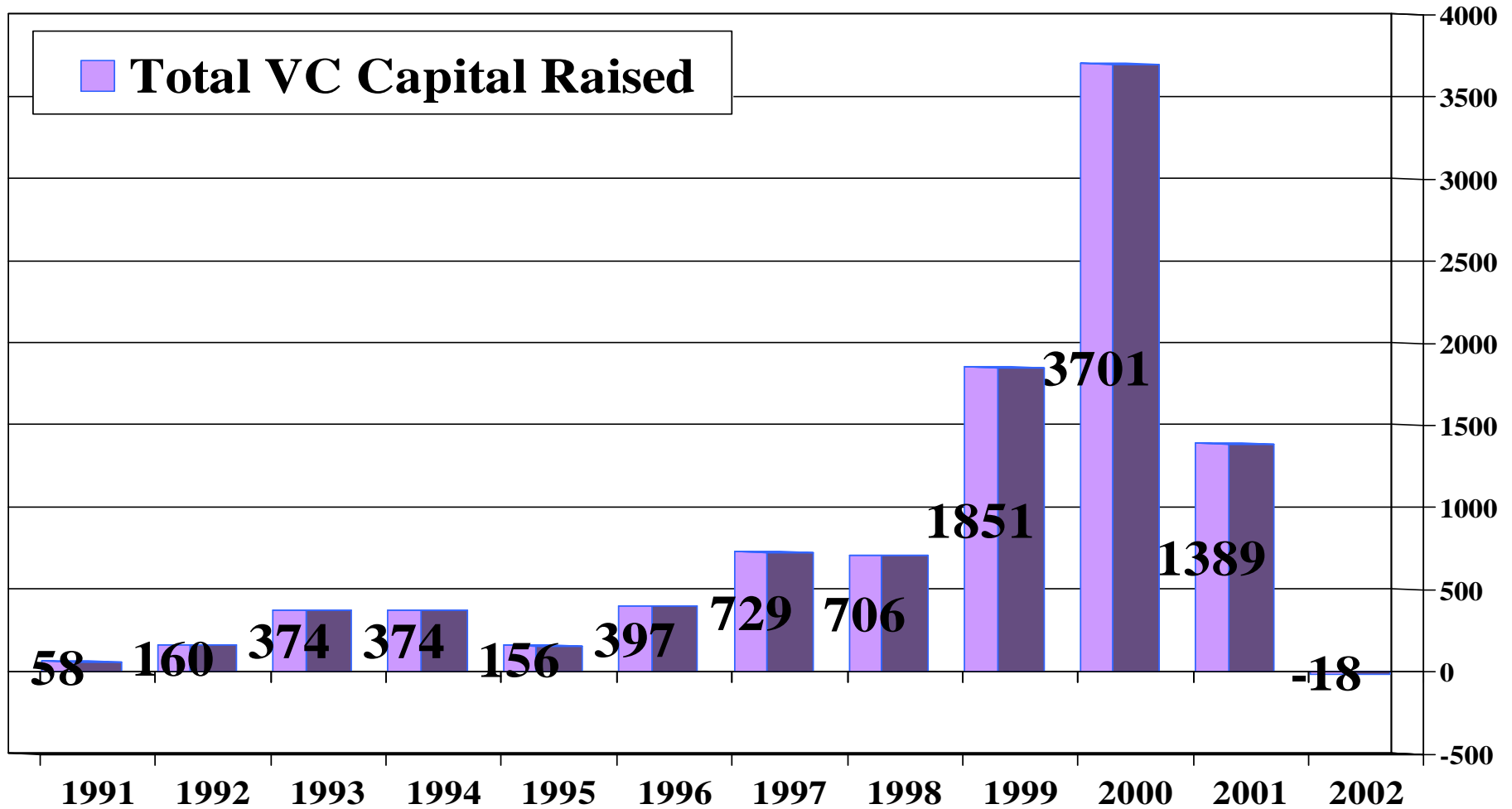
Their emergence had a strong impact on Economic Growth, both during the 1990s and also during the following decade. One reason is that once the new HLOs are in place they induce additional quantitative changes.

