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**WHICH PERIPHERAL COUNTRIES BENEFIT FROM  
GLOBALIZATION: LESSONS FROM AN ANALYSIS OF  
COMPANY GROWTH, ACQUISITIONS AND ACCESS TO  
COMPLEMENTARY ASSETS IN ISRAEL'S DATA SECURITY  
SECTOR**

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\*This is an extension of a prior first report undertaken jointly with Alon Gayego; and is part of a four-year study of Israel's high tech industry undertaken by the authors jointly with Danny Breznits. Aspects of Parts 4 & 5 will appear in a special issue of the *International Journal for Technology Management*. 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, and N. Brandman was critical. The present paper owes to Alon Gayego, Criatiano Antonelli, Ludovico DiBaggio, Dan Gelvan, Stephen Klepper, Patrick Llerena and two anonymous referees for their help and comments.

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## **OBJECTIVES**

The first objective is to analyze the emergence and development of very successful companies in Israel's Data Security Sector—an important branch of Israel's Software & IT high Tech Industry. The study will be set in the background of the Data Security Industry as a whole, at it evolved (especially) during the 90s and where a distinction is made between very successful and “other” companies. Very successful companies – 4 out of the 19 comprising the sector towards the end of 1999- comprised more than 90% of the sector's sales, employment and profits. A major distinction in growth profiles of such companies is between those following a “fast IPO track” and those following a “fast M&A track”(Section 3)<sup>1</sup>.

The second objective is to analyze the question of “Who Benefits from Globalization” in connection with the development of IT high tech sectors in Peripheral Economies, taking Israel's Data Security and ICT sectors as an illustration. The Data Security study suggests two effects-first, a strong positive stimulus particularly to Start Up (SU) companies, fueled by the growth of NASDAQ's index and the emergence of a domestic Venture Capital (VC) industry which “mediates” between such companies and Global Capital Markets; and second, a strong process of foreign Acquisition (M&A) of very good domestic companies including SU ones. This last factor raises the issue of the distribution of gains between Israel and the acquiring foreign multinationals. The analysis (Section 4) begins with a micro-economic study of three (out of six) successful companies who were so acquired, and encompasses a discussion of their post-acquisition pattern of development as well. It then proceeds in Section 5 to discuss the broader issue of the ‘share of SU output –e.g. from proceeds of sales of such companies-in total IT high tech output’-taking Israel as

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<sup>1</sup>IPO stands for "Initial Public Offering", the first floatation of a company in public capital markets; while M&A stands for "Mergers & Acquisitions" which in most cases here refers to the acquisition of a company by another company.

an example which might anticipate issues of this sort in other Peripheral Countries with emerging high tech industries. The discussion will inevitably involve an analysis of “access” to Complementary Assets (Teece 1986) and of the link between *post* SU companies (involved in Downstream production and marketing activities) and SU companies (Chesbrough 1999).

Section 1 will give Background Conditions, both concerning Israel’s Data Security Sector and concerning the broader IT high tech Sector during the 90s. Section 2 will characterize the Israeli Data Security Sector till mid 1999.

## **1. BACKGROUND**

The background to the emergence of a successful Data Security sector in Israel (a part of the Software industry) is the process of Globalization of the last two decades of the millenium, the associated surge of high tech industries in many countries, including Peripheral Countries such as Israel; and the emergence in Israel of a new type of High Tech Cluster, one spearheaded by ‘product’ Software and high tech Communications equipment/software.

### ***1.1 The Growth in High Tech***

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 also Services) we observe a sharp increase in the weight of hi-tech industry. The share of these industries in manufacturing employment increased from 14 % in 1980 to 19.5 % in 1998--a higher share of all or most OECD countries (Avnimelech op. Cit 2000)<sup>2</sup>. The share of IT high tech in total manufacturing exports has increased even more dramatically than the share of employment reaching 45% in 1999. A similar picture emerges from recent data on Israel’s Information & Communications Technology (ICT) sector (OECD definition) where output increased 4 1/2 fold during the 90s (CBS 2001). Moreover, the share of ICT growth in Israel’s Business Sector growth was extremely high - 74 % in the year 2000 and 39% for the decade of the 90s. Finally, a comparison between the share of ICT in Israel's Business Sector compared to the OECD' s average (for 1997) shows

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<sup>2</sup>The OECD average was 9.9 % in 1996; and that for the US was 11.8%.

that Israel's share (13.3 %) was slightly less than double that of the OECD average (7.7%)<sup>3</sup>.

### **1.2 A New High Tech Cluster**

No less important than the quantitative changes in High Tech 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 could be termed an "SU intensive High Tech Cluster"(Avnimelech et al in process) or a cluster following closely the Silicon Valley model of High Tech where both SU and VC increasingly play important roles(Teubal 1999). It is also much more integrated and linked with the US and its hi tech clusters in Silicon Valley, Boston area and elsewhere. Thus, the number of SU companies estimated for 1997 was approximately 3000 (Gelvan & Teubal 1997) while the number of VC funds increased from one in 1991 to a number between fifty and one hundred towards the end of the decade (IVA 1997,2000). The major features of the new High Tech Cluster which emerged in Israel during the 90s, over and beyond the fact that it was overwhelmingly IT oriented, are shown in the Table below

**TABLE 1: ISRAEL'S HIGH TECH CLUSTER OF THE 90s-SELECTED STRUCTURAL ELEMENTS**

<b>Number of SU:</b>	<i>approx 3000 (1997)</i>
<b>Number of VC Companies:</b>	<i>50-70 (1999)</i>
<b>Funds Raised by VCs:</b>	<i>1500 M\$ (1999) ; 3400 M\$ (2000)</i>
<b>Capital Invested by VCs:</b>	<i>1270 M\$ (2000)</i>
<b>Accumulated No of IPOs (hi tech):</b>	<i>83 (1999)</i>
<b>Accumulated VC-backed IPOs:</b>	<i>37 (1999)</i>
<b>Share of Foreign Sources in Total SU funding:</b>	<i>approx 2/3</i>
<b>Share of II Exports in Total Manufacturing Exports:</b>	<i>45.7 %(1999)</i>
<b>Mergers and Acquisitions(M&amp;A):</b>	<i>approx. 10 B\$ (2000)<sup>4</sup></i>

*Various Sources*

### **1.3 Factors Explaining High Tech Cluster Emergence**

<sup>3</sup> Central Bureau of Statistics 2000

<sup>4</sup>According to 'Value of the Exit or of the Transaction'. This high sum also reflects the capital market 'bubble conditions' at the time.

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 (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 the accumulated number of Israeli IPOs in Nasdaq till 1998 exceeded the accumulated number of all other countries combined excepting US and Canada. Israel ranked third in terms of accumulated IPOs (after the US and Canada) and effectively the first non-North American offshoot of the spreading Silicon Valley 'model' of high tech.<sup>5</sup>

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 establishment and operation of important multinationals in the 70s (Intel, IBM, Motorola, etc); 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; Korea, 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.

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 networks link such Israeli groups to US

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<sup>5</sup>An additional piece of evidence concerning the last statement was the preference, till 2000, of US Venture Capital companies' non- North American investments of investing in Israel over other countries.

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.

A list of background factors which explains the emergence of the new cluster plus trigger and reinforcing factors are listed in the box below. An analysis of the process itself goes beyond the possibilities of this paper.<sup>6</sup>

**BOX 1: EMERGENCE AND DEVELOPMENT OF ISRAEL’S HIGH TECH CLUSTER: LIST OF EXPLANATORY FACTORS**

<b>EXTERNAL ENVIRONMENT</b>
<b>Diffusion of Silicon Valley’s ‘model’ of IT high tech</b>
<b>Globalization of Asset and Capital Markets</b>
<b>The Ongoing IT high tech Revolution</b>
<b>The Surge of Nasdaq</b>
<b>INTERNAL ENVIRONMENT</b>
<b>A Pre-existing High Tech Sector (Electronics Industry) which was Restructured in the mid 80s</b>
<b>Macro-economic Stabilization (mid 80s) and Economic Liberalization (Trade, Capital Markets, De-regulation of Communications, Privatization)</b>
<b>Onset of the Peace Process (Oslo Agreements)</b>
<b>Government Policies (Horizontal R&amp;D Support ‘Backbone’ program; and Targeted Program supporting VC industry—Yozma)</b>
<b>Highly Qualified Immigration from the Former Soviet Union (during the 90)</b>
<b>Collective Learning and Co-evolutionary Process generating Cumulativeness</b>

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<sup>6</sup>It will appear in Chapter 1 of *Essays in Israeli Hi Tech*, (Avnimelech, Breznitz & Teubal, forthcoming).

#### **1.4 Stages in the Evolution of the Data Security Industry**

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 data base 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.

##### **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).

##### *Anti-virus*

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 share 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 noteworthy 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&D<sup>7</sup>. These changes had an impact on all stages of the development of the Data Security Industry.

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### **Stage 2 (1992-1996)**

This stage (1990-1996) is the outcome of two processes-in Israel, an 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

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<sup>7</sup>The 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 to external investors or Venture Capitalists.

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 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 created 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, Eagle Eye, Security7. A newer (and latest wave) of companies linked to e-commerce is currently taking off.

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<sup>8</sup>Despite 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).

### *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 a Government-owned VC fund (with the same name) which is credited with triggering development of the VC industry in Israel during this decade. In less than 8 years the number of VC funds rose from 1 to more than 70. This opened up new sources of finance for hi tech including for data security companies which could now choose among various alternative sources of finance (VCs of various kinds, private and strategic investors, foreign companies and financial institutions, Office of the Chief Scientist Grants, etc). These changes in the business sector “Support Structure” had a strong effect on high tech industry in general and on the Data Security sector. They stimulated the creation of a new wave of SU companies; and indirectly were factors in the emergence of post SU companies, some of which were quite successful.

## **2. THE UNIVERSE OF "DATA SECURITY" COMPANIES**

### **2.1 The Sample and its Characteristics**

Our sample includes 19 companies founded in the following 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 ). 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.<sup>9</sup>

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<sup>9</sup>There 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

### *Variables and Data*

We interviewed each one of the 19 companies during 1999, and the latest information collected does not go beyond mid/late 1999. Our interviews were also complemented by a Survey of all companies for Quantitative Data. The information collected referred to: Company foundation date, Background of Founders/Entrepreneurs; Products & Product Families; Company Status-- *Initial* (independent, linked to existing domestic company<sup>10</sup>, or incubator) and *Actual Company Status* (independent, public, foreign subsidiary, linked to domestic company, incubator and closed); Initial Financing ( Venture Capital, Strategic Partner, Backed by an Existing Company, Bootstrapping, Office of the Chief Scientist); VC involvement; Location (city, area); Mergers & Acquisitions; whether or not an IPO and in what market; Sales, Employment, Employment of University Graduates, Profits and Exports (last full year and rates of 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. Moreover in many cases the limited time for interviews did not enable full coverage of all or even most variables.

### *Initial(IS) and Final (FS) Company Status*

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

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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).

<sup>10</sup>Part of expected diversification efforts of incumbent companies, mostly in the Software area.

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 were 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.

#### *Acquisitions and Mergers(M&A)*

1. *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.
2. The qualitative picture is even more extreme. If we classify companies into Very Successful, (Moderately)Successful and "Others" (see 2.2 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 & Very Successful Data Security Companies were acquired by foreign multinationals. This however *does not* include CheckPoint, the most important of all.

