

August 2000

***GLOBALIZATION AND FIRM DYNAMICS
IN THE ISRAELI SOFTWARE
INDUSTRY: A CASE STUDY OF DATA
SECURITY***

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This is the first report of a four-year study of Israel's high tech industry. It was made possible thanks to the collaboration of: E. Diamant, H. Friedman, U. Savoray, M. Elgarissi, D. Elgarissi, Y. Margalit, Z. Dascalu, I. Mezin, S. On, E. Herscovitz, D. Dor, S. Gruper, R. Nave, S. Touboul, M. Zorea, G. Golan, Y. Cohen, R. Nitzan, N. Brandman.

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1.BACKGROUND AND RESEARCH OBJECTIVES

This paper focuses on some microeconomic aspects of the process of globalization, namely the patterns of growth of very successful Israeli companies in a specific but very important ICT area-Data Security. The background to this focus is the process of globalization of the last two decades of the millenium, the associated surge of high tech industries in many countries worldwide (including Israel); and the emergence of a new type of high tech cluster in Israel, spearheaded by the Software and hi tech Communications Equipment areas (of which Data Security is part).

The New High Tech Cluster

During the 90s the Israeli economy continued the process of structural change initiated in the seventies (Teubal 1993), but in an accelerated mode (Justman 2000). Within manufacturing (and probably also within Services) we observe a sharp increase in the weight of hi-tech. The share of these industries in manufacturing employment increased from 14% in 1980 to 18.5% in 1998 -- a higher share of all or most OECD countries (Avnimelech op. Cit 2000). The share of high tech in exports has increased even more dramatically than the share of employment. But not less important than the quantitative aspects are the qualitative ones. Thus the high tech cluster that emerged during the 90s was very different from the military industries dominated cluster of the 80s. It becomes much more 'intensive' in Start UP firms (SU) and in Venture Capital companies (VC) (Teubal 1999); and it is much more integrated and linked with the US and its hi tech clusters in Silicon Valley and elsewhere. Thus, the numbers of SU companies estimated for 1997 was approximately 3000 while the number of VC funds increased from one during 1991 to over fifty towards the end of the decade.

The success of Israel's high tech ICT sector during the 90s would not have been possible without the continued deepening of the globalization process during the last decades of the millenium and of the continued ICT technological revolution. Globalization of technology & knowledge, organizational forms, capital markets, and skills created new opportunities, which some countries more than others did (or earlier than others) happened to exploit due to their flexibility and capacity to adapt. Israel was one of the first countries out of the US, which was fortunate enough to have exploited such opportunities, at least during the 90s. Evidence of this is the fact

that US venture capital companies invest in Israel more than in any country out of US, this phenomenon is even more pronounced in Silicon Valley venture capital funds.

Israel's success with high tech and its 'reconfigured cluster' seems to have been linked to the following factors-

- The "Silicon Valley" model of ICT high tech has and is *diffusing* to other countries;
- Strong links to US (and to some extent other countries') *Asset and Capital Markets* were forged;
- Significant *Foreign Investments* into Israeli hi tech, particularly in ICT areas, have occurred;
- Strong *Personal, Professional & Business links* and networks have been forged between Israeli engineers, managers, investors and their counterparts in the US (to some extent also elsewhere).

As mentioned, Israel was one of the first countries beyond the US and Canada where the Silicon Valley model (See Saxenian 1998) of high tech has diffused. This was due to a number of factors such as the availability of large numbers of high level technical personnel (the numbers of engineers as a percentage of population is one of the highest worldwide), a pre-existing high tech sector in the 80s with at least moderate success; the existence of a set of country specific institutions such as the Army; and strong revealed entrepreneurial capabilities (particularly at the SU phase of company growth, much weaker at subsequent phases). Other countries in Europe and in the Far East are bound to follow suite and reconfigure their existing hi tech clusters (or incorporate Silicon Valley elements into hi tech sectors) e.g. Sweden and other Scandinavian Countries; Taiwan and Singapore; etc. There are a number of mechanisms explaining this diffusion process: 'imitation' & "Learning from Others"; enhanced cross border links; and enhanced selection pressures derived from the successful 'Silicon Valley' model; etc.

The remaining three factors co-evolved with the evolution of the high tech cluster during the last decade. A *central feature* distinguishing the Israeli hi tech cluster from Europe's and from Israel's a decade ago is the extent of integration of Israeli hi tech with US asset and capital markets. Links with the US in many ICT areas and capital market links are critical both because of the size of the US market

and because the US market sets the trend and paces technological and market developments (this may change in favor of Europe with 3G mobile technologies). Israel has been the country-not counting the US-with the highest numbers of IPOs (Initial Public Offerings) in NASDAQ after Canada and, till 1997 at least, its total number exceeded the cumulated IPOs at NASDAQ of all other countries combined (again, excluding Canada)¹. Another instance of asset market links are M&A with US and other foreign companies, particularly acquisitions of small & young Israeli SU by US companies. Large chunks of Israeli ICT hi tech seems to have been “internationalized” through this mechanism. M&As also comprise an important share of the growing flows of total direct foreign investment in Israeli hi tech.

Last but not least it must be mentioned that Israeli managers, engineers, entrepreneurs and investors have acquired substantial experience in the US; and that important personal, business and professional links link such Israeli groups to US counterparts. In the mid eighties there were about 300 Israelis, mostly engineers, living and working in Silicon Valley alone (personal communication). This number has undoubtedly been increased probably by an order of magnitude during the 90s. Saxenian op. Cit has shown that personal and professional links are important factors in the regional dimension of high tech growth. What is special here is the fact that *cross border links & cross border learning* seem to have been critical elements in the growth of the Israeli hi tech cluster in the nineties. Thus Globalization is enabling countries to acquire from abroad some important constitutive components of the emerging new configuration of hi tech.

Objectives of Paper

There are three main objectives of this paper:

1. An analysis of Firm Dynamics in the Data Security Area of Israel’s Software Industry
2. An analysis of the Emergence and Development of the Data Security Area itself
3. Theoretical (and some potential Policy) Implications

¹See Blass and Yafe 1998. To date 97 Israeli companies are traded in the US of which 47 have a MarCap of 500 M\$ or more (Haaretz, August 7, 2000).

The Israeli Software industry in general and the Data Security Industry in particular (the or one of the most dynamic of Software areas) are paradigmatic examples of the Israel's hi tech cluster of the 90s. Together with hi tech Communications Equipment (&Software) they comprise the majority share of the increase in aggregate hi tech value added during this period. They are the 'new hi tech areas'' which substituted the traditional 'instrumentation', 'electronics' & 'defense' related (e.g. aircraft components) areas which comprised the bulk of hi tech up to the 80s. They grew as a result of the globalization processes mentioned above; and also because of this process, a potentially enormous gap between private and social profitability of invention/R&D emerged.

A number of reasons led us to focus on the Data Security segment of the Software Industry. First, it is a very dynamic segment within IT both in Israel and abroad. Second, Israel has a 'competitive advantage' in the area, one major invention/innovation/market having emerged from the leader firm (Firewalls, launched by CheckPoint towards the mid nineties). Third, we had the opportunity to cover the 'whole universe' of companies (a total of 19 till mid 1998). Needless to say, there are additional reasons why a study of the implications of globalization for hi tech development should focus on IT (or ICT): first, IT lies at the heart of the Globalization process itself so every country should adapt to IT and local IT industrial activity could be part of this adaptation; second, it is a very dynamic sector with a multitude of competing and complementary technologies. Therefore there are both enormous opportunities and enormous risks. Two major issues, which this paper may make a contribution in answering to: could R&D intensive, *small economies*, develop a competitive advantage in advanced IT areas? If so, how?

The *central focus* of the paper is the dynamics of growth and internationalization of companies, which we trace through a combination of in-depth interviews, assembly of additional information on each one of the 19 companies, and conceptual (Appreciative) theory to build *growth profiles of very successful companies*. We firmly believe that this is an important first step in a broader research agenda covering the high tech cluster level; and in order to set a firmer knowledge and intellectual base for future, potential policy implications.² This is justified on two

²Our methodological approach is to proceed from the firm level to the cluster level of analysis rather than viceversa. This is justified when changes in the cluster are deep and when they are led by a small number of key firms. We have 'completed' the first stage (firm dynamics), but have only barely

counts: first it turns out that a dominant share of the activity is accounted by four ‘very successful’ companies, two of them who remained indigenous (despite ‘internationalizing’ e.g. through IPO and penetration of the US market) and two of whom having been acquired by foreign multinationals. Second the ‘R&D leverage’ and “Spillovers’ of these companies seem to have been much stronger than that of the remaining IT companies.

The final set of issues concern theoretical and policy implications of the analysis. First, the analysis will shed some light on the link between capability accumulation of firms and ‘internationalization events’ particularly IPOs and M&A. IPOs ‘generate’ capabilities, which are important for firms in a globalized world. Related to this, the decision and the location of IPO (and choice between IPO or M&A) will depend on firm strategy rather than being exclusively dependent on the calculus of company Market Capitalization maximization (net of IPO costs). Second, it will suggest a redefinition of Teece’s analysis of ‘complementary assets’ (Teece 1985,7) and adept it to the conditions prevailing in IT sectors at the end of the Millenium.

During the 80s difficulties in accessing specific “complementary assets” (such as those related to ‘implementation’ of R&D results such as assets related to production and marketing) were considered as a important causes for lack of positive profitability of inventors and firms pioneering important innovations (Teece op. Cit). One substitute mechanism available today and operative in Israel for accessing such assets (and much less available and widespread then) is acquisition of the domestic company by a large foreign multinational (M&A) possessing such assets. Inventors and associated investors and companies could thereby profit without having themselves accessed complementary assets and without having undertaken substantial commercialization of the invention. Undertaking an IPO in the target market for the invention –another possibility opened up by globalised asset and capital markets-- further enhances the options available to the entrepreneur/inventors both as far as

scratched the surface of the second (cluster level). One problem is that the cluster level involves much more than Data Security; it rather should refer to IT as a whole. Finally it should be mentioned that a complete separation between firm, area and cluster is not possible. Thus our analysis of firm dynamics is embedded in a study of the emergence and development of the Data Security Area as a whole; while the foundation of very successful companies will also be linked in some way to the overall characteristics of the high tech cluster (through for example the experience and background of the entrepreneur-founder).

private profitability is concerned and concerning the accumulation of 'complementary' assets.

The upshot is that the Globalization process has shifted Teece's argument for low *private* profitability to the inventor to one of potential low *social profitability of the invention/innovation*. This because in a globalized world, part of the 'R&D leverage' and the 'spillovers' from the invention/SU will frequently not accrue to the national economy after acquisition (M&A). Production and marketing will be undertaken anyplace in the globe, depending on 'comparative advantage' and costs. A major issue raised by this paper is whether an *indigenous* very successful company growth profile could contribute to close the gap generated by the globalization process between the private and the social profitability of Invention and R&D.

Needless to say that the analysis here has significant implications for Innovation & Technology policy broadly speaking under conditions of Globalization, especially pertaining to the Strategic Level of the Systems/Evolutionary Perspective to Innovation and Technology Policy(see Teubal 2000, 1999). Policy-wise we will suggest that building large (indigenous) IT companies may become an important policy priority and objective, no less than supporting R&D and SU creation. A full development of this topic, however, will be developed in a companion paper.