Table 1: Phase 3 compared with previous Phases

Decade	1993-2000	1985-92	1969-84
Accumulative Number of Startups established(VC-backed):	2,436 (855)	349(23)	136(0)
Accumulative Number of VC Companies:	~80	2 or 3	0
Capital Raised by Israeli VCs/Invested by VCs (M\$)	7,480/ ~5600	85/~50	0/0
Capital Invested in Israeli SUs, in M\$	~6,500	~100	0
No. of High tech IPOs in US (at EU & Tel Aviv)	101(75)	19(15)	14(7)
Capital raised- public markets and M&As, in B\$	36.7	0.8	0.3
Share of ICT in Total Manufacturing Exports(year)	53%(2000)	40%('92)	14%('84)
Patents issued in the US(R&D as share of GDP, same year)	969(4,5%)	355(2,7%)	194(2.4%)

Source: Avnimelech and Teubal 2008 & OCS, CBS, IVA, USPTO and other sources)

Acceleration of Rate of Growth of VC Activity Figure 1: Capital Raised by the Israeli VC industry: 1991-2002



Source: IVC

Figure 2: Foundation of SU companies: 1991-2002

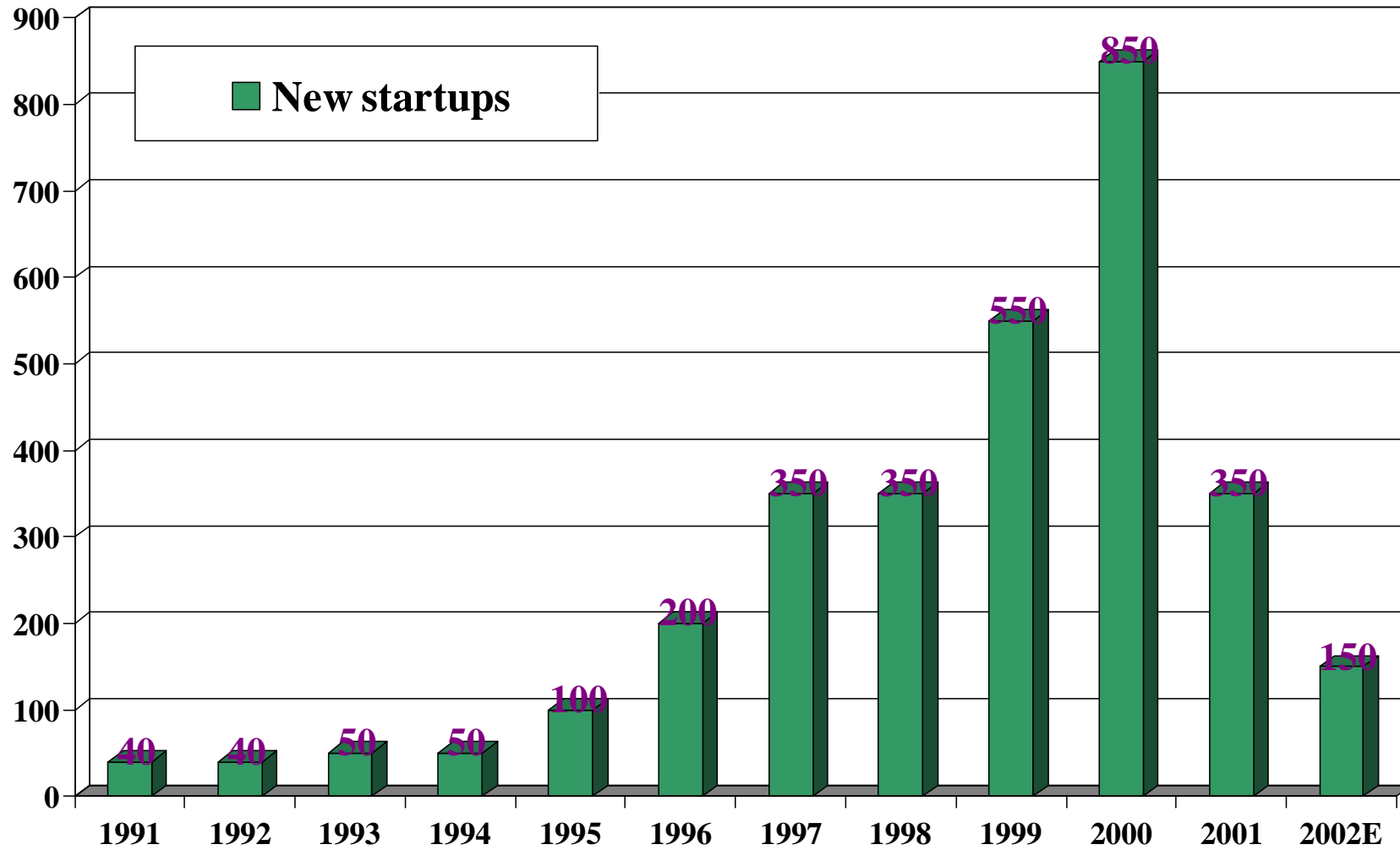
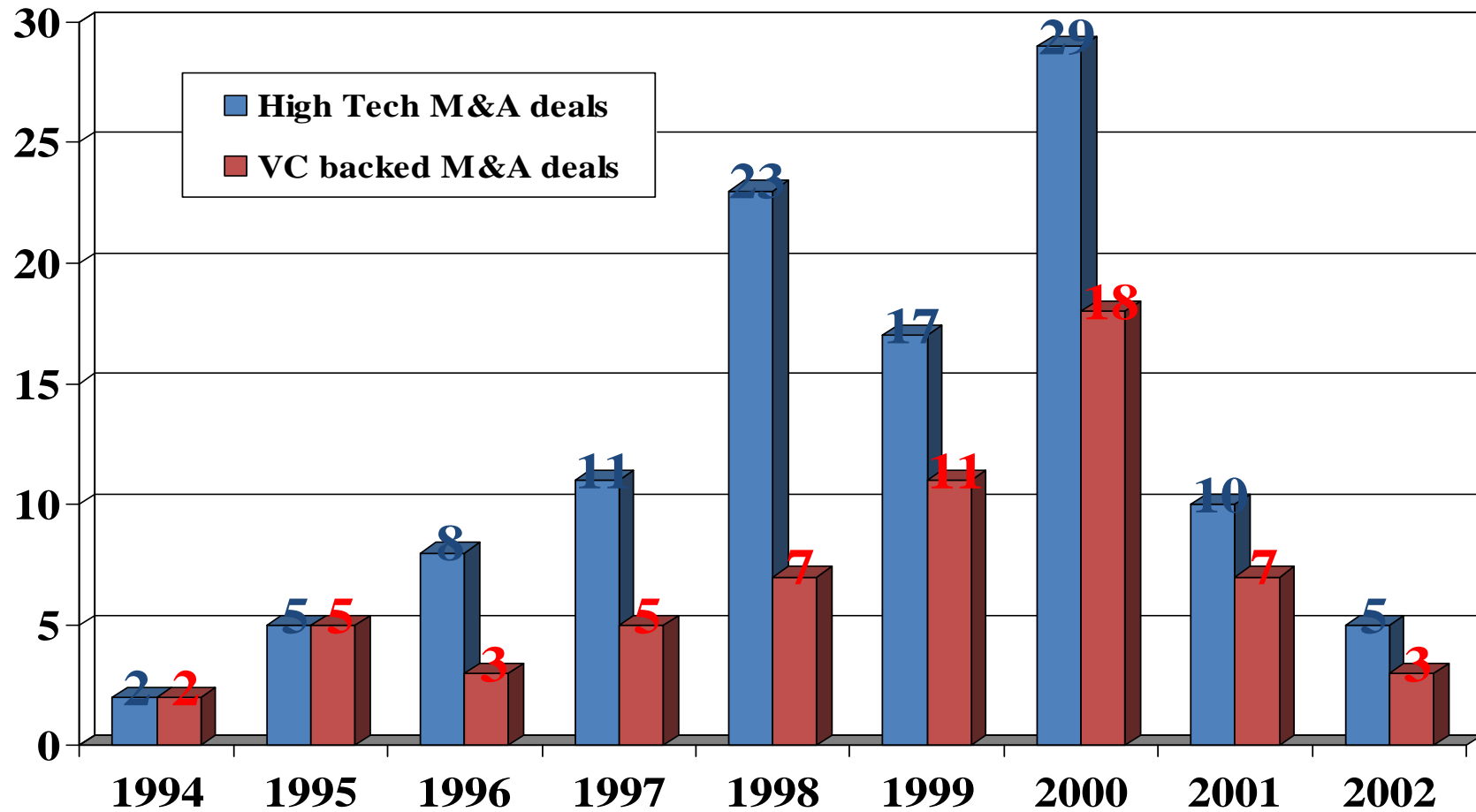