Table 3 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 [M&A2] )

**TABLE 2: COMPANY STATUS**

<b>INITIAL STATUS (IS)</b>	
<i>INDEPENDENT:</i>	<i>(14) COMPANIES</i>
<i>LINKED TO DOMESTIC COMPANIES:</i>	<i>(3) COMPANIE</i>
<i>INCUBATORS:</i>	<i>(2) COMPANIE</i>
<b>FINAL STATUS(FS)-mid/late 1999</b>	
<i>INDEPENDENT:</i>	<i>(8) COMPANIES</i>
<i>FOREIGN SUBSIDIARIES:</i>	<i>(6) COMPANIES</i>
<i>LINKED TO DOMESTIC COMPANIES:</i>	<i>(2) COMPANIES</i>
<i>PUBLIC COMPANIES:</i>	<i>(2) COMPANIES</i>
<i>CLOSED:</i>	<i>(1) COMPANY</i>
<i>INCUBATOR:</i>	<i>--</i>

<p><b>FS-INDEPENDENT (8)</b></p> <p><i>IS INDEPENDENT (6) + IS INCUBATOR (1) + IS LINKED DOMESTIC (1)</i></p> <p><b>FS-FOREIGN SUBSIDIARIES (6)</b></p> <p><i>IS INDEPENDENT (5) + IS LINKED DOMESTIC (1)</i></p>

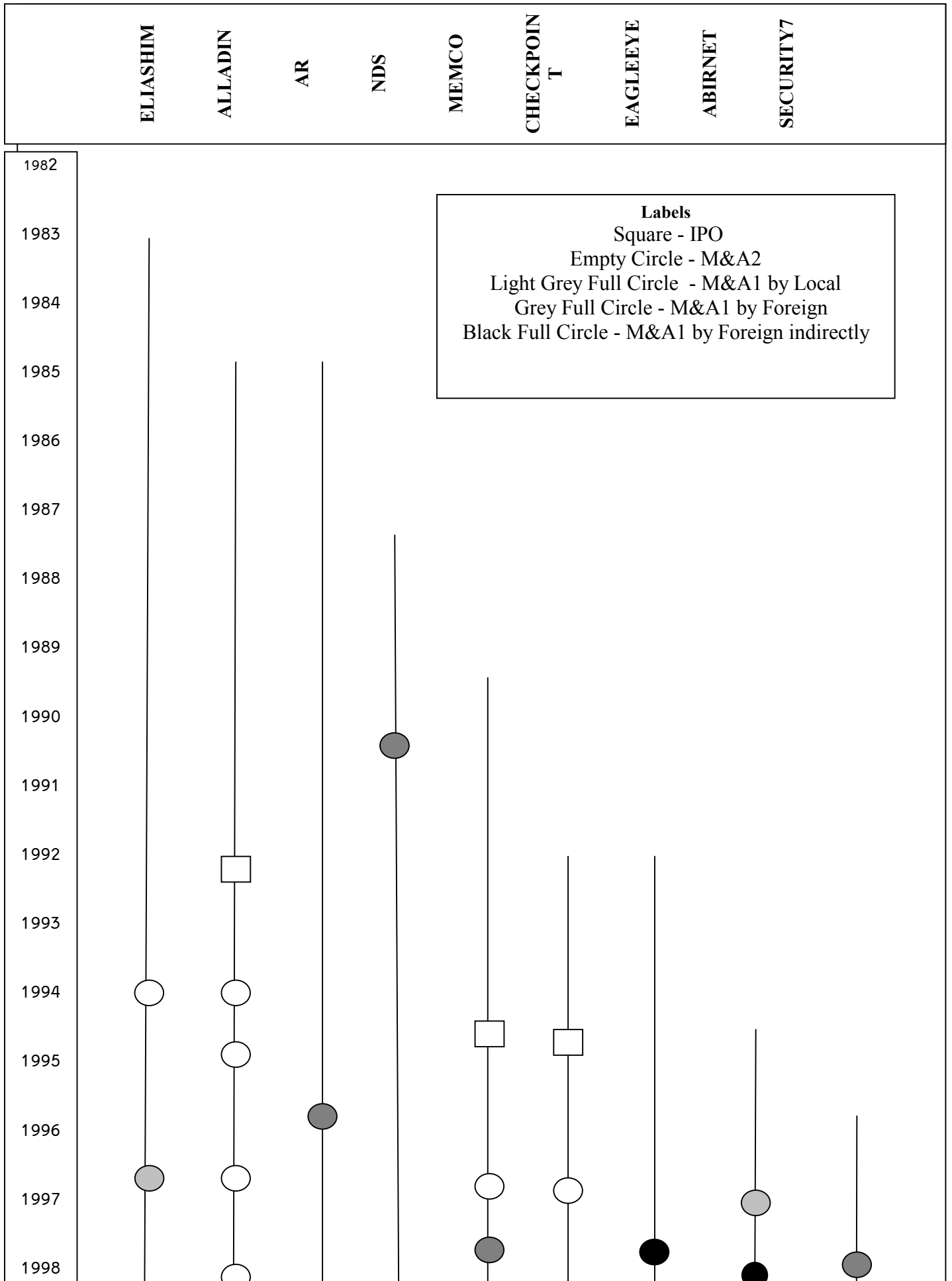
**TABLE 3: FOREIGN ACQUISITIONS (M&A1) OF  
SUCCESSFUL ISRAELI DATA SECURITY  
COMPANIES**

<i><b>DIRECT ACQUISITION</b></i>		
<b>Company(Performance Category)</b>	<b>Acquiring Company</b>	<b>Year</b>
NDS (SS)	News Group	1991
Memco (SS)	Computer Associates(CA)	1999
Algorithmic Research (S)	Cylink	1996
Security 7 (S)	Computer Associates	1999
<i><b>INDIRECT ACQUISITION*</b></i>		
<b>Company</b>	<b>Domestic Company</b>	<b>Foreign Company</b>
Abirnet (s)	Memco	Computer Associates
Eagle Eye (s)	The New Dimension	BMC

\*There are two possibilities-acquisition by an Israeli company (M&A2) first, with the latter being subsequently acquired by a foreign company(M&A1); or acquisition of parent company by a foreign company(M&A1)



Figure 1: The M&A Process



### *Employment, Sales and Market Capitalization*<sup>11</sup>

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\$<sup>12</sup>. 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 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 Performance: Categories and Distribution of Firms**

Throughout we consider three groups of companies according to Performance: Very Successful (SS--4 companies); Moderately Successful (S-6 companies); and Other (O-9 companies)<sup>13</sup>—see Tables 4a,4b below. The O- category includes Failures (2 companies); Struggling (3 companies); and young companies with potential-"Emerging" (4 companies).

*Very Successful Companies* are successful in terms of at least two of three indicators: sales -several tens of millions of dollars; market capitalization<sup>14</sup>-several

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<sup>11</sup> 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).

<sup>12</sup> At the time of preparing the first 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. Sales today are also much larger than 2-3 years ago-CheckPoint's alone are expected to reach the 600 M\$ mark during 2001.

<sup>13</sup> 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.

<sup>14</sup> Despite 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

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 (that the SS group is small is not surprising given the dynamism of the field). 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 launched IPOs in Nasdaq) or the value of the company at time of acquisition (the case of Memco or NDS).<sup>15</sup>

<b>Table 4a: FIRM PERFORMANCE CATEGORIES</b>				
<b>VERY SUCCESSFUL(SS)</b>	<b>MODERATELY SUCCESSFUL(S)</b>	<b>OTHER(O)</b>		
CheckPoint	Com2	<b>Emerging</b>	<b>Failure</b>	<b>Struggling</b>
Memco <sup>16</sup>	Com10	Com11	Com12	Com7
Aladdin	Com15	Com5	Com6	Com13
NDS	Com1	Com9		Com8
	Com14	Com4		
	Com3			

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

*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,

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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.

<sup>15</sup>A public offering during November 1999 of 10 % of NDS's shares implied a company valuation of over 1 billion US dollars.

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

### **2.3 Summaries of Major Companies<sup>17</sup>**

Summaries of the four Very Successful (SS) companies follow.

#### ***Checkpoint***

Gil Shwed, Shlomo Kramer and Marius Necht founded Checkpoint in 1993. In the seed stage BRM(an anti-virus turned VC company) 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

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<sup>16</sup>Memco was a security consulting firm until 1993.

<sup>17</sup>Updated till mid 99 approximately. Further information on NDS and Memco can be found in Section 4.

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 – an Interface 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)<sup>18</sup>. 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. 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.<sup>19</sup> Checkpoint has gone public in 96 with a market value of 500 million and by 10/99 it grew to 4.8 billion dollars. It employed then 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

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<sup>18</sup>In the last 2-3 years the company has eliminated its prior dependence on Sun and has increased significantly its Direct Sales Efforts worldwide.

<sup>19</sup>Sales (Profits) for the year 2001 are expected to be 600 M\$ (200 M\$) approximately.

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 coordinated (at least till 10/99) 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 as well as of its capabilities in 1999.

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. Sales and profits were from the beginning important sources of funds(bootstrapping). 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)<sup>20</sup>. 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.

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<sup>20</sup>This very successful merger was documented in a case study of the Harvard Business School.

## ***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).

The main business areas were already broader in 1999: "to provide the leading systems of the management control and broadcast distribution of entertainment and information to TVs and PCs"<sup>21</sup>. 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.

### **2.4 Remarks on 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. Three issues immediately arise. The first concerns feasibility that 'very good companies' in Peripheral Economies, active in ICT areas of great dynamism, achieve rapid growth while keeping their independence<sup>22</sup>. The second concerns the propensity of such companies to be acquired and the factors –both within the firm and of the external environment- explaining this propensity. The third issue concerns the 'Differential Impact' of successful companies which remain indigenous compared to successful

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<sup>21</sup>**Israel's Electronics Industry Profile**, May 1988, p.57 (a publication of the Association of Electronic Industries).

companies which are being acquired by foreign companies. The second, and to some extent the first, issue will be discussed in Section 3; while a systematic discussion of the last issue will be undertaken in Section 4.

### **3. PATTERNS OF GROWTH OF VERY SUCCESSFUL COMPANIES**

We focus on the *growth profiles* of the four very successful (SS) companies—CheckPoint, Aladdin, NDS and Memco- which, as mentioned, comprise an enormous share of the activity of Data Security firms in Israel.

#### **3.1 Defining “Company Growth Profile”**

The two groups of variables defining Company Growth Profile for our SS companies are *Phases of Company Growth* and *Company Events*. We distinguish these from the variables explaining Company Growth Profile: background of entrepreneur and company strategy; and at another level--cluster related variables and policy. This paper focuses on defining Company Growth Profile, and for lack of space, only scant reference will be made to explanatory variables. For example the analysis of the background of entrepreneurs/founders, will not be reported here;<sup>23</sup> and only brief reference will be made to the overall context within which firms operate. Thus there are a number of effects of the high tech cluster as a whole on company behavior or company events that will be only referred to in a superficial manner e.g. the fact that some entrepreneurs were active in the Army or in incumbent high tech companies. Also only brief reference will be made as to whether Venture Capital existed at the time (a key feature of high tech clusters) and if it did how did it affect the phases, strategy and internationalization events of companies after foundation.<sup>24</sup>

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<sup>22</sup> Very dynamic areas involving network products might give advantages to large companies like Cisco which could offer both Security solutions **integrated into** Network hardware & software.

<sup>23</sup> An analysis of the background of founders of 14 out of the 19 companies (rather than of the four SS companies) will be reported separately.

<sup>24</sup> Thus for example, Aladdin did not make use of Venture Capital in its SU phase probably because VC was not available at the time (*Early Stage* of Israel's Data Security industry) in Israel; whereas Check Point and Memco did make use of VC (VC was becoming available in the subsequent *Growth Stage B*).

### *Phases of Company Growth*<sup>25</sup>

There are three 'basic' Phases—SU/Product Development (Phase 1), Market Penetration & Broadening of Product Line (Phase 2), and Consolidation (Phase 3)<sup>26</sup>. 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 or vendor. At some stage a significant shift in the effort of the firm is recorded in the direction of (main) 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"<sup>27</sup> (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. VP for Business Development 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).<sup>28</sup> 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

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<sup>25</sup>The 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.

<sup>26</sup>Phases 2 & 3 are post SU phases.

<sup>27</sup>We should distinguish this from Industry Consolidation, which may be a major factor spurring foreign acquisitions of small domestic companies.

<sup>28</sup>Undertaking 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 early during Phase 2 which is consistent with a trend leading to subsequent 'consolidation').

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, VAR's and Direct Sales.

#### *Company Events*

These include -- *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*. Many of these are 'internationalization events' that is they involves activities, contractual arrangements and transactions with foreign agents and organizations. Company events may be strongly affected by Company Strategy e.g. whether or not a major objective of founders and investors is to foster a large indigenous company or to develop a company for selling.

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)<sup>29</sup>. 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)

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<sup>29</sup>This 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).

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 negative<sup>30</sup>; On the other hand a company which follows an indigenous path generally will be involved in a strong process of accumulation of such assets throughout (or in the pursuit of contractual arrangements to access them). Normally in the short run it will have to find a way to access such assets (externally). Marketing agreements here would play a very important role.

### **3.2 Types of SS Company Growth Profiles**

Figure 1 presents a stylized Phase Sequences for the four SS companies which reflects, *grosso modo*, their history. They are obtained by superimposing a *small number of events, particularly internationalization events*, on the sequence. Central among these are the IPO (followed by Memco, Aladdin 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)<sup>31</sup>. 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). Needless to say. The profiles shown in the Figure do not include all of the information that could be included, but only that which seems to be critical for characterizing them in the context of Data Security<sup>32</sup>. We see however that there is a *main phase sequence*, or *Main Growth Profile* which covers three companies: Check Point, Memco and Aladding; and *Special Growth Profile* -followed by NDS. Let us describe these.