1. OVERVIEW OF DEVELOPMENTS IN THE DATA SECURITY AREA

The data security area emerged during the third (and present) phase in the development of the computer industry--the Networking Phase of the 1980s (Malerba, Nelson, Winter 1997). Up until the 80's, using computerized databanks consisted of accessing a central databank (despite appearance of time-sharing architectures and workstations in the late 70s). In the 80's with appearance of the PC the so-called "workstation revolution" began. It involved the emergence of intermediate store sites and the reallocation of the central database to personal databases ("downsizing"). At this point in time communication networks based on LAN (Local Area Network) technology started developing as well. In the late 80s and early 90's two big changes took place in the world of computers which were related to the interaction of computers and communication. First the appearance of the World Wide Web (and the Internet revolution); and second the use of open systems which were imbedded in modems that enabled connectivity to the outside world. Most of the data security

problems emerged due to these changes. Prior mainframe and Unix-based systems were not designed to work as open systems. Moreover having efficient computer systems became important for companies, a strategic factor in their competitiveness. Like all economic assets computers, the data stored in them and their communication lines came under many threats. This together with diffusion of PCs to the population at large is the main reason for growing concern with Data Security.

1.1 Stages in the Development of the Information Security Segment

Stage 1 (1980-1992)

The 80's can be singled out as the beginning of the security field. "The Founders" of this field were anti-virus companies, software protection companies and applications of encryption algorithms in "defined" networks (e.g. within internal networks of large financial institutions).

Antivirus

They emerged as an answer to the computer viruses that appeared. This phenomenon was started and mastered by young computer hackers who saw this as an act of mischief but as time went on viruses became more harmful. A number of anti virus companies were founded and operated out of Israel. Those companies held a respectable part in this field. A few noteworthy companies were Carmel Software Engineering, Iris, BRM and Eliashim. The first products that came out were specific anti virus followed by general anti virus and other software protection solutions.

At this stage the security problem was acknowledged and the felt need to provide solutions induced firms to become active in the area. A lot of know how was accumulated during this period, which affected the future development of this field. Anti virus software companies became incubators of future security software entrepreneurs. BRM for example became a Venture Capital fund and entrepreneur greenhouse in the 90s.

Software Protection

The development of the software industry as a leading economic sector intensified the need in preventing illegal duplication of software. As a response the next stage in the security sector development consisted of solutions for protecting software from being illegally copied. Initially this was based on software but quickly it was replaced

by hardware based solutions – plugs (dongles). The products are based on encryption and forming a decoding key in a form of software (initially) or a plug (later on). The main company in Israel at this stage is Aladdin.

Encryption Methodologies

Simultaneously, during this period the first leading academics in math and statistics specializing in encryption at Universities became active in the field of encryption technology. A key figure was Dr. Adi Shamir of the Weizmann Institute of Science who in 1977 had co-developed an encryption algorithm RSA (the S stands for Shamir) that was based on a private and a public key. Most of the encryption engines in the world today are based on this algorithm. Some note worthy companies (some with links to Universities) were founded during this period. They include Algorithmic Research (products based on RSA) and NDS (based on the Adi Shamir algorithm). The products of these companies were mainly applications of encryption technology and their commercialization.

Policy

At this stage of the field's development there were no VC funds in Israel and less awareness of the potential (for Israel) of high tech industry in general and of the Information technology fields in particular. There was no targeted government program for helping technological development of these industries beyond the existing general\ horizontal support of R&D in all industries (with the problem that 'software' was not consistently defined as 'an industrial branch' till later on). The situation started to change during the second half of the 80s, when two important measures were implemented: first. Recognition of "software" as a sector that could benefit from the industrial R&D incentives handled by the Office of the Chief Scientist's "Industrial R&D fund"; and second, promulgation of the 1984 Law which led to significance increases in the subsidies extended to industrial R&D³. These

³The 1984 R&D Law (apparently) assured R&D grants at a rate of 50% to every project satisfying 'minimum criteria'. These were not 'competitive funds' but incentives that could be more or less relied upon when writing a business plan to be presented e.g. to external investors or Venture Capitalists.

changes had an impact on all stages of the development of the Data Security Industry⁴.

Stage 2 (1992-1996)

This stage (1992-1996) is the outcome of two processes-in Israel, incubation period for technology and entrepreneurs in the Army; and worldwide, popularization of the Internet. This happened within a background where the security problem intensified with the beginning of computer communications within big organizations and once communications expanded beyond the physical restraints of one building.

At this point the main incubator for human resource and learning in this field in Israel was the IDF's (Israel Defense Forces--the "Army") communication and intelligence units. The special nature of the army, being a big and spread -out organization entailed two main, data security- related needs: to communicate information on a real time basis; and to secure this information. Personnel in these units were accumulating valuable experience, ideas and technology , including those pertaining to a product(firewall) which played an important role in the future of the industry both at home and abroad. The Army then was years ahead of the civilian market in the information security field.

All of this meant that towards the end of the eighties a) some of the basic ideas and technology for the whole information security field developed; b) Israel developed a measure of competitive advantage due to two factors: the Army and Academia. As mentioned the Army was not only a source of ideas but also a source of entrepreneurs and skilled personnel (e.g. army veterans who worked in these fields during their army service). The companies that will be created a few years later by individuals having worked in the computer or other units of the Army developed without strong links with the companies founded by people from Academia.

This second stage in the development of the data security segment started in the early 90s with the development of the Internet. The development of the Internet proceeded in steps: initially the Net was used by academic institutes; and only after that the use spread first to big organizations and subsequently to the public at large (currently a more advanced E-commerce stage is taking off). The main changes that took place in the Internet age were in the volume of communications and in a new set

⁴Despite existence of one Venture Capital Fund--Athena- this period belongs to the "pre-VC industry" phase(the flourishing of VC in Israel is a phenomenon of the 90s).

of business and technological opportunities. This induced entry into the area of existing companies and entry of completely new ones. The most outstanding company is Checkpoint, which, according to well-founded opinions, basically defined that market in its present form: it both redefined needs (they had changed due to the Internet) and created the demand in the market. At this point other companies entered, the most important of these being Memco. Also some of the companies that existed before the Internet changed the strategies to fit the Internet age (Aladdin being the major one).

During 93-96, the would-be industry leaders five years beyond got established and consolidated. Moreover, a new wave of Israeli companies tried to apply their experience and knowledge in order to secure a leading position in the growing security field. Israel became a leading force internationally in the field of information security, a fact that helped other Israeli companies trying to join this field.

Stage 3 (1996-1998)

An important development in the Internet age was development of programming languages like JAVA and ActiveX. This development open new threats and therefore a need for new security technology and concepts .A result of this is a new wave of companies that emerged in '96-'97 (the third stage in the industry): Abirnet, Finjan, Netguard, Vanguard, Eagleeye, Security7. A newer wave of companies linked to e-commerce is currently taking off and are part of the current stage of the data security sector⁵.

Policy and Venture Capital (Stages 2 & 3)

Since the early 90s changes in the VC sector took place following the “Yozma” committee that resulted in the creation of “Yozma” a Government owned VC fund, which is credited with triggering development of the VC industry in Israel during this decade. In less then a decade the number of VC funds in Israel rose from 1 to more the 70 funds. This opened up new sources of finance for hi tech including for

⁵The current stage of the industry, which began in 1999, lies beyond the scope of this paper. This stage involves creating a unified platform enabling interoperability of all devices. The SVN platform created by CheckPoint is the leading example of this.

data security companies which could now choose among various alternative sources of finance (Venture Capital funds of various kinds, private and strategic investors, foreign companies and financial institutions, Office of the Chief Scientist grants, etc).

These changes in the support structure to the business sector had a strong effect on high tech industry in general and the information security sector in particular (particularly in stimulating ever increasing waves of start up companies). The effects were reinforced in information security by the fact that it 'sits' on an important crossroads between the Internet and E-commerce and by having a good track record.

2. THE UNIVERSE OF "DATA SECURITY" COMPANIES

2.1 The Sample and its Characteristics

Our sample includes 19 companies each one founded in one of three possible stages: the Early stage A (1980-1990)-- four (4) companies; the *Middle* stage B (1990-1996)--seven (7) companies; or the *Mature* stage C (1996-1998)--eight (8) companies (see Table 1). The sample pretty well covers all of the Data Security sectors of Israel, that is, we believe that rather than being a 'representative' sample it approximates the Universe as a whole. We say this despite the fact that there is no uniformly accepted way of defining the term "security" e.g. does it include Conditional Access to Pay TV? Our approach was to consider a broad definition of the area and our perception of what the area consists of gradually expanded throughout implementation of the study. For our purposes "security" included at least one of the following: implementing encryption algorithms in any kind of application; software or hardware-based defense of individual computers or computer networks.⁶

⁶There was no formal "roster" of "data security" companies, which could serve as the universe from which we could have sampled our companies. In "The Israeli Hi Tech Guide for the Year 1999 " there are 16 companies under the category "Security" a number of which are advisory\consultants companies rather than hi-tech start up companies. Moreover, some of the most important companies in the field were classified as "Software Companies" rather than "Security" companies. After our 'search' led to the identification of the 19 companies in our sample we thought that they would comprise the whole universe. Then our interviewing began. However, after six months of intensive interviewing, a number of additional companies were identified which might be considered as being active in Data Security, some of them recently founded. These were not covered in this project. Thus while we cannot be sure that we covered the whole Universe of Data Security (even as it was in mid 1999) we did include the most important companies which are market leaders in their field (see successful companies in the next section).

The table in Appendix 2 summarizes some of the qualitative information on these 19 companies: foundation date, stage of industry, and *Products & Product Families*. Table 2 presents Company Status-- *Initial Company Status* (independent, linked to an existing domestic company or incubator); *Actual Company Status* (independent non-publics company, public, foreign subsidiary, linked to domestic company, incubator and closed); and the links between both. Additional information gathered includes-

TABLE 1: COMPANY FOUNDATION BY STAGES OF GROWTH OF INDUSTRY*

STAGE A (1980-1990): (4) COMPANIES

AREAS: ANTIVIRUS, SOFTWARE PROTECTION, and ENCRYPTION

PERFORMANCE: (2) VERY SUCCESSFULL COMP.(SS)

(2) MODERATELY SUCCESS. (S)

STAGE B (1990-1996): (7) COMPANIES

AREAS: FIREWALLS, VPN, and SERVER PROTECTION

PERFORMANCE: (2) SS COMPANIES

(2) S-COMPANIES

(3) OTHER (“O”) COMPANIES

STAGE C (1996-1998): (8) COMPANIES

AREAS: MOBILE CODE, ACCESS CONTROL, MANAGING & AUDITING

PERFORMANCE: (2) S COMPANIES

(6) “O” COMPANIES

*For Performance Categories see 2.3

TABLE 2: COMPANY STATUS

INITIAL STATUS(IS)

INDEPENDENT:	(14) COMPANIES
LINKED TO DOMESTIC COMPANIES:	(3) COMPANIE
INCUBATORS:	(2) COMPANIE

FINAL STATUS*(FS)

INDEPENDENT:	(8) COMPANIES
FOREIGN SUBSIDIARIES:	(6)
LINKED TO DOMESTIC COMPANIES:	(2)
PUBLIC COMPANIES:	(2)
CLOSED:	(1)
INCUBATOR:	--

COMPOSITION OF FS-INDEPENDENT (8)

IS INDEPENDENT (6) + IS INCUBATOR (1) + IS LINKED DOMESTIC (1)