Figure 3: Israeli high Tech companies which were Targets in M&A deals 1994-2002



Source: Avnimelech 2002

IV-6: The Emergence Process

Emergence was a cumulative process with positive feedback (alternatively, a process characterized by Dynamic Economies of Scale

The trigger was the Yozma program, implemented during 1993 - ~96/7 (see below). In response to an “Excess demand for VC support”, it induced raising 250 M\$ embodied in 10 ‘Yozma Funds’ which eventually were to be invested in about 200 Israeli SUs.

This fact—given also the reputable foreign Limited Partners(investors) in the Yozma Funds-- together with some successful exits during 1996/7 generated a strong reputation effect which led to accelerated entry (see below)

In parallel with this, the early years involved additional qualitative changes in organization and management/strategy of SUs and VCs, a continuation of the processes that took place in Phase 2. The successful selected model of both SUs and VCs got further consolidated during this period.

IV-6'

At some point we observe a process of accelerated entry of SU and VC activity which led to a VC industry and market. The accompanying cluster would have attained then sufficient size to sustain large numbers of supporting services such as

specialized attorneys and lawyers, accountants, start up oriented marketing & manpower and technical services, in house production of some inputs and even opening of offices of investment banks & underwriters.

IV-7. Phase 3, The Emergence Process

This 'cluster effect' would induce entry of foreign MNEs & eventually even top tier US VC firms (towards the end of the decade), facts which induced further domestic SU and domestic VC entry.

These sub-processes to which we should add a continued 'collective learning process' by the various types of agents, led to a strong cumulative process of emergence with positive feedback

IV-8

We should not forget that that process built upon very favorable Phase 2 pre-emergence conditions part of them the result of policy

Moreover the domestic and global contexts during Phase 3 were very favorable

- ***growth in the NASDAQ index and globalization of these and of knowledge markets,***
- ***growth in global technology markets***
- ***highly skilled immigration from the former Soviet Union***
- ***The Oslo Peace Process***
- ***Continued ICT revolution (e.g the Internet); etc***

IV-9

Still, the cumulative process of emergence would not have happened without a new targeted ITP program-Yozma; and without luck!

The timing of Yozma and its design were crucial-see below.