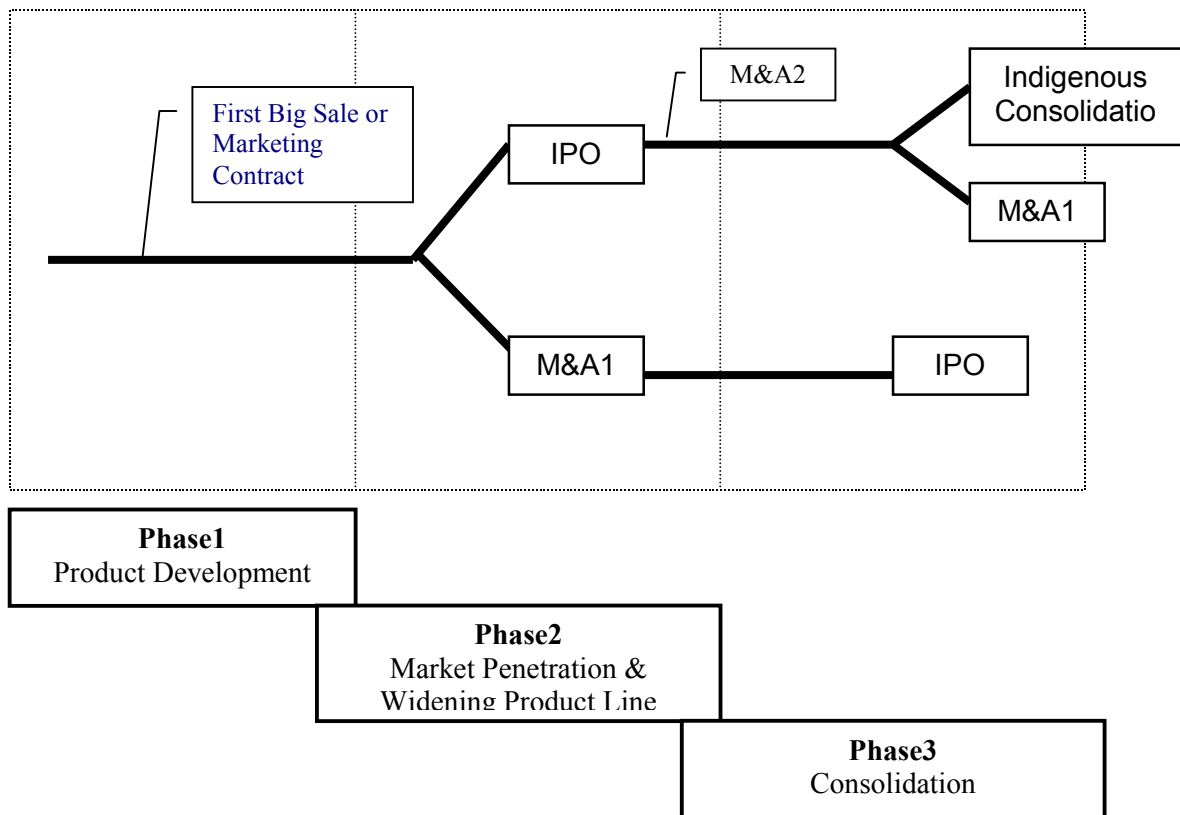
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<sup>30</sup>This might have happened, at least initially, with the acquisition of Memco by Computer Associates in 1999.

<sup>31</sup>See Figure 1. 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).

<sup>32</sup>Additional research on a larger universe of very successful IT (rather than specifically Data Security) companies would lead us to finer distinctions among profiles. These would be based on the superimposition of additional information on the phase sequence e.g. Strategic Partnerships, etc.

**Figure 1: Growth Profiles 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 or Foreign) by the Israeli company.

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

### *Characteristics of the Main Growth Profile("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 IPO<sup>33</sup> 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 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<sup>34</sup>.

### *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.<sup>35</sup>

### *General Remarks (both profiles)*

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<sup>33</sup> 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 and during 'bubbles'). The minimum level also includes some consensus about the 'quality/potential' of the innovation and of the team conducting the firm.

<sup>34</sup>This has been analyzed in Teubal et al 2000 op. Cit but is not reported here due to lack of space.

- IPO and M&A1 are *substitutes* in the early Market Penetration Phase of Very Successful Companies. Both are capital market transactions which enhance access to Complementary Assets (Teece 1986, op cit). They differ in that the IPO both directly and indirectly enables the company to accumulated or transact for the acquisition of such assets (or services from such assets) while M&A generally enables the acquired company to make *in house* use of the parent's Complementary Assets;
- IPO in NASDAQ seems to be a *necessary condition* for a company's products to succeed in the US market without losing company identify i.e. while remaining *indigenous*
- 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 Profile*) as part of the process of gaining access to Complementary Assets; or during the (and as part of) the consolidation process of the company(Phase 3, part of the *Main Growth Profile*).
- 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 M&A1 (NDS was acquired in the early 90s and underwent an IPO in late 1999).

### 3.3 Explaining Company Growth Profiles

#### **BOX: FACTORS EXPLAINING A 'FAST IPO TRACK'<sup>36</sup>**

	<b>Firm Strategy and Founders' Preferences</b>	<b>Existence of Experienced VCs</b>	<b>Country Hi Tech Reputation</b>	<b>Level of Nasdaq Indes</b>
<b>NDS(acquired In 1991)</b>	<i>NA (or neutral)</i>	<i>No</i>	<i>No</i>	<i>Low</i>
<b>Aladdin (1993)</b>	<i>Strongly Positive</i>	<i>Few</i>	<i>Fair</i>	<i>Fair/Good</i>
<b>Memco</b>	<i>NA or neutral</i>	<i>Yes</i>	<i>Strong</i>	<i>Very Good</i>

<sup>35</sup>The acquiring company could be an important client with important marketing capabilities.

<sup>36</sup>Yes, Strong, Good indicate a favorable effect of the variable on a 'Fast IPO Track'; No, Weak, Low imply a favorable effect of the variable on the alternative 'Fast M&A Track'. The 'Fast IPO Track' of Aladdin should be reinterpreted to mean 'after its re-orientation towards the US Market in the first half of the 90s'.

(1996)				
CheckPoint (1996)	Strongly Positive	Yes	Strong	Very Good

The box summarizes some of the factors explaining choice of a 'Fast IPO Track' company growth profile (Aladdin, Memco and CheckPoint) or alternatively, choice of a 'Fast M&A Track' profile by NDS. The factors include factors internal to the firm -- Preference of Founders; Company Strategy- and factors external to the firm. The latter include the External Environment of the country e.g. the Nasdaq index; and Characteristics of the wider High Tech Cluster e.g. the Reputation of Israel's high tech industries; and existence or no of an experienced VC industry (an experienced industry is considered to be essential for undertaking the more difficult IPO process relative to the 'easier' M&A' process). There are also other factors e.g. Area characteristics such as whether or not Data Security companies had to consolidate with Network Equipment and Software companies. The entries are self-explanatory, the conditions determining the *main* growth profile continuously improved during the 90s, so that with time, *grosso modo*, very good SU companies had better and better opportunities to undergo a 'Fast IPO track'. As mentioned, this reflects both the external environment (Nasdaq Index) and the 'maturity' of the high tech cluster (quality of VCs and country high tech reputation).

An important point is the role of Company Strategy including the preferences of founders/inventors and early investors. Our interviews show that some entrepreneurs had a strong preference for creating large (will ambitions of becoming global) indigenous companies, and this undoubtedly was a factor (or a factor reinforcing the other factors) in the decision to follow that 'Main' growth profile. Note that such preferences also affect which Consolidation Variant will be chosen--either indigeneous consolidation or 'late' acquisition by a foreign multinational. It is our opinion that the decision of Memco to sell to Platinum was significantly influenced by Strategy and founder preferences, although other factors were also important.<sup>37</sup>

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<sup>37</sup>One of the founders argued the inevitability of the late Acquisition on the basis of a process of Industry Consolidation(to his mind , one taking place in the Software Industry as a whole, not only in Data Security)

#### **4. WHO BENEFITS FROM GLOBALIZATION: ACQUISITIONS AND ‘R&D LEVERAGE’**

The frequency of the foreign acquisition process of good Israeli Data Security companies suggest that, as far as high tech is concerned, Globalization may have asymmetrical effects on Peripheral Countries (whose companies are being acquired) versus the US or other Advanced Countries(whose companies acquire them). In what follows we will attempt to grapple with this general issue using Israel as a Case Study; and subdivide it into a number of more specific questions. In our analysis we will be considering both SU companies and issues associated with Downstream Activities (e.g. production and marketing) particularly pertaining to the need & opportunity for accessing Complementary Assets (Teece 1986). An attempt will be made to link microeconomic with meso/macro levels of analysis of these issues. We start with specific companies in Data Security and then proceed to a broader discussion of the role of SU companies in Israel’s IT high tech sector as a whole(Section 5). Two statements summarize the broad set of issues, these will then be subdivided into specific questions .

**Statement #1:** The Benefits of Globalization might Accrue to those Acquiring SU Companies of Peripheral Economies. Therefore in such Economies a Pattern of Complete Specialization in SU may not be justified(even in countries with an abundance of R&D related skills).

**Statement #2:** One possible outcome of the Globalization process is Under-investment in Complementary Assets within the IT High Tech Sector. This despite the emergence of New Opportunities to Access or to Acquire such Assets.

The two statements will be dealt with in this and in the next Section, respectively.

Note that the doubts about wholesale acquisition of companies suggests that fostering indigenous company growth beyond the SU/R&D phase in some contexts is no less important than promoting SU per se; and that this objective is not inconsistent with a related objective of creating a (small) segment of indigenous, global companies in these areas. This would imply that Israel-a small, Peripheral, technologically sophisticated country-should adopt a pattern of *Incomplete Specialization in SU companies*.

The objective here is to clarify the argument first through a renewed look at Data Security companies. This will lead to a typology of cases and some ‘informed’ guesses about possible direction of effects. Second, we will be discussing the pro & con of a pattern of Complete SU specialization for a country like Israel. Our discussion here will be conceptual and more general since it pertains to IT high tech more generally. Needless to say that an exhaustive analysis of the issues is not possible at this stage of the research.

**Statement #1** will thereby be divided into three questions--

*Question 1a.* Do acquired companies actually move abroad? and; what parts of the overall activity actually do so?

*Question 1b:* Have there been Lost Opportunities or an Unexploited “R&D Leverage” Potential?

*Question 1c.* While Specialization in SU companies may be worthwhile for a country like Israel, “Incomplete” Specialization would be best.

#### **4.1. Do Acquired Companies Actually Move Abroad?<sup>38</sup>**

There always is a possibility that acquired companies remain in Israel, even when acquired. One could say that this is less likely 'with companies in the software and internet businesses, as the assets are largely intangible and therefore easily movable abroad'. But 'the value could be in a particular product, in which it is movable; or in people. In this case it may be that people would want to remain in their own country, and this may discourage the foreign acquiror to move the company elsewhere, or at least those activities that are more tightly linked with the original start up(e.g. the R&D department of a high tech business). It is also known in the literature on multinational enterprises that foreign acquirors keep their investment in the country if they find it convenient to do so, and this depends in turn on how much the country is capable of keeping or attracting foreign investments (e.g taxation, availability of high quality human capital or infrastructure, costs, etc). To advance the discussion of these issues we must look at cases of foreign acquisition of companies. In what follows we focus on such companies in the Data Security Area.

The two “Very Successful (SS)” companies that were acquired--NDS & MEMCO-- kept important segments of their activities in Israel. An ‘Acquisition

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<sup>38</sup>This and answers to the other Questions have been strongly influenced by a referee’s comments. His contribution to this section has been significant.

Pattern’ is defined by two main variables: (I) phase of Acquisition of the Company; (ii) post-Acquisition activity/aspects. A distinction is being made between acquisition at the SU phase itself (or shortly after); and acquisition at the *post* SU phase or phases. Post- Acquisition may involve expansion or reduction of R&D activities in the country ; expansion or reduction of non-R&D activities ; and other aspects. The following table summarizes the main Acquisition Patterns. It also includes a short description of how various firms fit into them.<sup>39</sup> We identify four (4) Acquisition Patterns –Patterns 1 & 2 for the Acquisition during the SU phase or shortly thereafter; and Patterns 3 & 4 involving Acquisition in the Post SU phase. Pattern 1 involves significant expansion of R&D personnel after Acquisition while Pattern 4 implies significant reductions in non-R&D personnel (with only some changes in R&D personnel after Acquisition). NDS belongs to Pattern 1 and Memco to Pattern 4. Our Analysis also covers in detail the case of Algorithmic Research, a Successful (“S”) company who fits into Pattern 3 where no significant changes in personnel seemed to have occurred after Acquisition.

**TABLE 5:POST-ACQUISITION PATTERNS: PHASE OF ACQUISITION AND CHANGES IN ACTIVITY**

Phase of Company Acquisition, Company	Change in R&D Activity	Change in non-R&D Activity	Post Acquisition Status	Other Organizational Features	Loss of ‘R&D Leverage’ Potential
<b>SU PHASE</b>					
<b><u>Pattern 1</u></b>	<i>Significant Expansion</i>	<b>Expansion</b>		<b>Considerable Autonomy</b>	<b>Quite Unlikely</b>
<b>*NDS</b> founded in 1988, part of News	Most Emp. Is R&D employment, - 400 in	Seemingly low level of employment in sales	Company uses common sales set up	Fully Owned Subsidiary, considerable	Significant expansion in local employment

<sup>39</sup>Data Security Companies are indicated by \*, the remainder being Communications Equipment/ (other)Software companies. In both the Table and in the text that follows it we abstain from giving a full description of small, SU companies (Pattern 2) and of non-Data Security Companies which are only listed. The last column of the Table relates to “lost opportunities” (Question 1b). The data and qualitative information are valid till the end of the year 2000.