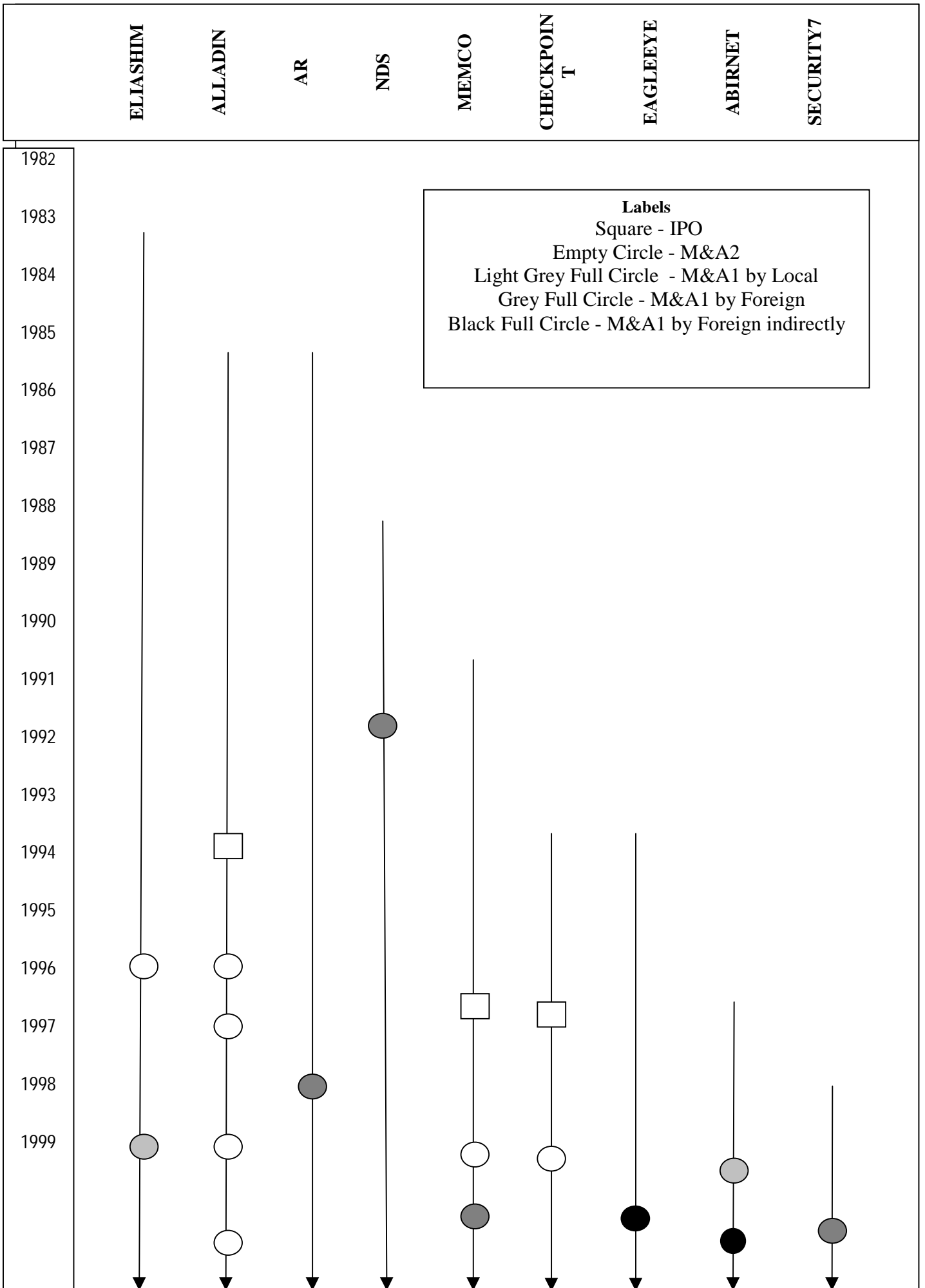
COMPOSITION OF FS-FOREIGN SUBSIDIARIES

IS INDEPENDENT (5) + IS LINKED DOMESTIC (1)

***Mid 1999**

Initial Public Offering (yes, no); *Initial Financing* (first year- Venture Capital, Strategic Partner, Backed by an Existing Company, Bootstrapping, Office of the Chief Scientist); and *Location* (city, area). In addition a company survey generated quantitative information on individual companies (Sales & Sales growth, Employment & Employment growth; and Market Capitalization). This information is incomplete (especially sales information- a sensitive figure for many SU companies); and Market Value, since only four companies underwent an IPO and even for those we have, we abstain from presenting the absolute values for individual companies (except on Market Capitalization)

Figure 1: The M&A Process



Highlights

1. *Initial Status*: the dominant shares of companies --(14) out of (19)--- were founded as *independent companies*. The others originated either as SU “linked to (incumbent) domestic companies” (3) -including being domestic subsidiaries or a separate team integrated within such companies; or Incubators (2) -who partner with SU located within their premises.
2. *Final Status*: the distribution of companies according to Final Status (mid 1999) includes a *lower share of Independent companies* -(8) from a level of (14)- and a *higher share of foreign subsidiaries-* (6) up from nil(Initial Status). Four (4) companies undertook IPOs of which (2) remained as *public companies* and another (2) became subsidiaries of foreign multinationals (or foreign companies). (2) Out of the three remaining nineteen companies were ‘linked to domestic companies’ and the remaining one failed and closed. No Data Security companies remained in Incubators.
3. *Links between Final and Initial Status*: Most (6 out of 8) of the companies who where independent and most (5 out of 6) who were foreign subsidiaries in mid 1999 were independent companies when founded. Of the original (14) independent companies--- (6) were acquired by others (4 foreign, 2 domestic); (2) undertook IPOs in NASDAQ and became indigenous public companies; and (6) remained independent.
4. *Foreign Acquisitions*: Four (4) companies (Memco, NDS and two others) were *directly* purchased by foreign companies and the domestic parent of two (2) additional companies (who upon foundation were ‘linked to domestic companies’) were also so purchased. This makes a total of six (6) foreign acquisitions out of a universe of (19) companies-about 30% of all companies. The qualitative picture is even more extreme. If we classify companies into Very Successful, (Moderately)Successful and “Other”(including failures and young companies)-see 2.3 below- we see that:
 - Two (2) out of four (4) Very Successful Companies were acquired by Foreign Multinationals
 - Four (4) out of six (6) Moderately Successful Companies were acquired by foreign multinationals.

Thus 60% of the Successful Data Security Companies were acquired by foreign multinationals. This however *does not* include CheckPoint, the most important of all. Figure 1 shows in detail the process of M&A within Israel's Data Security Industry (including acquisitions of Israeli companies by both Israeli and Foreign companies [M&A1]; and acquisitions of foreign companies by Israeli companies—what we have termed M&A2)

5. *Issues Emerging from the Pattern of Foreign Acquisitions:* The Data Security Industry shows a very active process of acquisition of good companies by foreign multinationals. This reflects the depth of the process of globalization in ICT and the strong external links of Israel's high tech cluster. One issue concerns the possibility of very good companies to remain independent in ICT areas with great dynamism and increasing connectiveness (which might give advantages to large companies like Cisco which offer both Security solutions **and** Network hardware & software); another concerns the propensity of such companies to be acquired including 'preferences' of owners (see below). Last but not least, it raises the issue of the potential 'Differential Impact' of successful companies which remain indigenous compared to successful companies which are being acquired by foreign companies (see below).

6. *Employment, Sales and Market Capitalization*⁷

Aggregate employment of 14 (out of the 19) companies was 1816 employees in 1998; aggregate sales for 14 companies during 1998 amounted to 406M\$ (sales data of two companies are 1997 figures); and estimated market capitalization of the group for October 1999 surpassed 6500 M\$⁸. There are problems with the aggregate data reported here: the employment figures reported by companies generally include employees in their foreign subsidiaries, not only domestic employment levels. Market capitalization values make use of different data sources (since only three companies are publicly traded companies- four including NDS who went public only after being acquired) and refer to different periods, depending on the date of a M&A

⁷ We have information about *rates* of growth of employment and sales for some individual companies. Data on sales is a sensitive piece of information for non-public companies (this is the reason it is not reported here even in cases where we have the information).

⁸ At the time of preparing this draft (August 2000) the Market Capitalization value is at least double this level due to the continued growth of value of shares of existing companies (especially CheckPoint) and due to the public offering, towards the end of 1999, of 10% of NDS's shares.

or the date of a Venture Capital investment in the company. The overwhelming share of market capitalization corresponds to companies who were founded during stage 2 (1990-1996) of the Data Security industry of this country. More than 80% of this value corresponds to one company-CheckPoint. Its foundation date coincides with the period when the Internet 'took off'.

2.2 Summaries of Major Companies⁹

Summaries of the four companies with larger market capitalization, employees, sales are shown below.

Checkpoint

Gil Shwed, Shlomo Kramer and Marius Necht founded Checkpoint in 1993. In the seed stage BRM invested 400K\$ in exchange for 50 % of the company's stock. In addition to the cash investment BRM aided Checkpoint with building and implementing its business plan. The idea and technology for **firewalls** were shaped in Gil's and Marius's minds during their service in the IDF (Israel Defense Forces--the "Army" in this report) in the late 80s. They waited till the Internet was ripe enough for widespread application not only within Universities but also in businesses. Most of Checkpoint's initial employees were friends of the founders from their army service. In 1993 with the founding of the company, the information security field was acknowledged as a separately identifiable sector. The firm's strategy was to become a leading force in all aspects of information security but not to move into other fields. In order to implement this strategy Checkpoint established OPSEC – a standards committee which includes today over 200 member companies. Control of OPSEC enables the company to be always plugged in into the latest developments in the market. Most of the company's sales are done either by OEM or distributors (over 1000 distributors worldwide). Checkpoint's first OEM was signed with SUN Microsystems, this OEM was of critical importance for checkpoint's sales and for establishing a strong brand name. Checkpoint's strategy did not involve (till lately when its first acquisition took place) buying other companies; it rather used strategic agreements with leading companies.

⁹Updated till mid 99 approximately.

CheckPoint has had a decisive influence on the information security sector in general and on Israeli companies in this area. The influence on Israeli companies has been felt in different ways. First, the company marked Israel as a leading force in the world of information security, a fact that has drawn the attention of foreign investors and clients thereby helping other Israeli firms get market recognition. Second, Checkpoint has proven that it is possible to be an Israeli company and still be a dominating force in its market.

Since its foundation Checkpoint has show amazing progress. Sales amounted to 9.5 million dollars in 1995, 32 million dollars in 1996, 83 million in 97, 142 million dollars in 98 and expected sales of over 200 million dollars for 99. Checkpoint has gone public in 96 with a market value of 500 million and has reached today (10/99) a market value of 4.8 billion dollars. It currently employs over 560 employees.

Memco

Memco-- one of the first Data Security Companies in the world.- was founded in 1990 by Israel Mezin and Eli Mashiach They began by offering "security" consulting services to companies and by developing their first security product(for servers) which started selling in 1994. In 1996 the company created a Business Development department in charge of identifying candidates for acquisition in Israel and abroad and it signed a strategic agreement with Platinum, a US software company. In 1998 Memco made two acquisitions- NIT (US) and the Abirnet (Israel). It was then acquired by Platinum who in turn was acquired by Computer Associates (CA-company evaluation of 570 M\$). The former R&D operation of Memco is an R&D center of CA's Security Division. In addition to performing R&D it coordinates all of the "security" resources of CA. In August 1999 the first outcome of this effort came to fruition-a product called eTrust which combines the technology from the former Memco, Security 7 and Iris AntiVirus (three Israeli companies purchased by CA during 1999). The position of the former Memco in CA's organization is indicative of the important role played by that company in the world information security market (a role which could be strengthened after its sale to CA) as well as of its capabilities today.

Memco's strategy during the last three years--which combined strong internal growth, M&A and good PR-- was singled out in some of our interviews as their 'model' for growth and exit.