So (and partly related to this) was the preparatory ‘policy learning’ process which took place during the late 80s and early 90s e.g ‘selection’ of the LP form of organization; and the requirement for the supported ‘Yozma Funds’ to partner with reputable foreign financial institutions

IV-10. Yozma program (1994-7/8)

Background & Objectives

- **Identification of the System Failures** constraining the growth of high tech: (early 90s): *Absence of a VC industry*
- **Creation of stable, competitive, domestic VC industry with strong capabilities**
- Ensuring **minimum government intervention** in management
- **Generating a critical mass of VC activity** (for triggering a cumulative process of emergence)
- **Linking with & Learning from foreign partners**

IV-11. Phase 3, Yozma program

- ***Government VC component***

A \$100M Government venture component which leveraged an additional \$150M of private capital

- ***Fund of Fund***

In each of the (10) Yozma funds supported, the government invested 40% of the capital raised - 8 M\$ (size of funds \$20M)

- ***Incentives to the upside***

The privately held 60% had a 5 years option to buy the government share at initial value plus interest

IV-12. Phase 3, Yozma program

- Focus on *Early Stage investments in purely high tech SU*
- *Adoption of LP form of VC organization*
- *Requirement to partner with a reputable foreign financial institution* e.g Advent, not a requirement in e.g the Irish case
- *All management companies were Israeli entities which included partners from both Israeli financial institutions and foreign (US) PE (VC) entities.*
- *Some selection of Teams*

IV-13: Phase 3, Co-evolutionary Processes-1

The implementation of Yozma ignited the two co-evolutionary processes dealt with in this paper.

In itself it is a central Innovation Policy event which directly, by reducing existing “excess SU demand for innovation support” in 1993, would induce additional SU activity, and therefore, more Innovation*. But Yozma would also directly affect VC. Therefore, the overall direct effect would be an ‘a policy push & pull’ effect triggering SU-VC co-evolution.*

VC-SU became the central co-evolutionary process of Phase 3, the outcome being an increase from 2/3 VCs and 300 Sus in 1992, to about 60 VCs and 3000 SU in the year 2000

Reputation Effects and growing expectations, the entry of new agents, cluster effects and collective learning would then assure continued growth of SU and VC and continued co-evolution

IV-14: Phase 3, Co-evolutionary Processes-2

Distinguishing features:

- **A Quantitative Process (to a large extent)**
- **Systemic**
- **Increasingly Synchronous**
- **Led to a VC market (and domestic VC industry)**

Relatively few qualitative changes at the agent level.

Co-evolution was supported by the emerging cluster itself, the changing NIS and exogenous events (e.g. immigration of STE personnel from the former Soviet Union). It was also supported by the mutual 'pull' and 'push' effect

It was much less random & more systemic; and

Increasing frequency of links among the two variables.

IV-15: Phase 3, Co-evolutionary Processes-3

Examples of Increasingly Synchronous VC-SU co-evolution

Frequently entrepreneurs from VC-backed SU

- subsequently became consultants to the VC or
- even partners (information from interviews during 1999-2001).
- SU entrepreneurs also created new VC funds

Aspects of Innovation Policy-Innovation* co-evolution (late Phase 2 and Phase 3)*

The early 1990s was a period of Innovation Policy creativity, partly in response to the capabilities accumulated (--> Magnet Program) and partly in response to new national objectives such as Immigrant Absorption(→ Incubators Program).

IV-16: Co-evolutionary Processes, Magnet Program-4

Magnet expresses a qualitative adaptation-- both of Innovation Policy and of the substance and organization of Innovation— resulting both from the commercial potential of the individual firm capabilities accumulated up to then, and from the new opportunities of the global environment (also new challenges, since multi-agent cooperation was becoming routine).

Being a program which supported consortia of firms and Universities undertaking Generic, Mission Oriented R&D, it spearheaded a new organizational and strategic form of Innovation. The quantitative growth of this program was associated both with qualitative new forms of innovation; enhanced cooperation among firms and between firms and Universities; and multidisciplinary R&D

IV-16. -5

The quantitative growth of the Program and its qualitative adaptations (e.g structure of expenditures and creation of the related Magneton and Nofar sub-programs) on the one hand;

and

introduction of new types of innovation programs and innovation organizations (industry-University Consortia), of larger innovation projects with greater multidisciplinary, strongly suggest that a co-evolutionary process took place within this program between 1992-2000

Conclusions and Possible Implications

IV-17. Phase 3 co-evolutionary processes