Corp since 1991. Acquired in 1996 by NDS(also part of NewsCorp.)	1999 (up from 120 in 1995)	marketing,.	with other companies of News.	e freedom of action	and in sales (200 M \$ in 1998). No clear loss in R&D Leverage Potential
<b>Pattern2- *Security 7 *Eagle Eye Butterfly. Libit</b>	<b>Slight contraction /Expansion</b>	<b>Non-Expansion (initial low base)</b>	<b>Division (or part of division) of Acquiror</b>		<b>Highly likely(for a small subset of SU)</b>
<b>POST-SU PHASE</b>					
<b>Pattern 3 An alternative IPO option existed</b>	<b>Some (or no) Expansion</b>	<b>Some (or no) Expansion</b>		<b>Considerable Autonomy</b>	<b>Quite Possible, but difficult to Ascertain</b>
<b>*Algorithmic Research (AR)</b> Founded 1985, initial EU orientation; Acquired by Cylink 1997	Possibly some expansion due to cooperation with Cylink.	Possibly Some expansion due to cooperation with Cylink.	Wholly owned subsidiary of Cylink since 1997(till 2001)	Considerable autonomy. Maintains own brand and separate marketing set up(Europe). Cooperates with Parent	Possible Loss—an IPO might have Leveraged its R&D even more <sup>40</sup> .

<sup>40</sup>Some “R&D Leverage” was achieved through AR’s Acquisition by Cylink. In May 2001, the employees and management of AR re-purchased the company’s shares from Cylink.

which helped US sales					
<b>Pattern 4</b> <b>A Leader in its (growing) market</b>	<b>Unchanged or slightly changed</b>	<b>Strong reduction both in Israel and abroad</b>	<b>Whole owned Subsidiary</b>		<b>Likelihood of Significant Loss</b>
<i>*Memco</i> Founded in 1990, IPO in 1996 led to steady expansion in US market. .Acquired in 1998	No Data available but strong expansion unlikely	Reduction of Marketing personnel in the US (estimate-around 120); and other in Israel	Part of Computer Associates( of its Data Security R&D Lab)	No independent Marketing Function	Yes, since there seemed to be a good chance of continued Indigenous Growth

Note that when identifying categories of Acquisition associated with expansion or contraction of activity (in the country) we are not yet making statements about “Social Desirability” of such Acquisition. For example, it might be the case that Acquisition has reduced the level of activity of the previously independent domestic company, but there was no alternative since continued company independence would have led to failure. Still it would be important to know which Acquisition Patterns led to reductions in activity; and which to increases-as a first step in trying to answer this broader question.

#### **4.2 Have There Been Lost Opportunities or an Unexploited R&D Leverage Potential?**

The issue is more complicated than what a simple look at Expansion/Contraction of activity would indicate since the real effect of Acquisition

of a very good company might not be the *actual change* but whether or not the *potential* expansion of activity has materialized. Since existing activity and assets of Israeli Start Up companies are R&D/technology, and -at least for very good companies- these could have created an opportunity for successful market penetration & growth, future post SU expansion could be viewed as a result of “R&D leveraging”. This might be influenced by company acquisition and by post-acquisition status e.g. whether it is part of a Division or a Subsidiary with significant autonomy; and by other factors.

The above suggests we must analyze *Losses of R&D Leverage Potential* which might accompany foreign acquisition of a very good domestic company. For example a post SU company with excellent technology and a market leader in its field may have had excellent sales, employment and profit growth prospects prior to its Acquisition (Strong “R&D Leverage” Potential). Suppose that in the aftermath of the acquisition the new Division or Subsidiary is transformed into an R&D Lab for the acquiring foreign multinational; and that all of its non-R&D functions and personnel are eliminated. Under these conditions there might be a significant *Loss* in ‘R&D Leverage’ Potential. In the extreme case, this loss could imply that emergence of a global, indigenous company- which would occur with a fair probability in the absence of the Acquisition- will not take place. The economy would have lost a market leader (or important market player) with a much stronger and *varied* pattern of activity expansion and asset accumulation relative to what occurred after the company was acquired (Memco’s case, would seem to fit this description, see Pattern 4 below))<sup>41</sup>. On the other hand, if a strong process of Industry Consolidation was underway, it could be that selling or merging with a foreign company is not only important for growth but also for survival itself.<sup>42</sup>

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<sup>41</sup> The notion of R&D Leverage as applied to very good SU company is predicated on the assumption that such company’s R&D has created, in principle, a new business opportunity the materialization of which requires significant non-R&D activities (and possibly additional R&D and complementary technologies). If successful, these ‘complementary assets’ ( Teece 1986) are accumulated or accessed during the company’s post SU, market penetration phase. Under this view, R&D is not yet another ‘factor of production’ in a neoclassical sense since, in creating the opportunity, there is no substitution between it and ‘conventional’ capital and labor. Rather than substitution in the production of existing products, the R&D undertaken by the SU company creates (in Neoclassical parlance) a new product and possibly a new production function.

<sup>42</sup>This would seem to be the case of Galileo’s-a successful Communications company-recent merger with its US competitor, Merval. It also might have been the case of Memco although we tend to emphasize the influence of other factors(see below).

We now summarize in more detail the four patterns of foreign acquisition of domestic companies shown in the Table, and provide illustrations for three of them.

*Pattern 1: Acquisition at SU phase led to fully owned subsidiary and to expansion of both R&D and non R&D activity*

NDS (News Digital Systems) Technologies Israel Ltd. was founded in 1988 by Cryptography experts from the Weizmann Institute of Science who, after searching for applications of their knowledge, solved the basic access & security problem of “Satellite Pay TV”. Shortly after the company received a contract from the Sky TV channel which both enhanced the reputation of the team and provided it resources to continue their work. Negotiations with News Corporation followed, and the company was finally acquired in 1991. What is now NDS Technologies Israel Ltd. became a fully owned subsidiary of the News group and maintained considerable autonomy. In 1996 it became part of (or was acquired by) NDS—a UK company also belonging to News Corporation. This apparently enhanced links with the Parent company and its management; and, despite some loss in flexibility and freedom of action, the company is still independent in day to day management

The Israeli subsidiary is in charge of Data Security of the products of the company while the Parent Company deals with Data Compression and with Transmission of the Information (including servers, cables, antennae, satellites, etc). There are two basic products—DBS(Data Broadcasting Satellite—seemingly the product which began in 1989) and, since 1997, DBS(Data Broadcasting Network—which are networks with TVs and computers which enable all forms of information and interactive TV).The big advantage of becoming a subsidiary of News was in marketing and sales. Thus, the first clients of NDS Israel come from the parent(this is less and less so); enhanced Reputation; and use of the marketing/distribution network which was common to all companies of News Corp. The disadvantage is loss of freedom and of flexibility, and some problem in selling products to companies which compete with the Parent

Throughout the 90s the company maintained its innovativeness and achieved a number of firsts: first in achieving a Satellite TV solution; first to use smartcards for Pay TV; first solution to Digital TV; etc. Employment grew very fast from a few tens to 120 employees in 1995, and 400 employees in 1999. Most of the employed personnel are University graduates involved in R&D whose budget in 1998 was 30 M \$. Sales also experienced an enormous expansion from 70 M \$ in 1995 to 400 M \$

in 1999. The expansion of activity of NDS Technologies Israel Ltd has had a lot to do with the freedom of action it has enjoyed under News Corporation.

*Conclusion:* The ‘early acquisition’ of NDS took place when the new Silicon Valley model was not yet established in Israel: the country’s High Tech Reputation was not yet established; and there was not yet a well developed Venture Capital industry. Therefore, the alternative option (to acquisition) of undertaking an IPO was quite improbable; and with it the possibility of growing then a large indigenous company (similar Israeli company in the mid 90s would have a greater chance of growing through an indigenous company trajectory). Moreover, NDS after its acquisition significantly expanded both its domestic employment (particularly R&D) and sales. On both counts we conclude that in all likelihood the acquisition of NDS did not entail a significant ‘cost’ in terms of a Lost “R&D Leverage”.

*Pattern 2: Acquisition at SU phase and retention of R&D in Israel at prior or expanded levels (firm did not undertake significant non-R&D activities prior to nor after Acquisition).*

While most companies that were acquired in this early stage were supposedly good companies technologically speaking, very little can be said about their pre-acquisition potential for post SU growth. The reason for this is absence of significant sales and no real proof of potential to undergo an IPO, etc. Presumably a fraction of firms in this category had such a potential and would implement it in the absence of an acquisition. But most might not have had it. Acquisition on the other hand did not lead to expansion of non-R&D activity, and in most cases, to only minor expansion in R&D. Therefore, an unrealized “R&D Leverage” potential (or “social cost” of Acquisition) did exist, at least for some companies in this category.

The set of SU companies in Israel which belong to this category is large-probably the largest among all Acquisition Patterns. There are two examples of Successful(“S”)<sup>43</sup> Data Security companies who belong to this category: Security 7 and Eagle Eye and other cases of Communications Equipment/ Software SU e.g. Butterfly, Libit . All four are mentioned in the Table.

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<sup>43</sup>In the sense used up to now, which –while indicative of potential—does not indicate an unambiguously strong capacity to succeed in an indigenous growth path.

*Pattern 3: Acquisition after the SU phase with maintenance or increase of both R&D and non-R&D activities.*

Compared to the previous pattern, here there is not only proof of technological prowess prior to acquisition but also a measure of success in the market place, and in company post SU growth. Thus “R&D Leverage Potential” definitely did exist. On the other hand, acquisition did not always truncate (or substantially truncate) the company’s development, in some case the contrary would be the case. Therefore a clear conclusion about “R&D Leverage Potential” *Loss* is not possible without looking at the specifics of each case. For example, it could be argued that Algorithmic Research (a “successful” Data Security company) could have survived and grown even in the absence of Cylink’s 1997 acquisition- although some post-acquisition growth and expansion did take place. It is likely, however, that in this case an R&D Leverage *Loss* was the case. Other cases within this category might give other answers, however.

In this connection it is important to realize that different patterns of post-acquisition organization & control may induce stronger or weaker expansion of domestic activities and, whenever relevant, of sales of the follow-up unit within the foreign multinational. For example, significant autonomy in decision making could be retained so long as the new Division (or Subsidiary) continues to be profitable (Algorithmic Research and RadNet—a Communications Equipment/Software company); and this may assure continued post Acquisition growth and ‘R&D Leverage’. However things can change abruptly and ultimate decision making—including the decision as to where decisions will be taken-- will be made abroad. The net effect could go both ways.

*Algorithmic Research*

The company was founded in 1985 by Cryptography researchers from the Weizmann Institute of Science. Venture Capital was not available in Israel at the time so the company had to earn revenues from day one, although a (subsequently terminated) investment and cooperation with a German Telecommunications company in 1989 and another with Israeli financial investors in 1996 also injected resources into the firm.. Its basic orientation till the second half of the 90s was the

European Market where it did well both in terms of sales and profits. In 1996 sales (profits) reached 6 M\$ (1 M\$) and in 1997-9 M\$(2 M\$) By 1996 it was clear that the company could not remain small in order to survive; that it should adapt to the Internet and with it, should penetrate the US market.

The company was in the early stages of an IPO process when the offer from Cylink-an important US company in the area-arrived. The IPO and the acquisition were considered as alternative means of penetrating the US market. Cylink purchased Algorithmic Research (AR) for 85 M \$ which then became a fully owned subsidiary. According to the CEO of AR (interview in 1999) this eventually opened the US market to the company and generated large US market feedbacks to AR's technology.<sup>44</sup> It did not occur smoothly, however, since initially Cylink took over the marketing organization of AR, its clients, etc; and only when the attempt failed did AR recover its 'autonomy' and control of its assets. Prior to this reversal significant damage was caused to the company-- particularly, from suspension of direct contact with c For practical purposes AR is an independent unit or profit center within Cylink, with its own R&D, Marketing and Sales; and with a mandate for selling in Europe. While Cylink is in charge of the US market both companies cooperate in which cases joint solutions involving R&D & Marketing personnel from both companies are worked out.

*Conclusion from the AR case:* Algorithmic Research had the option of undertaking an IPO (it was in an advanced stage of preparation to do so when the offer of acquisition by Cylink was made) and with it the potential for high growth and strong "R&D leverage" . On the other hand --due to the considerable degree of independence from its Parent-- the post acquisition level of activity has been maintained (at least till 1999). For example Algorithmic Research continued to market directly in its previous export markets. The expectation existed however that 'streamlining' of its non-R&D activities would take place sometime in the near future. For these reasons we conclude that acquisition might or might not have resulted in lost R&D leverage potential, although the weight of the evidence is that at least some

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<sup>44</sup> There were 70 employees in 1999 and my estimate of revenues is somewhere between 10-15 M\$.

Loss did in fact occur.<sup>45</sup> It is an intermediate case between Pattern 1 (little or no lost potential) and Pattern 4 (strong lost potential).