Aladdin

Aladdin was founded in 1985 by Yanki Marglit with a 10,000 \$ investment. The firm provided a hardware solution to software security/protection. It gained a respectable share of this market niche in Europe (sales in the US only began during the 90s). Sales have risen consistently and reached 12 million dollars in 1993. In 1993 the firm underwent an IPO in NASDAQ. In 1995, in order to strengthen its position in the software security market it purchased the technology developed by Elyashim. Sales in 1996 reached 30 million dollars, at which point the firm acquired (or merged with) its German competitor (FAST)¹⁰. By 1998 the firm realized that in order to stay ahead they must adapt their product to protect software on the Internet. This led it to enter the content control field. It then purchased Elyashim and the latter's US subsidiary--eSafe.

Aladdin had an important influence on the information security field before the Internet age and was one of the first player to enter the niche of software protection. It is a successful example of firm adaptation to the Internet-driven changes in the information security market. It is the second most important supplier in the software protection market today.

NDS

NDS was established in 1988 by a group of ten people from the Weizmann Institute of Science. The leaders of this group were Doctor Abraham Peled and Rafi Kesten. The technology of the group was based on the algorithms developed by Professor Adi Shamir in the 80's, who was a consultant to the group but not an associate in the firm.

The firm focused on data encryption (coding and uncoding) for satellite and "cable" communication; and specialized in products for TV broadcasting and conditional access to Pay TV by customers. By 1990 the company already had a complete product, which was a solution to TV broadcasting. A year after the company was acquired by the News Group, which was its main customer (thereby becoming a subsidiary of a foreign company).

¹⁰This very successful merger was documented in a case study of the Harvard Business School.

The main business areas are broader today: "to provide the leading systems of the management control and broadcast distribution of entertainment and information to TVs and PCs"¹¹. The company is well known for the excellence of its products and for its technological capabilities. Its continued growth in sales, profits and in domestic employment (a trend that continued after the acquisition) makes it one of the largest firms in the data security field in Israel and one of the main in its field worldwide.

2.3 Performance: Categories and Distribution of Firms

Throughout we consider three groups of companies: Very Successful (SS--4 companies); Moderately Successful (S-6 companies); and Other (O-9 companies)¹²—see Tables 3a,3b below. The O- category includes Failures (2 companies); Struggling (3 companies); and young companies with potential—"Emerging" (4 companies--*Com9, Com4, Com11* and *Com5*).

Very Successful Companies are successful in terms of at least two of three indicators: sales -several tens of millions of dollars; market capitalization¹³-several hundred million dollars; and high market share in well-established, non-niche markets. There are four companies in this group: Check Point, Memco, Aladdin and NDS. In three of them (all except Memco) all three conditions are fulfilled. Note that the most successful, Check Point, is a relatively young company--it was only established in 1993. Company value in the Very Successful company group is usually expressed in terms of the value of shares in the stock market --the first three had IPOs

¹¹**Israel's Electronics Industry Profile**, May 1988, p.57 (a publication of the Association of Electronic Industries).

¹² Due to sensitivity of the material the names of each one of the companies (excepting those of the SS group, which are public companies) have been "coded" as *Com x* where x runs from 1 to 15.

¹³Despite conceptual and measurement problems "Market Capitalization" should be considered as an important indicator of company performance nowadays, particularly in relation to hi-tech companies. This because current sales and profits alone may underestimate the potential contribution of a company to the national economy. For example, a company with little sales and negative profits may, through an IPO or an M&A bring hundreds of millions of dollars to the country. Having said that it is clear to us that the traditional distinction among economists between the private and the social profitability is particularly relevant here although its identification and measurement in a globalized world could turn out to be extremely difficult. Thus the hundreds of millions of dollars may accrue to a small number of entrepreneurs, managers or engineers who might not funnel them to the economy at all. Some may even be residing abroad.

in Nasdaq or the value of the company during acquisition (the case of Memco or NDS).¹⁴

Table 3a: FIRM PERFORMANCE CATEGORIES				
VERY SUCCESSFUL(SS)	MODERATELY SUCCESSFUL(S)	OTHER(O)		
		Emerging	Failure	Struggling
CheckPoint	Com2			
Memco ¹⁵	Com10	Com11	Com12	Com7
Aladdin	Com15	Com5	Com6	Com13
NDS	Com1	Com9		Com8
	Com14	Com4		
	Com3			

Table 3b: Companies by Performance Category and Foundation Date			
Stage	SS	S	O
A: Early	2	2	
B: Middle	2	2	3
C: Growth		2	6
Total	4	6	9

Moderately Successful companies include companies where sales have either already achieved at least 5 M\$; and/or whose company value is in the tens rather than in the hundreds of millions of dollars. Since there are no cases of IPO in this group, company value assessment reflects either an M&A or the valuation incidental to a Venture Capital investment. In three cases (*Com10*, and *Com3*) both the sales and the valuation conditions were fulfilled; in two cases (*Com14* and *Com15*)- only the company valuation condition has been fulfilled; and in the remaining cases (*Com2* and *Com1*) only the sales conditions holds. This group includes two relatively "older" companies (*Com3* and *Com10*, both of which were founded in the eighties) and four companies who were founded in 1993,1994, and 1996(2 cases).

The *Other* category of companies is an heterogeneous group where six (6) out of the (9) companies are "young" in the sense that they were founded in *Stage C* of the evolution of Data Security (the remaining three were founded *Stage B*). Clear "failures" can be found in two cases-a company founded in 1997 who closed (*Com6*); and another founded in 1995 who has been in crisis during the last years. "Emerging" companies are usually young (1996-two companies, 1997, and 1998) that have revealed certain potential e.g. a company with very little sales nowadays but having

¹⁴A public offering during November 1999 of 10 % of NDS's shares implied a company valuation of over 1 billion US dollars.

¹⁵Memco was a security consulting firm until 1993.

received an important multi-year sales order (Com5). "Struggling" companies lie somewhat in the middle.

3. DYNAMICS OF COMPANY GROWTH AND POTENTIAL IMPACTS

We focus on the four very successful (SS) companies—CheckPoint, Aladdin, NDS and Memco. We mentioned that they comprise an enormous share of the activity of Data Security firms in Israel. There is a strong presumption also that their contribution to the overall hi tech cluster has also been strong.

3.1 Approach and Main Variables

The two central categories of independent variables are *Phases of Company Growth*; and *Strategy*. These will be the central determinants of the following outcomes: *Profiles of Company Growth*; *(Private) Performance*; and *Social Impacts*. These appear in the overall Firm Dynamics Framework of Figure 4. We will focus on part of the overall scheme of firm dynamics only, namely explaining profiles of growth of each company in terms company phases and strategy. The third group of 'independent' variables is *Initial Conditions*. Two should be mentioned here—the "quality\potential" of the invention\innovation embodied in the product focused by the company in its initial, "product development/ SU " phase; and the "Background\Experience of the Entrepreneur". There is some evidence and a strong presumption that the initial invention/innovation which represented the initial focus of each one of the SS firms was a 'high quality' invention/innovation (this is not the case in other successful ICT companies in Israel where successful companies may grow from good market knowledge and links without having a particularly good 'initial' product). Concerning the founder/entrepreneur's background—a somewhat more systematic analysis was done comparing the four SS companies with a much larger group (at least 14 out of the 19 companies of the sample)¹⁶. We conclude that the origin of each of the SS companies studied there was both a 'high quality entrepreneur/founder' and 'high quality initial invention/innovation'.

¹⁶This paper will not define the quality\potential of innovations systematically, although there is evidence and also a strong presumption that the invention\innovation, which the firm focused on initially, was of "high" quality\potential.

In this paper (and in the report underlying it) we make only very brief reference to variables pertaining to the overall context within which firms operate. Two categories are important here: "*cluster-related variables and effects*" and "*policy*"¹⁷(see Figure 2 below). The former comes into the picture in at least three ways: first as a factor underlying the Background/ Experience of entrepreneurs e.g. some entrepreneurs were active in the Army or in incumbent high tech companies—both part of the pre-existing hi tech innovation system¹⁸; second, in the phases, strategy and internationalization events of companies after foundation. Thus for example, Aladdin did not make use of Venture Capital in its SU phase probably because VC was not available at the time (Stage A)in Israel; whereas Check Point and Memco did make use of VC (VC was becoming available in Stage B). The third mechanism linking firm and strategy concerns the impact of a particular firm profile on the cluster. The larger report which underlies this paper provides preliminary evidence which suggests that towards the end of the millenium very successful (SS) Data Security companies who remained indigenous made a more substantial contribution to the high tech cluster and to national objectives than those who were acquired by foreign multinationals (Avnimelech et al 2000 op cit, Appendix 1, Section 5). Despite the preliminary nature of these conclusions they are sufficiently suggestive within the overall background of the industry to influence the potential policy implications coming out from the analysis.

*Phases of Company Growth*¹⁹

There are three 'basic' Phases—SU/Product Development (Phase 1), Market Penetration & Broadening of Product Line (Phase2), and Consolidation (Phase 3). Every start up company starts with product development, which comprises the bulk of the effort in its initial phase. This stage also comprises initial marketing and it may also include the first orders for the product of the company and, in the case of successful companies, it will frequently include an agreement with a major customer

¹⁷The stage of the Data Security Area/Industry, while important, is part of the wider "cluster effects".

¹⁸As mentioned this has been systematically studied in the original TSER report of which this paper is an outgrowth.

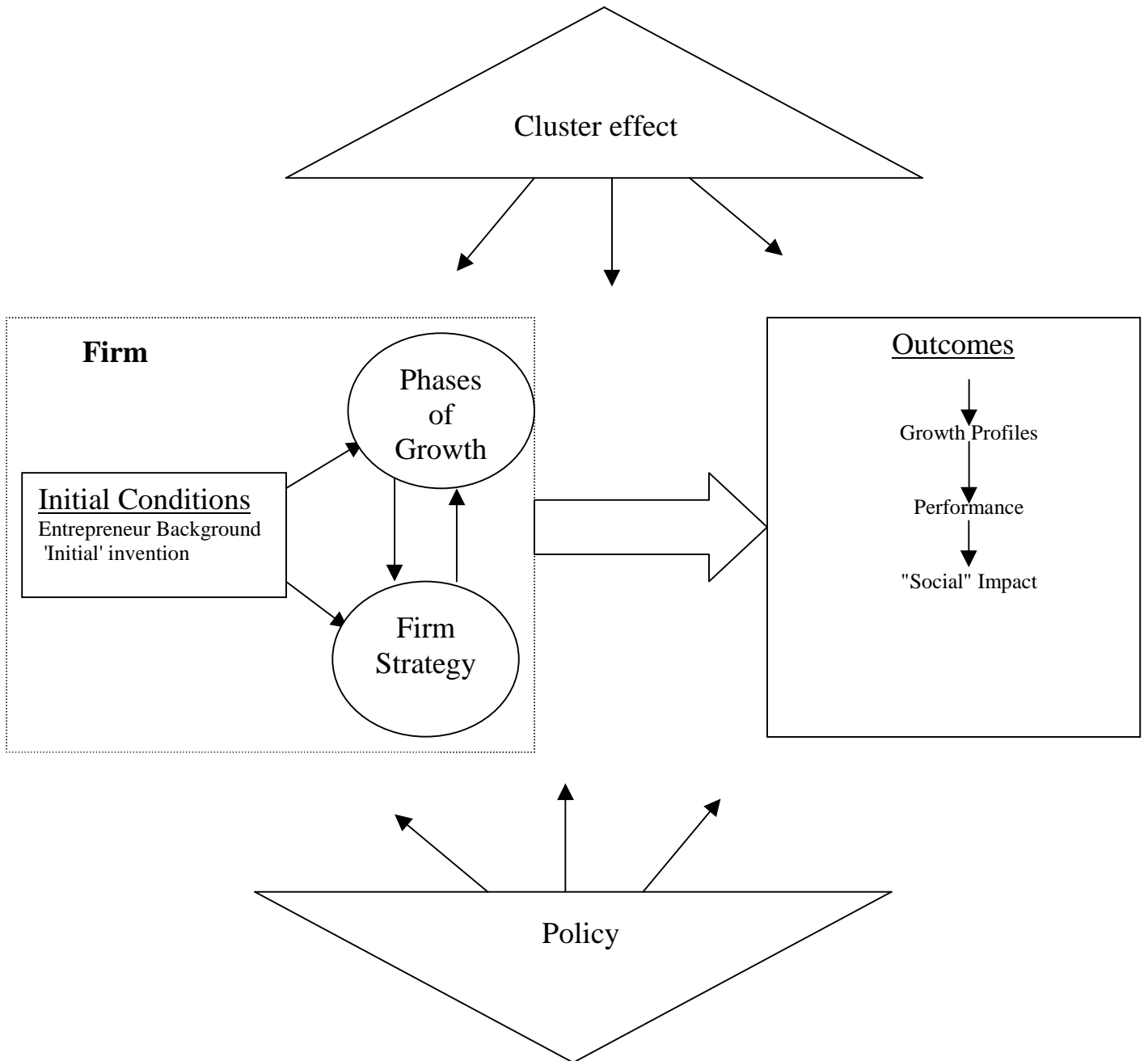
¹⁹The phases of company growth proposed below differ from those proposed in the literature dealing with Venture Capital (see for example, Ernst & Young and BRM 1998; especially pp.15-16). Our classification emphasizes the functional aspects such as R&D, Marketing etc whereas the classification used by VC emphasizes more administrative and especially financial aspects. We are also interested in phases of growth beyond the 'exiting' of VC-backed companies.

or vendor. At some stage a significant shift in the effort of the firm is recorded in the direction of Market Penetration while, certainly in the case of very successful companies, initiating development of new products (advanced versions of existing products and other related products). This is Phase 2. The consolidation phase (Phase 3) of very successful companies generally involves a much clearer and defined focus for the company and a strategy which is much more explicit and detailed; a clear organizational and managerial set up including the manning of important senior managerial positions e.g. Chief Financial Officer, etc; reduction of certain elements of uncertainty about the future and even more important a certain capacity to predict a reduction in the future "financial" performance of the company; and given disappointing results, rapid restructuring of the company. In parallel to all of this, the consolidation phase would tend to show a certain "balance" between technological and market\marketing efforts; and greater stability of rates of growth of sales (less variation, but still high at least for a time).²⁰ Our intent here is to associate the above sequence with an "indigenous" growth profile of Israeli companies. Whenever a foreign company acquires an Israeli company it enters a Post-Acquisition Phase. The Post-Acquisition Phase may begin at any one of the three phases of "indigenous" growth.

The Consolidation Phase of a company may involve two possibilities (see Figure): *Indigenous Consolidation* or *Acquisition by a Foreign company*. Acquisition by a foreign company is an extreme version of (or adaptation to) globalization one in which the domestic company may lose its identity. The alternative indigenous consolidation involves moving upwards and in a balanced way in terms of accumulated assets pertaining to technology, marketing\customers, and other tangibles and intangibles--while maintaining the essential Israeli identity. For example CheckPoint has shifted from almost exclusive reliance on an OEM agreement with Sun to a diversified portfolio of distributors, OEM agreements and even direct sales.

²⁰Undertaking an IPO will accelerate this process of consolidation considerably so issues of 'IPO timing' are critical - too early will make it less successful and with weaker 'dynamic' effects on company consolidation; too late will miss an opportunity both for achieving high capital values and for accelerating consolidation (we will see that IPO frequently in very successful companies will be undertaken during Phase 2 which is consistent with a trend leading to subsequent 'consolidation').

Figure 2: A Framework for Firm Dynamics: Company Growth and Potential Impacts



Aspects of Firm Strategy

The variables included in "Strategy" or associated with Strategy-related events include -- *preferences of founders, first major marketing\sale agreement, IPO, acquisitions by a foreign company(M&A1), domestic company acquisitions of(or mergers with) other companies(M&A2); Marketing Strategy & Target Customers; and the Accumulation of Marketing\Market & Customer-related Assets.*

The issue of asset accumulation seems to be critical since, Israeli companies frequently start with a technological idea and are characterized by a severe imbalance initially both in their outlook-- which is frequently 'technology push' rather than 'demand pull'; and also in the pattern of accumulation of assets (favoring technological over non-technological assets such as marketing assets)²¹. Asset accumulation related to 'marketing' goes beyond the usual 'understanding of needs/market' or 'marketing' as 'flow concepts'. It rather refers to market, marketing and client-related asset including 'reputation'. Moreover since the main Data Security market after diffusion of the Internet has and is the US(where most competitors are located) successful growth requires a significant accumulation of (or access to) marketing and client related assets which are specific to that market. A company which is acquired by a foreign company may enhance its *access* to such assets but the effect on accumulation of such assets may be negative²²; On the other hand a company which follows an indigenous path may be involved in a strong process of accumulation of such assets throughout. It will however, have to find a way to access such assets (externally) in the short run. Marketing agreements here would play a very important role.

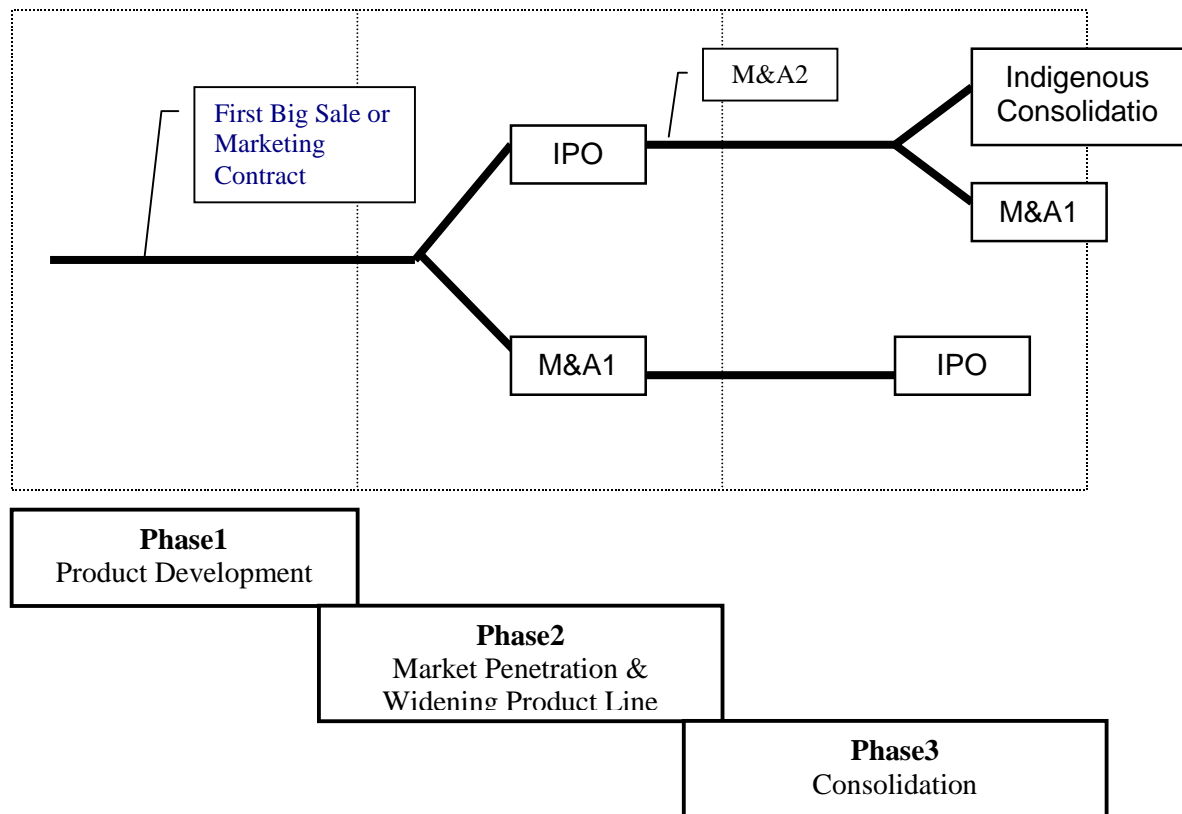
3.2The Phase Sequence of Very Successful Enterprises

Figure 3 presents a stylized Phase Sequence for these companies which reflects, *grosso modo*, their history. We superimpose only a *small number of elements of strategy and internationalization events* on the sequence:

²¹This seems to be stronger for Israeli Start Ups than what it is for its counterparts in the US(the latter are perceived as being much more demand oriented even at the beginning).

²²This might have happened, at least initially, with the acquisition of Memco by Computer Associates in 1999.

Figure 3: The Phase Sequence of Very Successful Enterprises



Explanation

The upper Main Sequence leads to Indigenous Consolidation (CheckPoint, Aladdin) or to Foreign Acquisition of the Israeli Company --M&A1 (Memco).

The lower Special Case involves M&A1 early in Phase2 (NDS).

Notation

M&A2 represents acquisition of other companies (domestic of Foreign) by the Israeli company.

M&A1 is acquisition of the domestic company by a foreign one.

IPO, acquisition of the Israeli Company by a foreign company (M&A1); and the Indigenous Consolidation option. These generate two instances of branching-out: the IPO (followed by Memco, and Check Point) versus the M&A1 alternative (followed by NDS) at the Market Penetration\Widening of Product Line Phase (Phase 2); and the two broad alternatives during the Consolidation Phase: Indigenous Consolidation (followed by Check Point); and Acquisition by a Foreign Company (Memco)²³. We have also included two additional "events" also reflecting strategic considerations: the "first big sale\marketing agreement" of the company (always occurring during Phase 1); and acquisitions by the Israeli company M&A2 (Phase 2 or 3).

The Figure represents phase sequences for very successful companies which incorporate some elements of strategy or strategy related events. It does not, however, represent complete *growth profiles* of these companies since most of the information on strategy is still missing. We see however that there is *a main phase sequence, which* covers three companies: Check Point, Memco and Aladding; and *special case (NDS)*. Let us describe these.

Characteristics of the Main Sequence(“early IPO track”)

- Successful Development and Initial Marketing in Phase 1 opens up the possibility of undertaking an IPO early in Phase 2. The IPO becomes an important component of the Market Penetration Strategy of that phase
- An early IPO opens up a number of possibilities for Phases 2 and 3. Thus all three companies following this course have undertaken acquisitions of both local and foreign companies subsequent to this event(M&A2);
- There are two main configurations of Consolidation--Indigenous and becoming part of a foreign company (M&A1).

Our casework shows that a minimum level of "achievement" is required for an IPO²⁴ and that this IPO takes place in Phase 2 rather than as part of company "consolidation". We should again emphasize that the “early IPO track’ of SS

²³See Figure 5. The essentials of the IPO -Indigenous Consolidation profile also holds for Aladdin once it began focusing in the US market (initially, before the Internet, it focused on Europe).

²⁴ It seems that some sales are inescapable as proof that there exist customers who see the product as satisfying their needs (things might differ as regards to this point with respect to Internet Companies). The minimum level also includes some consensus about the 'quality\potential' of the innovation and of the team conducting the firm.

companies is a critical factor in those company's subsequent growth. This because success in the US 'capital market' (Nasdaq) by raising reputation, credibility and trustworthiness, is almost a *sine-qua-non condition* for generating links with important customers (a critical step in US market penetration of SS companies). IPO is an element of firm strategy rather than a simply a method of 'exiting' for VC and other investors (see Section 4).