*Pattern 4: Acquisition after IPO and after successful Market Penetration. The effect: is dismantling of non R&D activities while R&D could increase or decrease.*

When MEMCO was purchased in 1998 it was not a SU company but a company that had done well far beyond the SU phase. By then it had an excellent product in the server-security market; significant sales/marketing organization (most of the 120 employees in the US), OEM agreements with Platinum (who also held over 10% of ownership) and Tivoli—a wholly owned subsidiary of IBM; strong links with VARs and System integrators like EDS; alliances with other leading providers of security products in Israel and abroad (CheckPoint, CyberSafe, Eagle Eye and Security Dynamics); and annual sales of a few tens of millions of dollars (55 M\$ in 1998). It also successfully underwent an IPO in 1996 the proceeds of which enabled it to acquire two security companies (Abirnet in Israel and a US company) and to develop its multi-pronged, successful, marketing strategy. The IPO and its effects were instrumental in the rapid growth of revenues, profits and employment of the company during 1997 and 1998. During this period Memco also generated significant spillovers to the Israel's high tech cluster.

Memco's marketing capabilities were dismantled after acquisition by Platinum. Computer Associates (CA) —who subsequently acquired Platinum—, transformed MEMCO into an R&D Lab. The company did not become a Subsidiary but a Division (or part of a Division) of CA. There seemed to have been at most only moderate increase in the R&D performed in Israel.

#### *Conclusion from Memco's case*

Memco's case probably epitomizes the likelihood of *strong loss of potential R&D leverage effect* resulting from Acquisition—seemingly a clear case of 'trunkation' of an indigenous growth path. Interestingly, there probably was no great reduction in the level of activity in Israel (which was mostly R&D activity prior to acquisition)—the reductions that took place concerned the company's US-based staff which was involved in marketing, sales and customer support. It was clear, also from the

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<sup>45</sup>This hunch is to some extent reinforced by the recent decision of AR's employees and management to purchase back its stock from Cylink (who had entered into difficulties).

information supplied by Memco, that they had a good chance of growing into a large indigenous Data Security Company.<sup>46</sup> What distinguishes this case from those of Pattern 2 is that a significant amount of R&D leverage had already occurred in terms of actual sales and growth of Israeli based personnel (150, mostly in R&D); that the company had already undertaken a successful IPO; and that it had a leading position in what supposed to become a very important market within the Data Security area<sup>47</sup>.

A major aspect of the loss to the Israeli hi tech cluster is what seemingly seems to be loss of direct contact with clients (this is now done by CA staff). This effect cannot be measured by the reduction *in domestic* non-R&D activity and personnel since most such employees were, prior to acquisition, based in the US. The Israeli based team probably benefited considerably from the intense two way interaction taking place then between marketing and R&D. This process would, a priori, seem to be much weaker after Acquisition, although this may very much depend on the acquiror's intra-firm information flows.

From another point of view, the acquisition of Memco must have changed the pattern or structure of asset accumulation of the company (or of what was then the company)making it more specialized in R&D/technological assets and less specialized in market and client-related assets ( less contacts with clients, weaker identifiable reputation effects; fewer direct links to VARs and System Integrators; etc).

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<sup>46</sup>For example, a research note of the Gartner Group of January 1988 entitled "The Unix Root Protection Market" which surveys the various offerings of the field states "...The most exciting offering is Mecomco Software's SeOS, now offered directly by Memco as well as Platinum Technology as AutoSecure and by IBM as Tivoli Access Control Activity (TACF). Memco also has the most effective worldwide channel up to date, with resellers in Europe and Asia as well as an original equipment manufacturer channel...Other platform vendors will include Memco's technology in their Unix operating systems by year 1999 (0.8 probability)." This statement was made only a few months before Platinum's acquisition of Memco. The report also compares Memco's product with the offer of CA (the latter acquired Platinum in 1999). The report states:" Computer Associates International's CA-Unicenter offers a form of root protection as well; however customers have reported failures in their Unix Systems resulting from Unicenter's attempt to intercept access requests for data or programs.....".In the same line 1998 report of Aberdeen Group on Memco emphasizes the role of independent software suppliers in providing "security solutions capable of supporting the heterogenous environments the enterprise relies on to run the business". It adds that Memco "...known for supplying cross platform security solutions that deliver effective protection at the operating environment level...has established a leadership position in the security market".

<sup>47</sup>This distinguishes it from Pattern 3 and AR's experience. AR at the time of acquisition had successfully penetrated the European market but not yet the US market(which, with the oncoming of the Internet, was becoming the main Data Security Market).

### ***Summary of 4.1 and 4.2***

-The change in the level of (domestic) activity is only one impact brought about by the acquisition of a successful company. A related and potentially more significant impact is the likely 'Loss of R&D Leverage' . Actual changes in activity could be particularly inadequate to indicate overall impact when the acquired company is a very good SU with very little non-R&D activity or a 'very successful' post SU company with non-R&D activity taking place abroad.

- Overall impact of an acquisition should go beyond loss or gain of potential R&D Leverage. It should consider also spillovers from incumbent/post SU firms to the overall high tech cluster(these are not fully analyzed in this paper)

-Of the two 'very successful' Data Security companies which were acquired one involved a potentially strong loss in R&D Leverage (Memco) and the other a small loss or even a positive impact stemming from the acquisition(NDS).

-A loss in potential "R&D Leverage" will occur with strong likelihood when a domestic company has a reasonable alternative to acquisition through continued dominance of (or important player status in) a growing market. In the case of Memco(Pattern 4), the company was a leader in its field in the US market, thanks to its excellent product and to the successful IPO completed two years before acquisition. To a lesser extent this was also the case of Algorithmic Research (Pattern 3).

-When such an alternative does not exist or is much less likely ( e.g. due to the growth of competitors or to a strong process of Industry Consolidation) the loss of 'Potential R&D Leverage' is smaller and the impact of the acquisition (excluding spillovers), in most cases, will be more faithfully measured by changes in actual activity. This is the case of NDS (Pattern 1) where the SU phase was completed before the process of Globalization & Evolution of the High Tech Cluster made 'R&D Leverage' a more realistic possibility<sup>48</sup>.

- The major open question were more research is urgently needed concerns *early* SU acquisitions of 'good' Israeli SU during the 90s(Pattern 2). Some of them

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<sup>48</sup> Non acquisition of NDS might have led to the classical case of inadequate 'inventor' performance due to difficulty in accessing 'Complementary Assets' (Teece op.cit 1986). This would reflect an 'appropriability constraint' to innovation and SU companies (mentioned by Chesbrough 1999), one resulting from failure to access Complementary Assets rather than from technological/R&D externalities

might have become a Memco (before its acquisition) or even better, but this potential has and will probably not materialize in the aftermath of their acquisition by a foreign company. In a minority of cases acquisition must have created a loss of potential R&D Leverage. It is very difficult to identify these cases and to measure this Loss. It is clear however that it cannot be measured only by post-acquisition changes in company activity.

#### **4.3 Why Incomplete Specialization in SU maybe Justified for a Country like Israel**

Given that the pattern of foreign acquisitions of SU companies found in the Data Security Area is prevalent elsewhere in Israel's IT high tech industry-the question arises as to the extent of 'SU specialization' which could be justified from a economy-wide or "Social" perspective. Since specialization is a normal consequence of free International Trade. Israel's abundance of Engineering and R&D-related Skills, coupled with distant main high tech Markets and weaknesses in Management, imply a Comparative Advantage in creating innovative SU companies that eventually would be acquired by foreign companies. It also means a Comparative *Disadvantage* in further downstream development of these innovations since this would require both a different set of factor proportions and new organizational & managerial forms (e.g. large firms, hierarchical rather than creative organizations, etc). Moreover in a world with strong Increasing Returns for post SU activity (as implied by Teece 2000, Chapter 1) , Israel's small domestic market would further strengthen its Comparative Advantage in high tech SU companies.

Even then one could argue that one does need some companies to grow to the point of being able to sell into the final markets, and that while the creation of SU for subsequent sale can be beneficial, the creation of indigenous companies that also operate in such final markets(possibly becoming multinational themselves) could be quite desirable<sup>49</sup>.

Stating that a country has a 'Comparative Advantage in SU Companies' may mean fulfilling one or more sets of conditions. We define two sets, *Set A* and *Set B*.

*Set A*

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<sup>49</sup>Alternatively, having a Comparative Advantage in SU companies does not negate the possibility of having or developing Competitive Advantages in some post SU , even Global, companies.

- Strong entrepreneurship and a large number of SU (normalized e.g. by country size, etc)
- A Reasonable or “low” rate of SU ‘failure’
- Strong Advantages from **early** Foreign Acquisitions of ‘good’ SU

*Set B*

- In some areas: Advantage of Foreign Acquisitions of **post** SU companies (e.g. after IPO & initiation of Market Penetration)
- In other areas: Advantage to Indigenous post-SU growth (including in some cases, generation of large, indigenous companies)

*Set A* seems to hold in the case of Israel. A comparative study of entrepreneurship locates Israel quite high in a the set of countries surveyed (Global Entrepreneurship Monitor 1999). This is independently confirmed by the existence of thousands of SU companies in this country<sup>50</sup>. Concerning SU failure, this of course depends on many factors e.g. on NASDAQ, but conventional wisdom till at least half or one year ago was that the rate of failure of Israeli SU was lower than the number usually mentioned in the US (9 out of 10)

Two alternative interpretations of ‘Comparative Advantage in SU’ are suggested by Neoclassical Trade Theory<sup>51</sup>: ‘complete specialization’; and ‘incomplete specialization’. The former would correspond fairly well to conditions of Set A; the latter would involve *Set A* + *Set B* i.e. it would be consistent with some SU not being acquired very ‘early’ but only in the post-SU phase; and with some proceeding along an indigenous development path—including or not excluding the generation of some large, indigenous companies.<sup>51</sup> We subscribe to the latter ‘incomplete specialization’ version as applicable to Israel at least for the Data Security sector , and possibly for other IT high tech areas as well. Presumably this is also the case for other, skill intensive, Peripheral countries..

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<sup>50</sup>There are no systematic figures on SU nor are there good definitions. The Office of the Chief Scientist defines a SU company as “a young company whose first and main activity is R&D”. Every year it provides assistance to several hundred SU, 300 SU companies during 1997(all programs). The stock of SU companies in Israel is commonly stated to be ‘several thousands’.

<sup>51</sup>Set A fits with the “Fast M&A track” or ‘*subsidiary*’ growth profile of very successful (SS) Data Security Companies; while Set B corresponds to the two variants of the *main* growth profile—the “Fast IPO track”. See above, section .

The reasons for having SU companies beyond the SU phase and for generating (some) large indigenous companies, even when the Peripheral Country in question has a comparative advantage in SU, may be *direct* or *indirect*. The former concerns the direct contribution to GNP of post-SU companies (and other large IT incumbents) relative to SU companies<sup>52</sup>; the latter refers to the contribution of post- SU & incumbents, through ‘unintended spillovers’ (Chesbrough 1999) and possibly other factors, in promoting and enhancing the efficiency of the process of SU creation and development itself. We start with *Indirect Reasons* for having a post SU segment of IT high tech..

#### ***4.3.1 Assuring an Indigenous Supply of Managerial Inputs***

We refer to the Management Inputs of companies, which has been identified by Teece as a major source, in present world conditions, of the Dynamic Capabilities of firms—a condition for company survival and growth(Teece 2000, op. Cit). The argument thereby focuses on one type of spillover of ‘large’ indigenous companies which benefit SU – management input spillovers to SU companies<sup>53</sup>. Its existence in Israeli IT high tech emerged from interviews conducted during 1998-9 with over 35 high tech companies (mostly Data Security and Communications Equipment/Software companies). Most of them were SU companies, while some were in the post SU phase. The argument looks like this-

- Management skills are required to transform a very good SU company into a high value 'technological asset' which could then be acquired by a large multinational or could set the basis for indigenous growth e.g. scaling up from 5 M\$ annual sales to 50 M\$. There are two broad sorts of reasons for this. On the one hand, an experienced management would ensure a good fit between the products/technology being developed by the firm and emerging needs of the market (For Data Security, generally the US market). This could mean for example, helping the SU focus on the ‘right’ market segment. A second source of value where management seems to play an important role is the capacity to acquire or access Complementary Assets & Technology e.g.

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<sup>52</sup>This of course will depend on factors such as the mix between SU activity and post SU activity in the IT high tech sector.

<sup>53</sup>A recent paper by Klepper (Klepper 2001) has focused on the spin-offs of large, established companies in the US Automobile Industry. He found that founders of successful new companies

through the leverage of personal and business links which experienced managers can bring to inexperienced SU companies. Many SU entrepreneurs in Israel and other Peripheral countries lack Export Marketing & Production Experience, and bargaining experience with suppliers of Complementary Assets. Moreover, and in contrast to US entrepreneurs, they are strongly 'technologically oriented' rather than 'market oriented'; and they have the disadvantage of lying far from their main markets. All of this makes accessing Complementary Assets all the more difficult without experienced management help, that is from managers with prior experience in other companies. Alternatively we may say that availability of high quality Managerial Inputs would contribute to effective “R&D Leverage” of very good SU<sup>54</sup>.