Special Case (the "early M&A1 track")

The main feature here is foreign acquisition of the local company--M&A1-- already at Phase 1 (end, or beginning of Phase 2). A major function to be served is Market Penetration and therefore this action is in effect a substitute for IPO.²⁵

General Remarks (both types of Data Security SS profiles)

- IPO and M&A1 are *substitutes* in the early Market Penetration Phase of Very Successful Companies.
- There are two *patterns of foreign acquisition* of a very successful Israeli Information Security company(M&A1):during market penetration (Phase1-2 of the *Special Case*) in which case if there will be an IPO it will take place after the foreign acquisition; or during the (and as part of) the consolidation process of the company(Phase 3, part of the *Main Sequence*) in which case IPO precedes the acquisition;
- IPO and M&A1 could be *complementary*. In the *Main Sequence* the IPO precedes the A&M1 without foreclosing a future Acquisition (case of Memco). In the *Special Case* either there is no IPO at all or the IPO comes after A&M1 (NDS was acquired in the early 90s and underwent an IPO in late 1999).

4. SELECTED THEMES

For lack of space it will not be possible in this paper to expand very much on matters of firm strategy nor to give a detailed description of all of outstanding cases of phase sequencing and strategy. This however has been done elsewhere (Teubal et al 2000 pp.34-49). We will here try to summarize part of the material and to refer to some other implications of the analysis. The themes we will be covering are

- Firm Growth Profiles, Strategy and Sequential causation
- Capabilities and Complementary Assets
- Two types of IPO

4.1 Firm Growth Profiles, Strategy and Sequential Causation

We will first attempt to set our firm dynamics within a broader perspective and to bring some additional information of firm profiles.

Stage Models of Early Corporate Growth

Levie & Hay (1998) survey the early corporate growth field and identify and review “sixty-three identifiably separate ‘stages’ models published between 1960 and 1996”. Most of the models are ‘organismic’ that is they find an analogy between the growth of organisms and the growth of organizations. The common ‘organismic’ conceptual base for these models is described, and their principal tenets of organismic models²⁶ presented. These are basically three:

- “Growing human organizations pass through identifiably different stages...”
- these stages occur in a set sequence i.e. “the order in which growing organizations undergo these recognizable stages is predetermined and thus predictable”, and
- The sequence is common to all organizations (within a certain defined population such as new technology based firms).

In their survey, only a few models are more complex in that they provide a limited range of development options at certain stages—similar to the ‘branching out’ of our Main and Secondary Growth Profile of the previous section. In other words most of the stages models of growth of companies agree that “all growing organizations develop through a common sequence of stages”; they differ only in the number of stages identified and in the details of each stage. The authors conclude that there is ample room for the development of phases of growth models of the firm, since little ground has been broken beyond ‘organismic’ models and their ‘deterministic’ assumptions which allow little role for volitive behaviour (pointed out

²⁵The acquiring company could then be an important client or this together with important marketing capabilities.

²⁶ For our purposes here ‘organismic’ theories are basically ‘life cycle’ theories of the firm (although they are not strictly equivalent).

by Penrose) nor, we may add from our perspective, firm strategy and path dependency.

Our research indicates the existence of a small number of ‘growth profiles’ for very successful companies in the Israeli Data Security Area. Profiles are more than a sequence of phases (or stages) since they also include major “events” and links between both and firm strategy. These profiles differ considerably one from the other e.g. the growth profile of a very successful indigenous company (e.g. CheckPoint along the Main Sequence with its “early IPO track”) is different from that of a successful company who is acquired by a foreign multinational (e.g. NDS along the Secondary Sequence with its “early M&A1 track”). The differences are much more than questions of detail along a predetermined sequence of phases of early corporate growth. They do reflect different initial conditions such as—the background of entrepreneurs (see Avnimelech op. Cit Section 6 pp.57-62); the external environment e.g. whether the Internet had or had not yet taken off; the state of the Israeli hi tech cluster at the time of firm foundation (whether or not there was Venture Capital); and very significant differences in firm strategy. Rather than a pre-determined sequence of phases (a la Rostow) and Internationalization Events our analysis emphasizes the importance of adopting an Evolutionary Perspective to firm growth (Nelson & Winter 1982) where different firms will have different strategies and different capacities to adapt to changes in the environment they face²⁷

Moreover, firm growth involves a *pattern of sequential causation* (a la Hirschman 1956) where the experience, reputation, knowledge, links/networks, infrastructure and cash & other resources generated in early phases of a company growth are instrumental in propelling it towards later probably more complex and sophisticated phases (Teubal 1982). The pattern depends on Strategy, on success in the marketplace (both product and capital marketplaces); and on changes in the environment (new opportunities, new competition, etc).

In what follows we pursue some of these themes.

Mechanisms of Sequential Causation

²⁷ See Dosi, Pavitt and Soete 1991 and Teubal & Andersen op. Cit.

A look at the *very successful* (SS) cases would show some of the mechanisms for Sequential Causation. In what follows we distinguish them according to phase of company growth.

- *OEM agreement* with a major player in the field or *an agreement with a major customer* in Phase 1 seems to have been an important factor in enabling the subsequent growth of the company.²⁸ The point to mention here is that such agreements not only assure access to market/client-related resources (or enable sales in the short run) but also generate high impact intangibles such as credibility/reputation in the eyes of customers, investors and potential partners. They also provide cash flow and relative stability of this flow. This is very important for small, young companies in a world of great uncertainty. The agreements also enhance the reputation of the company and its valuation.
- Having a *name in the market* –through the processes mentioned above-- is a precondition for an IPO towards the end of Phase 1/beginning of Phase 2. Both CheckPoint and Memco fit this case.
- *An IPO generates new tangible and intangible assets* including some which are ‘market specific’ assets (see 4.3 below) This has been a condition for (or has contributed significantly to) successful market penetration (Phase 2) and for *indigenous* company consolidation (Phase 3).
- *Early links with key customers paves the way for subsequent Acquisitions (M&A)*. This is clearly the case of NDS (Phase1) and Memco(Phase 3). In both cases the time taken for this dynamic effect is very short, in the case of NDS it seemed to be almost instantaneous; maybe two or so years in the case of Memco. The prior link could be an OEM link (Memco, although Platinun had also invested in the company) or a principle client (apparently the case of NDS with Sky).
- The growth of all successful *indigenous* companies involves *strong inter-phase and feedback effects*, which enable a company to change its mode and structure of marketing and clients. In the case of Check Point for example we observe a shift from OEM and large reliance on one customer (Sun) to: greater customer

²⁸OEM agreements played an important role in the case of CheckPoint and Memco while an agreement with a major customer did so with NDS. No clear information about such an early high-impact agreement exists in the case of Aladdin and this probably reflects the different *industry stage* when this company was active in the early years after foundation. Thus, marketing to Europe during *Stage A* of the industry probably involved lower critical mass relative to what was required during the 90s (*Stage B*) for Memco and CheckPoint to start selling in the US market.

diversification; to greater diversity of marketing modes (resellers, etc); and to an element of direct sales. Each sub-phase must have involved significant asset accumulation especially enhanced credibility & reputation and enhanced links with & knowledge about customers\ marketing agents.

Strategy

Phases of company growth involve a description of the dynamic evolution of companies. This will be affected both by what a firm does and by changes in the environment. What a firm does frequently is a reflection of its Strategy. It could be defined as “ *the way the firm perceives it should proceed in order to achieve its aims --including the characterization of the aims themselves*”; and as a “*set of principles or overarching aims and targets which can contribute to explain the links between the various phases of company growth*”.

Company strategy is affected by "preferences and disposition" of owners; by the state of the firm (and perceptions about it); and by changes in the Environment facing the company. Thus a Data Security company's strategy could aim at 'selling the firm' to a larger software company; or alternatively, could aim at 'building a large Israeli company' which would become an important player in world markets. Thus "similarly" successful companies—roughly speaking, Memco and CheckPoint at some point in the second half of the 90s-- may experience very different profiles of growth (including different sets of phases). The former “selling” strategy may lead to the company being acquired, to the dismantling of a marketing network in its major export market; and to a renewed R&D focus (the company—now an Israeli subsidiary-- could become the Data Security Division of the Parent multinational). Moreover, throughout its growth as an indigenous company it would be exploiting its initial successes in marketing the product, etc and even its success in launching an IPO in order to subsequently sell the company. A different profile and even sequence of phases would characterize another company with a strategy of growing into a large Israeli company. This ‘overarching aim’ may lead it, after the SU phase, to re-orient the pattern of asset accumulation and to promote a greater diversification and balance in the accumulation of assets (with a greater share of market, marketing and client related assets). If successful this strategy could lead to a gradual shift in marketing from dominant dependence on an OEM agreement in "Phase 2" to a greater variety

of modes of marketing, less dependence on any one market agent and a gradual incorporation of "direct selling\servicing" in Phase 3.

The above examples--which reflect a central difference among some of the Very Successful Data Security companies--illustrate two very important points. First of all, there are strong *feedback links between strategy ("thinking") and actual behavior ("doing"-the stuff of phases)*; second, firm strategy may reflect *the preferences and outlooks of its founders*. Evolutionary feedback links like those between strategy and phases are commonly known in other areas for example when characterizing specific innovation processes within companies (the so called "learning perspective --See Imai et al 1988). Also entrepreneurs' actions may be motivated by a strong quasi-ideological component which may lead founders to aim at building strong indigenous companies rather than simply 'making money'.²⁹ Some of the differences between CheckPoint and Aladdin on the one hand and Memco and Com15 on the other may derive from these differences³⁰.

The Case of CheckPoint

General Aspects of Strategy

- *A long-term perspective* can be seen throughout the history of the company.
- *Objective -Creating a "Real" Israeli Company*: Founder preferences\outlook parallels that of Aladdin's founder. Acquisition by another company (M&A1) seems to be ruled out, contrary to the Memco strategy (offers to acquire the company were not accepted).
- *Continuos upgrading and diversification in Marketing*
- *Active Standardization Efforts*
- *Internationalization and HQ*: setting up offices or subsidiaries abroad--yes; but leaving company HQ in Israel.³¹

²⁹We believe that entrepreneurial motivations could include "self realization" through actions such as the building of global companies. Monetary rewards are important but they are no less proof of having attained such objectives than being an objective in them.

³⁰There are probably more successful and less successful strategies and sometimes these may be easily differentiated. It may be however much more difficult in our case here. Success or Failure depend very much on objectives

³¹This is the model followed also by Aladdin. It also involves a particular way of managing and staffing overseas offices.

Specific to Phase 1(1993-95 approx): In the first phase(starting with foundation of the company in 1993) the product launched was the Firewall-1 and most sales went through an OEM agreement with Sun. Some strategic aspects were

- *Strategic Waiting:* founders decided to wait a couple of years for the Internet to take off before establishing the company in 1993. Observers stated that the timing decision was right and "the company grew with the Internet".
- *A Major Innovation:* the company's first product (Firewall 1) was a "major" innovation(practically the first representative of a "new product class") which also *created a new market*.
- *Marketing:* Initially was done through an OEM agreement with Sun Microsystems (the clear potential of the new product made this possible. Not every company, however, has the option of entering into an OEM agreement with a major player). Such an agreement is not inconsistent with the objective of building a global, indigenous company, on the contrary, it might provide 'breathing space' to build the assets of the company and to generate a capability to shift to other marketing modes in the future. A major issue is to what extent the agreement with Sun represented a 'mechanism of learning' for CheckPoint, no less than a 'sales channel'.

*Phase 2 (1995-9)*³²: Some widening of the product line (always software) through the launching of VPN-1³³ in 1995; an IPO in 1996; and diversification from Unix to NT. Related to the latter and since 5\98 there is a strategic relationship with Microsoft for network security and network management (the agreement is technological but may have led to marketing links as well). Also from the 'technology side' a clear strategy seems to be involved in the company's initiating OPSEC-Open Systems Security for Enhanced Connectivity (an industry standards committee led by CheckPoint to ensure interoperability between its and other security products).