- Management Skills are to a large extent an *experience based, non-traded good*. This is likely to be the case in many peripheral countries, Israel included (Israel also has specific circumstances which may reinforce this effect i.e. they may deter US managers and their families to move there)
- Management Skills for SU companies are frequently generated by large indigenous companies, and could spill-over to SU through a variety of mechanisms. For example, experienced managers may join SU companies or may join Venture Capital companies which provide management inputs to their portfolio SU thereby raising their value. Both mechanisms were present in the areas and firms studied<sup>55</sup>.
- The identified managerial input adds value both at the SU and post SU phases. Even for those companies who will eventually be acquired by foreign companies they may directly or indirectly facilitate the option of going public

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frequently came from successful incumbents. Here we will focus on Managerial Inputs more generally speaking.

<sup>54</sup>Note that there are differences between the management inputs required to lead a SU towards a “Fast M&A track” and those required for a “Fast IPO track” (both when the company, in the post-IPO phase remains indigenous or is acquired by a foreign company). . Everything else equal, a “fast IPO track” requires relatively more “complementary assets” and actual sales-compared to what is required to prepare a good SU company for acquisition(Source: interviews with VC companies).

<sup>55</sup>We must recall here another source of Management Inputs to SU—those flowing from large Multinationals like IBM, Motorola, Intel and Digital who got established in Israel during the 70s. These were ‘Greenfield’ investments with unintended managerial spillovers to SU companies. Despite their important contribution, especially before the 90s or in the early 90s, they seem to have been imperfect substitutes of the management inputs provided to SU by Israeli post SU companies, especially during the second half of the 90s.

first and then selling to a foreign company rather than selling early ("fast M&A track)

- Beyond their direct contribution to growth and their management contribution to SU companies, large indigenous companies generate other types of spillovers to SU companies and to the high tech cluster. Those found in Data Security include<sup>56</sup>
  - Investments in or Acquisitions of SU companies (prior to being acquired, Memco invested in Pelikan & acquired Abirnet; Aladdin acquired Elyashim & E-safe;)
  - OEM agreements with SU companies(Memco with Pelikan)
  - Personal networks may lead to valuable information flow from senior managers of large companies and managers of SU companies
  - Standardization efforts led by indigenous companies, which are beneficial to Domestic SU. (CheckPoint's "Open Systems for Enhanced Connectiveness" forum—OPSEC)

#### *Link With Chesbrough's Analysis*

We will consider both the 'appropriability constraint' facing SU companies and the role of indigenous, post SU in helping to relieve it; and the 'incentives constraint' facing large incumbent companies which induce spin-offs of important managerial and engineering personnel, including to SU companies.

*Incentives Constraint:* Chesbrough op. Cit has linked the 'unintended spillovers' to SU from incumbent companies in high tech areas in the US to characteristics of labor and capital markets, particularly to flexibility in the market for highly skilled personnel; and the existence of Venture Capital.<sup>57</sup> Incumbent companies are confronted with an 'incentives constraint' which prevents them from providing strong incentives to intra-firm would-be entrepreneurs. This is due in part to the need of maintaining a 'balanced incentives' structure within the company. Start up

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<sup>56</sup>Subsequent work will systematically report on the spillovers of Data Security companies. For the time being let us mention that spillovers from incumbent and post SU companies did exist; that some included management spillovers as well as agreements between such companies and SU which directly helped in 'accessing' complementary assets. There are much fewer if any recorded spillover flows from SU or from acquired companies were reported.

companies are not prevented from offering high powered incentives both to such managers and engineers e.g. through stock options, handsome salaries etc. In this way, top notch engineers which embody the experience and knowledge of years of research in incumbent companies may joint SU companies. This has happened frequently in the US e.g. in the Hard Disk Drive Industry where IBM time and again contributed such spillovers to successful generations of SU companies (Chesbrough, op. Cit) This link is reinforced by Venture Capital which provides the funds, by headhunting and by other Value Added Services which facilitate this process. The conditions of Israel during the 90s are similar to those described by Chesbrough as prevailing in the US as far as mobility of high level personnel, flexibility of labor markets and availability of Venture Capital are concerned. A further, country specific, facilitating factor has been the existence of an Horizontal Program subsidizing bottom-up determined R&D projects in the Business Sector, without favoring particular segments nor discriminating against SU. This program has facilitated both the flows of new SU and the transfer of engineering and managerial talent from post SU/large indigenous companies to SU companies.

We conclude that favourable 'System Conditions' exist in Israel which support our belief that post- SU companies and large indigenous companies have generated an 'Indirect Contribution' to SU creation and evolution. This lends additional weight to the notion that while Israel may have a comparative advantage in SU the appropriate pattern or configuration is one of 'incomplete' rather than 'complete' specialization.

*Appropriability Constraint:* Teece and Chesbrough have emphasized the problems of achieving investment 'coordination' between suppliers(in our context, a SU inventor) and users/customers of new technology, where effective use of such technology requires investments in specialized complementary assets and technologies. Imperfect coordination, particularly in very competitive environments characterized by considerable uncertainty, could create a significant 'appropriability constraint' on the SU-inventor's returns i.e. returns could be low or negative<sup>58</sup>. A major factor helping

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<sup>57</sup>More specifically, prevalence of the limited partnership mode of organization of Venture Capital.

<sup>58</sup>Where complete independence between supplier and the buyer is the norm an innovation's adoption is coordinated through the market, with its attendant high-powered incentives and potential hazards... whoever has the best product at the right time at the right price can expect to win the customer's business. Buyers have little supplier loyalty a priori and try to design their systems to use products from many alternative suppliers. Suppliers must refrain from becoming locked into a particular customer, since it might go elsewhere in the next round of product competition. Part of the customer's

in this regards are 'intermediate' forms of supplier-user links, forms lying between a pure market/arms-length configuration and supplier/user 'integration'. In Israel's Data Security Sector several mechanisms were in operation(see above) which represented contributions of incumbent and post SU indigenous companies to SU activity. These included: OEM agreements (e.g. Memco with a SU called Pelikan); direct investment or acquisitions of SU companies(e.g. of both Memco and CheckPoint); and CheckPoint's Standards Interface organization—OPSEC—which must have solved the coordination problems of complementary technologies for many new Data Security and other IT SU companies.

*Link with Teece's Analysis (Teece 2000, op.cit):*

The criticality of the Management spillovers from indigenous post SU companies to SU companies in Israel's IT high tech sector conforms with Teece's recent analysis of the core conditions for competitive advantage in the emerging, new international context. Management Know How is an important *Intangible Asset* for which efficient markets do not exist. The existence of an efficient market for a particular input implies that having that input cannot be the source of Competitive Advantage (since any agent not having it could simply participate in the market and access it). The present era is characterized by the emergence of numerous (efficient) markets in product and input areas where previously such market were not existent. Therefore, there is a narrowing of the range of company activities or functions which can become sources of company competitive advantage. More than anytime in the past, *the area of Intangible Assets including Management Know How* is becoming one of the fundamental sources of Competitive Advantage. This makes Chesbrough's unintended spillovers of incumbents so important as applied to management inputs for SU companies.

#### **4.3.2 Direct Growth Contribution of Large, Indigenous Companies**

Peripheral Countries may also have a comparative advantage in some IT high tech, post SU, downstream activities some of which could lead to the creation of global

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decision will depend on the supplier's ability to provide the right product at the right time. However, the customer is unwilling to make any extended commitments ex ante to allow suppliers to secure the requisite complementary assets in advance. The *appropriability constraint* here can therefore be quite

indigenous companies. A number of factors may generate this possibility, here are some examples from Israel-

- *A Singular Technology*— several areas in Israel ,in the last decade e.g the security products of Memco and of CheckPoint .
- *Areas with Relative Ease of Implementation*: For example, Software where production is easy and in those cases where market penetration either does not require large amounts of complementary assets or could be gradually be built up
- *Growing Local Market and Existence of Sophisticated Users*: Despite its size Israel has and will have a non-insignificant local market for software ( at least compared with Ireland, see Breznitz 2001, in process). Moreover, the Army has had special needs which spurred new technology, partly within the Army itself<sup>59</sup>. Finally, large mobile communications providers with millions of users will increasingly represent important sources of sophisticated domestic demand and domestic 'testing of new Security and Communications-related products'<sup>60</sup>. Wireless providers and other 'technology demand companies' will increasingly enable Israeli SU to test their products domestically, thereby gaining some of the advantages which counterpart SU companies have in advanced markets. (Scandinavian companies enjoyed early and growing domestic markets for advanced telecommunication services. This seems to have induced product innovations by local companies in some such areas<sup>61</sup> .

Finally an important additional factor further raising the *Direct Comparative Advantage* of post-SU, downstream activities even in small economies like Israel is the greater possibility today of accessing & coordinating the acquisition of such Complementary Assets. We will be referring to this in Section 5 ( *Question 2b* and also in *Question 2a*). Here we would like to state that there are both *External Environment* conditions and *Endogenous Hi Tech Cluster* conditions which support the argument. Among the former we have the Globalization of Asset/Capital Markets already mentioned, which enable even young & technologically sophisticated

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high, since companies that have a great product but are unable to produce and deliver it in a timely way might fail to win the business".(Chesbrough op. Cit p. 467).

<sup>59</sup>This would conform to Von Hippel's User Dominated Innovation Pattern (Von Hippel, 1976) and Users being the 'Dominant Locus' of Innovation (Von Hippel 1987in some areas).

<sup>60</sup>In early 2001 they have also created funds for investing in interesting SU developing technologies relevant for the services they provide(The Market, March 2001).

<sup>61</sup>Financial Times, May 2000.

companies to float in International Capital Markets thereby generating resources for acquiring or accessing (e.g. through Strategic Partnerships) such assets. The high level of the NASDAQ index till the year 2000 has undoubtedly contributed to this; and conversely, this factor now is less important due to the 60% reduction of the index in the last 16 months (between 3/2000 and 7/2001). Another external environment factor is the appearance of new intermediate goods markets which might enhance access to certain types of Complementary Assets; or the enhanced ease—due to the diffusion of Information Technologies, etc-- of entering into complex contractual relationships with suppliers, users and competitors, including agreements pertaining to the access of Complementary Assets.

Among the endogenous factors we should mention the increased capacity of Israeli companies, either by themselves (e.g. due to enhanced Dynamic Capabilities) or with the assistance of other organizations (e.g. Venture Capital companies) or by virtue of other High Tech Cluster features (e.g. Reputation, personal and business links), to access such assets or to achieve the required coordination mentioned in the literature. These 'intermediate' contractual forms frequently are based on supplier-user or Technology Supply-Technology Demand links. They therefore lie between a pure market/arms-length configuration and complete 'integration'. The Israeli hi tech cluster seems to be developing such links. In the Data Security area, both CheckPoint and Memco signed OEM Marketing agreements with important customers/System Integrators (Platinum and Sun Microsystems respectively) which represented or facilitated access to complementary assets. These agreements considerably favored post SU company evolution<sup>62</sup>.

## **5. GLOBALIZATION AND COMPLEMENTARY ASSETS**

We will distinguish three different questions or issues which are addressed in the two subsections that follow--

*Question 2a:* Is it true that there is under-investment in Complementary Assets (from a Social rather than Private point of view)?

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<sup>62</sup>An additional factor is that Dynamic Capabilities which are required for successful post SU growth (including successful accessing of Complementary Assets) can increasingly be learned as part of the Globalization process. Moreover the easier access to Complementary Assets which acquisition of Dynamic Capabilities entails could compensate in part the disadvantages of small domestic market size.

Question 2b: What is the Desired Balance between SU and post SU ('Downstream') Activity?

Question 2c: Compared to the Past, Israeli IT High Tech During the Last Years Faced Wider Opportunities to Access Complementary Assets

### **5.1 Is there Underinvestment in Complementary Assets?**

Our presumption is that Israel has still some way to go in achieving an adequate balance between SU companies and post-SU companies involved in downstream activities, although the situation, following the fall of NASDAQ, might be about to improve. While the high tech cluster has proved to be a good environment for the creation of SU companies, relatively few larger & global companies have emerged. This means a measure of "Under-investment in Complementary Assets" since these assets are necessary for a company to undertake those downstream activities which are associated with post-SU company growth..

The presumption of a low proportion of SU versus post SU activity in Israel's high tech IT sector cannot be ultimately proved at this stage, since it would require a major research effort which combines both micro and macro analysis. One problem is identifying high tech areas within Services, where till recently little data is available. Despite the conceptual and measurement problems our presumption is buttressed by the following facts and/or reasons--

- *IT High Tech Makes a Relatively Low Measured Contribution to Total Manufacturing Revenues(flow indicator):* The 1999 share of "Advanced (IT) Sectors" in industrial employment--27%-<sup>63</sup> generated only 30% of total industrial revenues<sup>64</sup>. Thus 'measured' revenue per employed person in IT high tech is only 10% higher than average revenue for Manufacturing as a whole-- despite employing 57 % of engineers and scientists and 30% of the capital stock. This indicates weak "R&D Leverage" that is lots of skilled engineers in R&D who generate less measured revenues than what one would expect. This is consistent with a situation where large numbers of SU operate in the hi tech sector, absorbing an enormous pool of skilled labor, with

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<sup>63</sup>"Industry in Israel-Tables and Diagrams, 1999" Ministry of Industry and Trade, Sept 2000, p.52.