This phase is also characterized by intense changes on the side of marketing and probably a much larger relative focus on Marketing compared to R&D (relative to what was the case previously). There is an increased role of resellers and of OEMs beyond Sun e.g. Nokia has lately become a substantial source. Sales through Sun went

³²This phase may have to be divided into two separate phases.

³³VPN stands for Virtual Private Network which is use of the public Internet network to generate a network transmitting encrypted information linking the company with outside suppliers, customers and partners(as well as linking the employees of the company itself).

down from 40% of total during 98 (or 97\98) to 6% in 99 (or 98\99). All of this may comprise a sub-phase of enterprise consolidation.

The strategic aspects of this phase included-

- *Shift in the Marketing Mode Perspective*-the first mode of marketing would only set the base for subsequent modes which would be less dependent on Sun; more varied e.g. adding over 1000 distributors; and including an increasing element of direct marketing\support (1999). This accords with the idea of creating a global company.
- *Moderate increase in Product Line within the Data Security Area*: the company entered the VPN area (1995) and the Windows NT area (in mid 199?). This decision might have been linked to an agreement with Microsoft for technological cooperation). It also acquired one US Company in 1999 (MetaInfo) whose products were complementary to some of the latest products launched.
- *The company's strategy up to mid 99 seemed to be to abstain from providing integrated solutions to customers*³⁴, certainly not wide scope integration of Security with Network\Networking products. In this connection the company is only a software company and even in the security area itself only integrated solutions of moderate is contrary scope seem to be offered.³⁵
- *Active Standardization Efforts are a Mainstay of CheckPoint's Strategy*: the creation of and active leadership of OPSEC (Open Systems Security for Enhanced Connectiveness) has as an objective assuring interoperability among the various security products more specifically among products of member company's and those of CheckPoint. This required the company to have an open systems strategy and to be actively involved in generated interfaces between other company's products and CheckPoints' products.

³⁴Value Added Resellers or distributors are frequently involved in 'system integration'.

• ³⁵ Contrary to the perspective and actions of Memco.

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- *Collaboration:* the scope of collaboration within OPSEC seems astounding--over 200 companies are members including many Israeli data security companies.

Phase 3(1999-): Lately we see the development of new products (FloodGate and Remote Link) and the purchase of the American company MetaInfo. This may signal the beginning of a more explicit M&A2 strategy of growth for the company. MetaInfo Company specializes in managing organizational networks and its product\products are complementary to FloodGate. There are also the beginnings of Direct Sales which in most cases complement rather than substitute for marketing through resellers e.g. they could offer 24 hours a day, 7 days a week support which resellers in general do not offer. There are also selected Enterprise Accounts where direct sales are undertaken for small number of large and potentially valuable customers.

4.2 Capabilities and Complementary Assets

Firm Capabilities grow through experience & feedback mechanisms; through explicit investments (in R&D, marketing, in introducing new management routines, etc); through the incorporation of new, key personnel which e.g. may result from a re-orientation of Firm Strategy; and through other factors. Some of these are or are affected by the process ‘sequential causation’ and growth. In linking our firm dynamics and firm growth profiles to the literature on Firm Capabilities we will focus on some specific aspects rather than systematically survey the literature. Teece’s notion of ‘dynamic capabilities’ is particularly useful (Teece, Pisano & Schuen, 1994; Teece, 1997). Dynamic Capabilities refer to the *Ability to Reconfigure* a process which leads to new Competencies (related to elementary functions such as logistics and Quality Control); to new Complementary Assets and to a new structure of Alliances and External Relations of the firm. All three aspects of Teece’s Dynamic Capabilities have been affected by the process of globalization. More particularly Globalization calls for novel processes to acquire competencies and complementary assets as well as changing their nature & importance; and it creates new roles for Alliances and External Relations of the Firm (some of the ‘internationalization events’ referred to in this paper pertain to this last point).

We will be focusing on the private and social need for ‘complementary assets’, on non-R&D capabilities e.g. concerning management and organization; and on Social (Relational) Capital. As mentioned in the introduction of this paper, as far as Israel and Israeli hi tech are concerned, a central aspect of how globalization is affecting them concerns access to world asset and capital markets (particularly US markets). As far as ‘complementary assets’ of ‘high quality companies’ is concerned this has two effects,

1 the returns to investors and entrepreneurs in high tech companies are less dependent on possibilities of directly purchasing/ accessing complementary assets (or services of complementary assets).

2. Companies may more easily than previously have the means to acquire or to access Complementary Assets- e.g. through flotation of companies in stock markets or through Mergers and Acquisition;

The first point is that the problem posed by ‘complementary assets’ to inventors or investors, originally raised by Teece (Teece 1985,7), becomes less important given that through IPOs, M&A1, VC investments,etc a positive return on their investments could be obtained without significant levels of such assets. The second point is that the solution to whatever ‘complementary assets’ problem still exists is enormously facilitated— all of this compared to the situation prevailing in the 80s.

However from the Social Profitability side the two above tendencies may have opposite effects: on the one hand there are greater opportunities for profitable ‘invention’; on the other side, since individual companies might abstain from accumulating Complementary Assets and undertaking production and marketing of new products. This may weaken the ‘R&D leverage effects’ and the ‘indirect spinoffs’ they create to the country’s Business Sector. Thus a new problem arises

3. The globalization process may lead to under-investment in Complementary Assets from the National Economy/ Social Profitability –of- Invention perspective; and to a truncated or one-sided accumulation of capabilities.

A second link between our firm-growth dynamics and the competencies literature concerns Social Capital and the Efficiency of Inter-Organizational Learning

(Yli-Renko et al, 1999), where the former “facilitates learning in interorganizational relationships”. The context is one of young entrepreneurial firms that normally need access to external resources including knowledge to compensate for internal resource constraints. Social or relational capital enables access to these resources. Social Capital has three dimensions: a Structural Dimension, a Relational Dimension; and a Cognitive Dimension. The structural dimension refers “to the pattern of connections, to the mechanisms used to connect; and to the social ties among actors”. The Relational Dimension relates to “the behavioral assets embedded in relationships such as trust, trustworthiness, norms and sanctions”. Finally, the Cognitive Dimension involves “shared language and codes; shared vision and goals”. This type of capital seems to be extremely important in the process of internationalization of companies—a critical element in the growth of large, global indigenous companies. Moreover our study suggests that major internationalization events such as IPOs have effects that seem to be similar in structure and in content to the above notion of “social capital”. Thus the analysis of firm dynamics must consider the domestic and the international dimension of social capital with a clear focus on the processes which led to the generation of this kind of capital.

The IPO process and capability Accumulation

A major focus in research of the kind reported here is the links between complementary asset accumulation and major internationalization events: IPOs, M&A, Strategic Partnerships, OEM Agreements, etc. We will here refer to those linked to IPOs as suggested from the experience of very successful Data Security Companies. First it is important to understand that IPO is a *process* involving a multiplicity of actions--- Before, During and after the actual floating of a new company. It may start with the nomination of a Chief Financial Officer (very early in SU life cycle and probably no later than a year before the expected date of launch); the introduction of new administrative and reporting procedures and routines to comply with SEC regulations; a *Road Show* orchestrated by the underwriter in which the entrepreneur-CEO meets potential investors, customers, suppliers and partners; and post IPO incorporation of key Management Personnel e.g. for Marketing in the US, for Business Development etc. The IPO has two types of effect on “asset accumulation”—a direct effect from the activities mentioned (some of them preceding and others coming after the actual floating of the company); and the better known

indirect effect that is the possibility of accessing or acquiring complementary resources which the 'Shares and Cash' generated by the IPO entails.

The direct effects of IPOs includes

- **overall reputation and visibility of the company viz a viz investors and potential customers;**
- **Social capital in the form of newly formed personal and company links which enormously facilitate US sales;**
- **Enhanced managerial capabilities (and/or of CEO-founder) after the IPO process; and/or building of a team of senior managers during or immediately after the process ; increased managerial commitment to investors and motivation to succeed; and new organizational routines**
- **A new strategic focus for the company.**

The fact that highly reputable Investment Banks and Underwriters vouch for an unknown Israeli Start Up is one factor creating the latter's Credibility & Reputation. A second factor, of course, is performance in the Stock Market which is related to attaining declared sales and profit goals. In addition, companies are introduced to major clients during e.g. the Road Show or before this, and this presumably is very important at a later stage. Companies have viewed the IPO as a major factor for US market penetration(European SU are beginning to appreciate this too); and in Data Security, US market penetration, at least in the second half of the nineties, was a condition for being successful. All three components of the Direct effect of IPO could be critical for accessing large, (usually) corporate clients which is frequently the strategy of companies who have become very successful. Such clients will not buy let alone try or interact with new and unknown companies. Thus IPO is a ways to gain "access" to them.

The 'indirect' contribution of IPOs to asset accumulation is no less important-

- **Cash and Shares-- which enable the purchase of 'complementary assets' either directly or through the purchase of US companies; or "access to these assets" through strategic partnerships/alliances under favourable terms(or even through 'symetrical' mergers)³⁶**

³⁶Another non-insignificant outcome of an IPO is the possibility of offering share options to employees of indigenous SU companies, both those already working at HQ in Israel and those to be employed in the US office.

The shares and cash generated enhances the set of options for intangible and tangible asset accumulation or alternatively, to access such assets. All of the three strategies mentioned by Teece,--vertical integration, market transactions, and ‘hybrid’ modes—will now be open, even to firms who in the pre-IPO stage had very limited possibilities in this regard. The hybrid mode would include mechanisms which are not purely internal to the firm (integration) nor purely ‘market’ but a little of both. This would include e.g. entering into Strategic Partnership agreements with other companies such as competitors or owners of complementary assets. Our interviews reveal that after a successful IPO “potential partners” approach the Israeli company with a completely different and more positive approach.

4.3 Two Types of IPO

Two perspectives on the causes and impacts of IPOs of high tech companies emerge—a *Finance Perspective* (Blass & Yafeh 1999); and what may be termed the *Firm-Dynamics Perspective* of this paper. The former is based on a broad study of the choice of IPO location by large numbers of hi tech Israeli companies (why Nasdaq and not the Tel Aviv Stock Exchange?) with a focus on benefits and costs of undertaking IPOs in Nasdaq relative to Tel Aviv. This differs from our perspective which focuses on the dynamics of very successful companies in Israel’s Data Security sector. Three out of four such firms chose an “early IPO track” while the fourth undertook an IPO after having chosen to be acquired very early during Market Penetration.

The Finance Perspective (FP) assumes that a decision to go public has been made by the company and the only question is where; and how can one justify the overwhelming choice of NASDAQ IPOs over Tel Aviv. The Firm Dynamics Perspectives (FD) on the other hand would state that you cannot separate the IPO and its location with ‘strategy and phases of growth’ of the company. It also explicitly looks at ‘substitution and complementarily’ between IPO and M&A (in the sense of acquisition of the Israeli company by a foreign company). Frequently, and for company growth reasons, the real alternative to NASDAQ would be acquisition by a US (or another non-Israeli) company rather than listing in Tel Aviv.

Reasoning and Main Variables

a) FP perspective: Under the FP there are clear benefits for hi tech companies to IPO in NASDAQ relative to Tel Aviv, but also there are additional costs (Blass & Yafe op cit). The Benefits are

- **Revelation of true value of innovative companies;**
- **Access to a larger number of potential investors (size and variety; and also because “familiarity breeds investment”)**
- **Dynamic Effect 1: Stamp of Approval by leading Wall Street underwriters**
- **Dynamic Effect 2: Customer Recognition in a large exports market.**

The larger (NASDAQ relative to TASE) costs include underpricing, greater dilution of ownership and no tax benefits. Despite the Dynamic Effects, the authors believe that the “true value” is reflected in NASDAQ. There is very little hint about the effect of a NASDAQ IPO in creating new assets rather than in reflecting the value of existing assets.

b) Firm Dynamics perspective: As mentioned for the SS Data Security companies, a major objective of undertaking an IPO in Nasdaq was to facilitate US Market Penetration—a strategic objective after the Start-UP or Product Development stage in 3 out of 4 such companies. It is also a strategic objective for other IT hi tech companies in Israel and abroad (Financial Times 2000). Frequently companies cannot survive without a strong presence in the US.

This is accomplished by the accumulation of assets during and after the IPO process (see above). Only the first direct effect (reputation) is recognised somehow by the Finance Perspective; and we will show that its role there is minor. Note also that the assets accumulated include important *client & market related assets, which are specific to the US market*; and therefore, these *cannot be accumulated through IPOs undertaken elsewhere*.

It follows that for those companies attempting to penetrate the US market, it is wrong to state that the alternative to NASDAQ is to float the company in Tel Aviv (or Europe). The only alternative for such small and promising hi tech companies in Israel is to be acquired by a (generally US) company having a strong market presence in the US (whose country-specific complementary assets the acquired company could then access); or by another company with asset complementarity in some more general sense. The IPO way however, is risky/costly but also would bring in a larger

capital value than a M&A; and would not foreclose a future, post IPO acquisition by a foreign company. On the other hand not all companies can undertake a Nasdaq IPO. This means that the choice among the two alternatives is not that simple.

Comment 1: Reflecting Asset Value versus Creating Assets

A necessary condition for the Firm Dynamics Perspective to be the relevant one is that the IPO (Nasdaq) generate considerable asset accumulation over and beyond merely reflecting value. This would be the case for very good high tech companies in Israel who are poised to penetrate the US market. That is why the choice of Nasdaq should be linked to firm profiles (phases of growth and strategy)

By the same token, a necessary condition for the Finance Perspective to be relevant is that neither the NASDAQ nor the TASE IPO alternative generates significant asset accumulation beyond ‘reflecting existing value’ to a greater or smaller extent. In this case the choice of IPO location would be similar to the choice of best ‘exiting mode’ of a Venture Capitalist.³⁷

Related to the above it might be important (due to Capital Market “Imperfections”) to make a distinction between maximizing the actual value of a company and maximizing its growth potential.

Comment 2: The Motivation to undertake an IPO

Parallel to the two perspectives mentioned above there are two basic motivations for undertaking IPOs—exiting/getting the best value for the company; and generating important assets which contribute to maximizing the growth potential of the company (in accordance with company strategy). Each might dominate at a different phase in the growth of very successful companies.

Comment 3: IPO versus M&A

A broad “firm dynamics” perspective would consider IPO as one among a set of possible actions/mechanisms for maximizing the growth potential of a company (with explicit consideration of the accumulation of complementary assets and competencies more generally speaking). For the companies studied, the

³⁷Under the Financial Perspective there would also be a timing decision for the IPO, not only a choice among alternative IPO venues.

alternative to an IPO in NASDAQ is not to float at Tel Aviv but being acquired by a US company (M&A2). An IPO is riskier but may generate higher returns in terms of company growth and even private profitability. The actual choice may depend crucially on the existence of experienced Venture Capital Funds in the country (these would mediate between or link the Israeli company and US capital markets), on preferences of founders & investors; on the institutional and taxation set-up, and on other factors.

The above considerations have strong policy implications. If there are strong grounds to assume that the economy-wide impact of having some very good companies go the indigenous way rather than being acquired by a foreign multinational—then the incentives and institutional set up should be such to at least be neutral with respect to the choice among IPO and M&A2 at the end of the SU phase of such companies (first branching out between Main Sequence and Special Case in Figure 5). Even more so, policies may be devised to create some bias in favor of the former.

SUMMARY AND CONCLUSIONS

This paper is part of a wider project focusing on the Israeli Information Technology hi tech cluster of the 90s and on its evolution in the present decade. Its focus is on the dynamics of firm growth, particularly of very successful companies which became global companies—both those remaining indigenous and those having been acquired by large multinational corporations (mostly from the US). We consider the generation of large global indigenous companies as an essential ingredient of the successful adaptation of small, Science & Technology intensive economies to the requirements imposed by the ongoing Technology Revolution (as well as to the requirements imposed by Globalization). The approach followed recognizes the importance of undertaking analysis in at least three levels: the firm level, the cluster level and “policy”. While future work will expand our analysis of firm dynamics by considering other sectors such as hi tech communications hardware and software internet-related companies, etc. we will also be more explicit than what we have been up to now in our analysis of the of

Israel's IT hi tech cluster as a whole; and of the potential policy implications of the analysis.

The work reported in this paper overwhelmingly focuses on the micro-economic, firm level of analysis of the Data Security sector of Israel-- an important segment of that country's ICT segment of hi tech during the 90s. The identification and characterization of *very successful company growth profiles* is embedded in a detailed study of the emergence and development of the Data Security Sector (19 companies till mid 1998). We distinguish three stages of growth-Emergence (Stage A), Middle (Stage B); and Growth (Stage C)-defined on the basis of developments in Technology and in Markets. Company interviews, a survey of firms and additional information helped us map the area as a whole and, through this, helped us identify and characterize the four- (4) very successful ("SS") companies, which comprise the core of our analysis. These companies represent between 80-90% of the activity in Data Security (defined in terms of Sales, Employment, Profits and Market Capitalization). In this phase of the research we also detected the importance of foreign acquisitions of promising Israeli companies (two out of the four very successful companies; and four out of six 'moderately successful' ones). It also revealed important information about the nature, timing and role of other non- M&A internationalization events such as Initial Public Offerings (IPOs), OEM agreements, and Acquisitions by Israeli companies(both within Israel and in the US). Overall Israel's Data Security sector was successful in terms of the various 'economic' dimensions mentioned above; in terms of the high rate of new company formation; in terms of the numbers of very successful companies generated ; and in terms of the scope of foreign investment attracted into the sector.

The main research outputs pertain to the 'profiles of growth' of very successful companies. A *Main (Phase) Sequence* was identified which involves an "Early IPO track" –three companies out of four—which took place shortly after completion of the Start-UP/Product Development phase and/or very early in the second Market Penetration phase of company growth. The *Special Case*(or Secondary Sequence) on the other hand was characterized by an early foreign acquisition (M&A) of the remaining very successful company(an "early M&A track" situation). The Main Sequence in turn branched out during the third 'Consolidation Phase' of company growth. Two out of the three companies which

followed the “fast IPO track” remained indigenous companies; and one was acquired by a US multinational during this phase.

One of the implications is that all very good companies that did remain indigenous up to and including the Consolidation phase, underwent an IPO very early after Product Development. The early IPO track was a necessary but not a sufficient condition for maintaining the Israeli company identity. It represented a “substitute” internationalization event to an early M&A; and set the base for a rapid process of market penetration and firm consolidation.

The analysis has generated some additional implications concerning “Globalization” generally speaking. The main ones are:

- 1) For those countries where the Globalization process in combination with ‘national adaptation’ has facilitated access to world asset and capital market, and in comparison with the situation prevailing during the 80s and pointed out by Teece-the private return to inventors/SU investors is less dependent on acquiring or accessing ‘complementary assets’. Globalization also generates additional means for acquiring these assets (e.g. through IPO or M&A); and large private returns may coexist with weak or low social gains since implementation of the ‘outputs’ of R&D may easily take place abroad;
- 2) IPOs have direct and indirect effects on company ‘asset accumulation’. The former relate to Reputation, Management Skills and Capabilities, and Social (Relational) Capital; the latter are the cash and shares which may enable a promising SU company to access complementary assets in its target market;
- 3) IPOs are part and parcel of the ‘Growth‘Strategy’ of a company rather than simply a mechanism for “exiting” of investors, VCs etc.

A major potential implication of the analysis of this paper is that very successful companies which remain indigenous may play important roles in enhancing the social profitability of domestic inventions, R&D and SU companies. We are not saying that all good or promising companies should remain indigenous, far from this(also, some have no choice but to be acquired or perish). What we are saying is that the broader institutional & taxation context and the existing “environment for business” are not and cannot be neutral with respect to this issue so even those who

would like 'market forces' to decide could not be sure that the actual 'outcome' is adequate let alone optimal. We are also stating that most probably a mix between the two types of very successful companies is adequate at the current stage of the Israeli hi tech cluster (were very few IT companies beyond 800 M\$ turnover exist and were widespread M&A1 activity is taking place). Preliminary analysis reported in Avnimelech op. Cit on very successful companies in the Data Security area suggest that both "R&D leverage" effects and "Spillovers" of Check Point, Aladdin and Memco (till its acquisition by Computer Associates) are high, compared to those of the remaining company (and compared to the post acquisition phase of Memco). Both types of effect depend to some extent on the accumulation of 'complementary assets' such as those related to markets, marketing and other client-related assets; and to production. A typical (although not unique pattern) post acquisition situation is one where the previously independent Israeli company is transformed into an R&D laboratory for the its large multinational parent; whereas companies which remain Israeli perform a large spectrum of post R&D activities with important linkages to the National Economy and to Employment (not only of R&D personnel but of other personnel as well). Moreover, the three companies mentioned above (Memco till its acquisition) made enormous contributions to other companies of the Israeli IT hi tech cluster through a variety of mechanisms: help in 'scaling up' through e.g. vital help in marketing (through OEM agreements or other means); through investments in and acquisitions of other younger companies; through the reputation effects they generated and the business models which they offered to these other companies, and through participation in CheckPoint's OPSEC forum. While most of these effects are qualitative they are nonetheless real and, pending additional research, have very important policy implications.

The major potential policy implication pertains to the 'Strategic Dimension' of Innovation and Technology Policy of small, science & technologically advanced, economies (Teubal 2000). Side by side with the need of supporting R&D in the business sector and supporting the generation of SU and VC (which Israel already has in abundance) a major strategic objective should be 'growing large, indigenous companies in the ICT area'. At the operational level, this implies first and foremost, supporting the emergence of VC and continuing to support companies' R&D through subsidies or other means at least till a well developed VC industry is established (in Israel such an industry is quite well developed); institutional and tax reform

concerning mergers and acquisitions among local companies; adequate regulation of Telephone, Cable, Satellite, Internet and Mobile services; a privatization strategy of the national Telecom company oriented to the above mentioned strategic priorities; the full implementation of 'dynamic' competition policy, etc. If these aspects of policymaking are geared to the above mentioned priorities, then they a) will generate the possibility of 'International Expansion' (end of Phase 1, beginning of Phase 2 of company growth) of good but small/young Israeli IT companies through facilitating access to world asset and capital markets; b) will create at least 'neutrality' with respect to the IPO or M&A1 option of such companies at the end of their SU (and beginning of Market Penetration) Phase; and c) may generate a measure of 'level playing field' vis a vis the context under which counterpart or competitor companies in other countries may operate. Complementing these measures at the Consolidation Phase would see other actions such as the reinforcement of the Magnet Program supporting cooperative, generic research; and creating conditions to facilitate Strategic Partnerships with major international players in the principle world ICT markets.

Further work must be undertaken to consolidate the policy implications of the analysis. We believe that the links insinuated or surmised from this paper between microeconomic analysis & conceptual theory on the one hand; and policy analysis on the other are important in fully moving from a Neoclassical to an Evolutionary & Systems Perspective to Innovation and Technology Policy.

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