<sup>64</sup> "Advanced IT Manufacturing Sectors' include Electrical Equipment, Office Machines & Computers; Communications, Control and Medical Equipment; Electronic Equipment and Transport Equipment & Vehicles. The Data of Table 1 refers to these sectors .

relatively little 'merchandise or service output' coming from their activity (relatively weak post-SU, downstream, activity).

- *High Value of Sales of (Foreign) Acquisitions of IT High Tech SU Companies(stock measure)*: The above 'paradox' is explainable once we recognize that there is a second important source of 'revenues' from high tech—sales of 'technological assets" which take the form of (mostly but not exclusively)foreign acquisitions of SU companies. This is a 'stock measure' of revenues not included in the statistics of Industrial Revenues nor Industrial Exports(at least till 1999). There are indications that the value of SU acquisitions by foreign companies is "high' relative to the merchandise exports of Advanced IT Manufacturing sectors. These exports amounted to 7521 M\$ in 1999 (See Table 6); while foreign purchases of high tech SU amounted to several B\$--one estimate being more than 10 B\$ for the year 2000, and several billion dollars for the year 1999<sup>65</sup>. Despite problems with the data the important point here is that towards the end of the Century, SU acquisitions (*stock measure*) seemed to be a large fraction of the value of IT high tech revenues (*flow measure*). This is especially so during the year 2000.

**TABLE 6: ISRAEL'S ADVANCED IT MANUFACTURING SECTORS- VARIOUS INDICATORS 1999**

INDICATOR	SHARE IN TOTAL MANUFACTURE	ABSOLUTE VALUE
<i>Employment</i>	27 %	
<i>Revenues (flow)</i>	30 %	
<i>Capital Stock</i>	30 %	48. 452 K Shekels
<i>Exports</i>	45.7 %	7. 521 K \$
<i>Investments</i>	53.1 %	

<sup>65</sup>See IVA 2001 (p. ). These figures reflect the value of acquisitions at time of purchase. Note that a significant share of the payment was in shares and that their value, during 2000, declined considerably. This fact emphasizes the measurement problems associated with the new high tech indicators in this era of Globalization. From another perspective, foreign SU Acquisitions are a component of Foreign Investment in Israel, where a distinction is made between Direct, Portfolio and Bond Investments. It is part of Foreign Portfolio Investments (for which there are figures); but. it must exclude foreign investments in Listed Companies, in post SU unlisted companies, and in non IT high tech companies. This again highlights the difficulty if arriving at precise estimates of SU acquisitions.

<i>Skilled Labor</i>	57 %	

*Source: Industry in Israel, Tables and Graphs 1999, Ministry of Industry & Trade*

### 5.2 The “Balance “ Between SU and post Start Up/Downstream Activities

Our presumption would be further buttressed if *SU activity involves different and probably higher risks than downstream, post-SU activity*, particularly a strong sensitivity to increases and decreases in the Nasdaq Index. If this factor is not sufficiently taken into account by private agents, a ‘market’ solution when Nasdaq is high might involve *undesirably high* shares of SU activity over total IT high tech activity<sup>66</sup>. That this might be relevant is buttressed by the data in Table 7. It shows that SU contributed significantly in a positive way to Israel’s GNP growth of the first three Quarters of the year 2000; and in a negative and significant way during the last quarter (first quarter) of 1999 (2000).

**TABLE 7: CONTRIBUTION OF SU ACTIVITY TO ISRAEL'S GNP GROWTH-2000/1(five quarters)**

	00/1	00/2	00/3	00/4	01/1
<b>GNP Growth (%)</b>	6	7	9	-10	1.75
<b>GNP Growth Excluding SU(4%)</b>	4	4.5	3.5	-8	4
<b>SU Contribution-Absolute (%)</b>	2	2.5	5.5	-2	-2.75

<sup>66</sup> This may happen especially under conditions like those prevailing for a couple of years till mid 2000 where bandwagon and/or demonstration effects may prevail over the choices that investors or entrepreneurs would take in ‘normal’ times. Moreover, private decisions to grow companies in the post SU phase would not take into account the ‘collective’ learning effects accruing to future attempts of this kind, especially when such capabilities are at an infant phase.

<b>Relative Change in GNP growth due to SU activity</b>	50%	56%	157%	-25 %	-69 %

Source: V. Shohat, *The Marker*, 29-5-01 (Approximate Figures)

The upshot of the above are two possible meanings to the *presumption that the share of SU in overall IT high tech is high*: a) that it is bound to decline (after having risen considerably during the second half of the nineties), partly in response to a 'more normal' NASDAQ index; and b) that this is Socially Desirable, especially if the share of High Tech industries and Services in the Business Sector continues to increase in the future. Point a) implies an upward sloping curve plotting "IT high tech SU intensity" over time, one which peaks in 2000. This stretch of the curve (not drawn here) would reflect, among other things, the almost continued increase in the NASDAQ Index during the second half of the 90s which has inflated the value of SU acquisitions relative to the flow value of revenues generated by IT high tech (especially in the year 2000). Under the conditions prevailing today one would expect a higher share of downstream activities (reflected in output and export flows) in total IT high tech<sup>67</sup> and correspondingly a downward segment in the above mentioned curve after 2000. The upward sloping section of the curve is confirmed by the "IT hi-tech SU intensity" index used in Table 8. This index is the ratio of "SU output" to "total ICT output" (or "total ICT exports"<sup>68</sup>) where ICT stands for the Information & Communications Technology Sector<sup>69</sup>

<sup>67</sup>While it is true that a lower NASDAQ Index will also negatively affect IPOs and the possibilities for indigenous company growth, this effect is only *indirect*. Our presumption is that it will affect the SU segment more than the post-SU segment. This is a reasonable assumption although it may require further justification.

<sup>68</sup>Foreign Acquisitions of SU are not registered as exports in the ICT Indicator (presumably since they are sales of assets to foreigners rather than merchandise/service exports). That's why we have used SU output as the numerator of the SU-intensity index of ICT exports in Table 7.

<sup>69</sup>See Central Bureau of Statistics, 2001. The ICT sector computed for the decade of the 90s is a mixed Manufacturing-Services sector as defined by the OECD. The Manufacturing Sectors include 'Electronic Components', 'Communications Equipment' and 'Scientific and Industrial Process Control Equipment'. The Services Sectors include 'Communications Services', 'Computer Services (Software)', 'R&D Services' and "Start Up Output". The latter has been calculated using

**TABLE 8: SHARE OF SU ACTIVITY IN TOTAL ICT ACTIVITY(%)**

	1990	1995	1996	1997	1998	1999	2000
<b>Output</b>	-	4.25	7.8	8.2	13	20	43
<b>SU out/ ICT exp</b>	-	7.2	13	14.1	20	28	50

Source: Central Bureau of Statistics, "Development of Information and Communications Technology In The Last Decade", 28-03-01

There are additional reasons, beyond the behaviour of NASDAQ, which support one or both of these statements:

- First, Government Policy is strongly biased towards the support of R&D rather than a) promoting a balance between support of R&D and of non-R&D; and, related to this b) promoting the growth of companies beyond the post SU stage (Teubal 1999, Avnimelech & Teubal 2001). Presumably, a neutral set of policies -everything else equal- will induce an increase in the share of effort going to those downstream activities relative to that devoted to SU<sup>70</sup>.
- Second, the enhanced "maturity" of Israel's IT high tech cluster and its enhanced capacity to generate not only good SU companies but also adequate post SU growth profiles. We have shown that in Data Security and other IT high tech areas successful post-SU growth has frequently been associated with an ability to undertake IPOs as part of a strategy of (foreign) market penetration. Throughout the 90s more and more companies, via a process of 'collective learning', seemed to be able to do so. One aspect of this enhanced capability has been the increasing ability of Venture Capital firms to lead good companies beyond the SU phase through a 'fast' IPO track' (this is a much more difficult set of actions than that of preparing a SU for acquisition).

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macro-figures of Venture Capital Investments weighed by a factor which includes the average Rate of Return in Nasdaq. Needless to say this is a rough measure of SU output, and it is not based on actual value of SU acquisitions, the indicator used in the text. This however is quite immaterial to the analysis being conducted here.

<sup>70</sup>Approved Enterprise Status, which exempts high tech companies who undertake 'conventional' investments (a post-SU activity) from Corporate Income Tax, would only reduce the "pro-SU Bias" of policy rather than eliminate it.

Recent interviews of 10 VC companies have shown that only in the second half of the 90s did VC companies develop such capabilities

- Third, large Communications companies in Israel are creating for the first time strong, civilian, demands for novel communications technologies. The larger domestic markets will presumably help post SU activity more than SU activity<sup>71</sup>.

Quantitative data on numbers of high tech IPOs launched in the US, on share of VC-backed versus non VC-backed cases, etc-- seems to be consistent with the second reason above, about enhanced 'maturity' of Israel's high tech cluster.<sup>72</sup> The upshot is that the accretion of capabilities during the last 4-5 years could support, in principle, a greater accumulation of complementary assets compared to the past. Correspondingly this would lead to a larger share of IT indigenous, post-SU company growth in total IT high tech growth. This is a both a Positive and a Normative statement in support of a (future) downward sloping section for the (not drawn) 'IT SU intensity' curve mentioned above-whose upward sloping section would reflect the data of Table 8. As will be shown below consideration of the wider context within which IT high tech operates would seem to further strengthen this presumption.

### **5.3. Are Complementary Assets More Easily Accessible Today than in the Past?**

The process of "Globalization of Asset and Capital Markets" has proceeded one step further during the 90s—it is involved not only in "Global Production Networks" but also in the upstream and extremely uncertain activity of New Product Invention and R&D . In North America for some time already, and for the first time in history in selected geographical areas beyond-- creative inventors and entrepreneurs have an opportunity to sell part or all of their young SU companies in

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<sup>71</sup>By easing the acquisition of Complementary Assets, it would—everything else equal-- enhance the share of SU which may succeed in the post SU activities.

<sup>72</sup>Yearly IPOs increased by over 20% between the first phase in Israel's VC industry (1993/5) and the second phase (1996/9) (for first and second phase--see Avnimelech & Teubal, in process); and the share of VC-backed IPOs rose from only 33% to 59%(Lukomet, 2001). Moreover at time of the IPO, average age and employment of companies floating in the first phase were higher than in companies floating in the second phase. Thus in the second period, Israel managed to float younger and smaller companies compared to the first period. This reflects the combined effect of a continued growth of the NASDAQ index and a new capabilities to float companies at early phases(a characteristic of the overall high tech cluster)

world public (stock markets) or private(M&A; VC investments, angels, individuals)capital markets. Two important implications follow:

- first, the returns to inventors and investors/entrepreneurs in SU companies will be higher than what they would have been prior to the onset of the current Globalization wave;
- second, the resources raised (and other factors linked to participation in such markets) create new opportunities for accessing Complementary Assets.

We will refer to each one of these effects separately.

*Higher Rate of Return to Inventors/SU:* Whereas in the past materializing the returns to inventors/entrepreneurs/early investors associated with new hi tech products required significant production and sales ,and correspondingly significant investments in Complementary Assets, today under the new conditions they may obtain an anticipated or relatively ‘early’ return on their investments by “*exiting*” in asset/capital markets. It is worth mentioning that there are exiting options beyond being acquired by a foreign company (M&A) like selling a *share* of ownership (rather than *full ownership*) so the company can remain indigenous and eventually proceed along a full fledged post SU trajectory. The options are VC and Angel investments; and IPOs. Another important point is that exiting in general may take place with few prior investment in Complementary Assets(relative to the level of investments required for successful marketing, sales and positive profitability).

*More Resources for Accessing Complementary Assets:* The same exiting operation generates resources for purchasing or accessing complementary assets or alternatively, for materializing ‘R&D Leverage’ potential. Moreover, beyond the cash and shares raised, the process of VC investment or the IPO process *directly generates new complementary assets such as Reputation, Visibility/ Exposure, new & reinforced Links & Networks; and new Management Skills*<sup>73</sup>. The IPOs direct and indirect role in accessing Complementary Assets is the basis of our view that such an

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<sup>73</sup>This fact has come out from our interviews, both with Data Security and with Communications Equipment/Software companies. The Value Added generated by VC is well documented; the important thing here is to realize that the IPO process also *directly* generates important Complementary Assets or facilitates access to such assets

event is part of a wider process of Market Penetration by good companies rather than simply an exit mechanism for investor.

### ***Link with Teece's Recent Analysis***

Other authors, particularly the recent analysis of Teece (see Teece 2000, op. Cit. Chapter 1), have mentioned the enhanced ease of accessing Complementary Assets in the current era. Teece points out to a number of explanatory factors e.g. decreased cost of information flows, expansion of intermediate product markets, etc. He also sees this as part and parcel of the transformation of the sources of Competitive Advantage in the direction of a new logic where 'developing, owning and deploying/orchestrating intangible assets which are not easily replicable'<sup>74</sup> is critical. Our conclusions, originally appearing in Teubal et al 2000, are consistent with the conclusions of Teece. Both analyses emphasize that in the new environment accessing Complementary Assets seems to be 'easier' than what it was traditionally. However neither analyses, by virtue of their emphasis on the role that Management plays either in Dynamic Capabilities (Teece) or in 'R&D Leverage' (this paper)- do not totally wipe out the role that Accessing Complementary Assets still plays in generating Competitive Advantage at the company level.

They are also differences in emphasis . This paper has focused on the problem of developing High Tech Industries in Peripheral Countries or Regions, particularly those like Israel which are small and relatively sophisticated technologically speaking. In those countries/regions, accessing assets (and technologies) complementary to those developed in domestic SU is a major issue for the competitive advantage & growth of such companies. Moreover, the conditions under which such assets are accessed will determine the *nature & scope* of the country's Comparative Advantage in High Tech e.g how much high tech, and what share of SU is justified. In this context, the globalization of Capital/Asset markets - in the sense that there exists a social institution where 'good' inventors and SU may systematically both obtain a return to their investments *and* get access to resources for further expansion- is certainly one of the determining conditions.

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<sup>74</sup>Teece's recent analysis would assign a lesser role to the problem of accessing Complementary Assets nowadays compared to the role it played in the competitive environment underlying his 1986 article. Our major point here is that-at least for Peripheral Economies- this has to do no less with globalization of capital markets than with the factors he emphasizes in his recent book(See below)

The above is also, in our opinion, a factor to take into account in the analysis of high tech in Advanced Countries (particularly in Regional Analysis, and in the spread of the Silicon Valley ‘model’). Under the new conditions, *Peripheral Regions* in these countries, with a greater likelihood than before, will also join the high tech bandwagon.

### ***Supporting Evidence for Israel***

There are strong indications that Israel is one of the few non-North American areas where such ‘participation’ in world capital & asset markets has taken place. The best indicators are numbers of IPOs compared to other countries and normalized by GNP, population or other parameters; and Capital Raised and Invested by VC companies, also compared to other countries and normalized. Suffice for our purposes here to describe the general situation rather than to present a complete set of data on these matters. Concerning IPOs -many observers have indicated the large numbers of Israeli IPOs in Wall Street and the high share of technological stocks in accumulated IPOs. Till at least 1997/8 the Israeli total exceeded the cumulated total of all other countries except the US & Canada (Blass & Yaffe 2000). The accumulated number of high tech IPOs (overwhelmingly in Nasdaq) till 1999 was 83, where 46 were non VC-backed companies, and 37 were VC-backed (Lukomet op. Cit. 2000). There is some increase in yearly numbers of IPOs throughout the 90s (till the recent crisis in NASDAQ) and in the share of VC-backed IPOs; and a reduction in size & age of companies undertaking IPOs during the second half of the 90s compared to the first half. Thus hopefully the global capital market in conjunction with the local high tech cluster, are increasingly working in the direction mentioned in this paper, namely in supporting the effort of ‘good’ SU to enter the post SU phase (this might be related to the enhanced importance of VC-backed category of IPOs, see Lukomet Op. cit).

## **SUMMARY AND IMPLICATIONS FOR OTHER PERIPHERAL ECONOMIES**

Continued Globalization of Asset/Capital Markets(with respect to Invention/SU companies) together with the diffusion of the Silicon Valley Model of

high tech to other areas will enhance the possibilities of creating high tech industries beyond North America. A subset of small and large Peripheral Countries--Israel, Ireland, China, India, South Korea--has or will benefit. They have or must acquire the requisite infrastructure, ample and high quality human resources and a favourable cost situation(e.g. 'low' salaries of engineers, low taxation, etc) especially in the early phases of high tech development.

The stimulus to high tech operates both at the SU phase of companies (by assuring returns to inventors prior to achieving significant sales and profits) and at the post SU phase (through new possibilities for accessing/acquiring Complementary Assets). For technology & skill intensive peripheral countries access to Complementary Assets for penetrating main overseas markets (e.g. the US as in the Data Security sector focused in this paper) is crucial. Firms in these countries have a distinct *dis*-advantage in this respect compared to their competitors in Advanced Countries. The 'appropriability constraint' to inventors & first innovators of a new product class (as analyzed by Teece 15 years ago in the context of Advanced Economies) re-appears today in a different form in Peripheral Economies. On the one hand, the problem is more acute in Peripheral Economies than what it is in Advanced Economies; on the other hand, the process of globalization of Asset & Capital Markets presents new opportunities for accumulating or accessing such Complementary Assets, directly or indirectly (e.g. through an "Early IPO" strategy for very good SU companies).

The new Globalization context, however, creates new problems and challenges as well. A major one for technology & skill intensive economies of the Periphery is related to the widespread process of Acquisition of very good SU companies(which is part and parcel of the same process of globalization). The massive dimensions of this process in the last years prior to the fall of Nasdaq in 2000, raises the issue of the distribution of gains between the country generating the SU companies (the equivalent to Teece's 'inventor or first innovator' in his 1986 article) and the large IT high tech multinationals which acquired them. Is it desirable to develop a High Tech sector with a lion's share of activity devoted to the generation & sale of SU companies? Or is it important that a non-insignificant share of IT high tech activity be devoted to Downstream Production and Marketing activities, processes undertaken in post SU companies? In other words is it true that the successful adaptation of at least some small, technology & skill

intensive Peripheral Economies to the requirements imposed or the opportunities opened up by Globalization and the ongoing Technology Revolution requires not only a dynamic process of SU creation but the generation of large numbers of post SU companies including indigenous ones, some of which will become global leaders in their markets?

Some of these issues are explored both theoretically and empirically taking Israel's IT high tech cluster and its Data Security Sector (and important Software sector) as an illustration. The paper initially stresses a micro-economic, firm level analysis of Israel's Data Security sector; and only then proceeds to consider aspects of firm-cluster interactions and "macro" IT high tech issues. Company interviews, a survey of firms and additional information helped us map the whole (or almost the whole) Universe of Data Security Firms till mid 1998(19 firms). We identified the four (4) very successful ("SS") companies, which comprise the core of our micro, firm-level analysis, and which represent 80-90% of Data Security Sector activity in 1999. 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). Our research also revealed important information about the nature, timing and role of internationalization events such as Initial Public Offerings (IPOs), OEM agreements, and Acquisitions by Israeli companies(both within Israel and in the US).

The analysis of *very successful company growth profiles* (the first objective of the paper) leads to a *Main Growth Profile* characterized by an "Early IPO track" where an IPO took place shortly after completion of the Start-UP/Product Development phase (3 firms); and a *Special Case* involving an "early M&A track" rather than an IPO(1 firm). This 'early IPO track' was a necessary but not a sufficient condition for maintaining an indigenous identity. It represented a "substitute" internationalization event to an 'early M&A' strategy ; and set the base for a rapid process of market penetration and firm consolidation

We then analyze *post-acquisition* patterns of (3) very successful and moderately successful companies who were acquired (out of a total of 6 such companies in Data Security). In one case acquisition led to a significant *increase* in domestic activity (almost exclusively R&D); in another, while no significant change in activity occurred, acquisition seemed to involve a significant *loss* in

R&D Leverage *potential* that is significant increases in downstream activity & employment could be expected in the absence of the acquisition. With a lower likelihood this was also the situation with the third acquisition studied. A major gap in our knowledge concerns the loss of “R&D Leverage” potential of what seems to be the largest group of foreign acquisitions in Israeli IT high tech--good SU companies, acquired *very early* in their lifetime, with potential of generating (as a group) a non-insignificant number of indigenous, high growth post SU companies. An horizontal study across several IT high tech sectors, therefore, is required in order to answer in a more definite way the question of the distribution of benefits as a result of foreign acquisitions of very good SU companies.

In the search for answers to those and other issues pertaining to the impact of Globalization the latter part of the paper (part of Sections 4 & Section 5) proceeds to a more general and macro-economic level of analysis—again, taking Israel as an example. The focus is on the actual and ‘desirable’ share of SU output over total IT high tech output (or exports); and on accessing complementary assets. We contend that despite Israel’s Comparative Advantage in SU, that its specialization in this segment of IT activity should be Incomplete i.e. that side by side with the generation of SU who are later being acquired, a segment of growing indigenous companies with Downstream Production & Marketing activities should be developed. The crucial role of Managerial inputs (and other spillovers) flowing from such companies to SU is stressed. The analysis also suggests that the share of SU in total IT high tech during 1999-2000 was too high; and that it is bound (and should) decline in the future. The reasons for the latter are three: a) the decline of the Nasdaq index since 2000 and non-expectations of a new ‘bubble’ in the near future; b) streamlining of existing biases in Innovation & Technology Policy which focused disproportionately on R&D & ‘neoclassical market failure’ rather than on strengthening both R&D & non-R&D (e.g. management) in such a way to overcome *systemic, institutional & market failure associated with the generation of post SU companies*; and c) the increasing maturity of Israel’s high tech cluster (particularly of Venture Capital) in the sense not only of having a capability of generating SU but also of leading good SU to post SU phases and to indigenous, global company status.

### ***Implications For Other Peripheral Economies***

Our understanding of the Israeli case is still patchy, but it is clear that there were a number of factors which explain Emergence and Development of the new form of IT high tech involving large numbers of SU companies and Venture Capital. These are classified into three groups of factors: Background & Structural Conditions, Triggers and Conditions assuring Learning & Cumulativeness.

*Background & Structural Conditions(1980s):* there are two groups-large pool of engineers/R&D personnel, good Universities, and special Institutions like the Army on the one hand; and—a pre-existing high tech industry in the 80s, a backbone business firm R&D support program, a strong MNE presence in Israel (involved in IT-related R&D and product software), and the restructuring of the Military Industries in the 80s (which liberated personnel for the new push to high tech in the 90s)

*Triggers(1991093):* In Israel they involved Government programs which complemented the above mentioned Backbone R&D support program. These included a *Targeted* Program supporting Venture Capital (Yozma); and complementary programs raising the Demand for VC-services (e.g. Technology Incubators' Program)

*Conditions Assuring Learning and Cumulativeness(1993-6-):* A critical mass of SU companies appeared in the early 90s (in part due to a Cultural Change that took place in the second half of the 80s). This represented a *potential for learning*. Actual learning took place through implementation of this potential, triggered by new Venture Capital Funds created under the auspices of Yozma; and fueled by favorable changes in the *External Environment* in particular the rise in Nasdaq and deregulation of communications. Additional factors were the Oslo peace agreements, the Russian Immigration, and domestic regulatory changes.

Without systematic *Comparative Research* we cannot know which of the above factors are *Generic Conditions* which have to be present in all or most circumstances; and which are *Country Specific Conditions*. For this reason, sharp and clear implications for other Peripheral Countries cannot be concluded at this stage. However we believe that the existence of large pools of IT Engineers, good Universities and a prior High Tech or Software Industry are requirements although not sufficient conditions for Globalization, etc to induce High Tech development in a significant number of such countries. However, success in developing new high tech industries depends also on *Seizing The New Opportunities* opened up by Globalization. Thus appropriately timed trigger conditions, including policies leading

to variation & selection e.g. of new actors, organizational forms, etc must emerge; and post-trigger conditions as well, assuring Learning & Cumulativeness. Moreover, their success depends on other favorable External and Internal Conditions e.g. a rising index of Nasdaq and other factors. Without these, an infant learning & cumulative process might be truncated. Since the set of conditions seems to be quite large, the number of Peripheral Countries capable of exploiting the new opportunities for developing High Tech Industries is probably quite low.

Finally, even for those countries that will succeed to adapt and develop high tech industries—there is the question of the distribution of gains between the peripheral country and other Advanced Economies participating in the process. This was reflected in our analysis of Data Security by the high level of direct and indirect Foreign Acquisition of successful Start Up companies; and significant possible losses in “ R&D Leverage”. It is not enough to generate large numbers of very good SU for acquisition, especially ‘early acquisition’. It also is important, for direct and indirect/cluster-related reasons, to generate post SU/ downstream production & marketing activity. In fact, the Israeli experience suggests that full benefit of Globalization may necessitate, for sophisticated skill & technology intensive economies, a high tech cluster which eventually becomes mature enough to help individual companies grow fast beyond the SU phase, with the effect that some of which will acquire Global Company status.

Needless to say that the above has enormous implications for Innovation & Technology Policy for Peripheral Countries in the current phase of Globalization. It also enhances the importance of adopting an Evolutionary/Innovation Systems perspective to policy, rather than a simplistic ‘Neoclassical Perspective’ which a lot of the Economics of R&D literature adheres to.



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