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**Venture Investments in Israel - A Regional Perspective**  
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## **Venture Investments in Israel – a Regional Perspective**

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### **Abstract:**

This paper analyzes the geographic distribution of venture investments in start-ups in Israel, using data for the period of 1995-2004. The findings show that their location behavior differs from that of high-tech activities: they show a pattern of "dispersed concentration" (as compared with a pattern of "concentrated concentration" of high-tech activity), with high levels of concentration in focal places, but at a commuting distance from the main metropolis. This is explained by the fact that venture investors also play the role of entrepreneurs and managers. The comparison between different types of venture investors shows that local venture capital funds lead to the heaviest concentration in the metropolis, in comparison with foreign venture investors. This heavy concentration of venture investments implies increasing regional gaps, with a minimal participation of peripheral regions, even those that enjoy some high-tech activity.

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## **Venture Investments in Israel – a Regional Perspective**

Dafna Schwartz and Raphael Bar-El

Research and development activities, or start-ups, can certainly be classified as high-tech activity, and may be subject to quite similar influences in the decision about their location. Still, in the last few years, their increasing importance has apparently led to changes in their structure and specific characteristics. Research and development for the elaboration of a new product or a new technological process is not necessarily conducted within the framework of a high-tech firm: it may be out-sourced, or established in a separate firm (Cooke, 2005). The start-up activities have gradually developed into an industry in itself, which may sell its products to other industries. Venture capital investments have played an important role in the development of such a pattern.

High-tech activities are known for their tendency to concentrate in central locations that have specific qualities. The various factors that lead to the concentration of high-tech activities are expected to apply as well for venture investments in start-ups. We argue in this article that, although venture investors may be influenced by high-tech location factors, there are specific additional factors that affect their location decisions regarding start-ups.

The basic reason is that venture investors invest in the start-ups through equity, and as partners they are not only suppliers of capital, but in addition play the role of entrepreneurs and of managers. The location of their investments is therefore expected to be influenced by the requirements of such roles.

We define here venture investors as venture capital and private equity investors that invest in start-ups. They can be placed into four groups: venture capital funds (VC's), private investors (angels), investment companies, and corporate venture companies. The venture investors in all groups may be local or foreign. Venture investors assist the firms they are backing by providing

financial and non-financial resources in the most needed phases of their development. Consequently, they are an important factor in the development of start-ups and of the regions where such investments are made.

We analyze in this article the location considerations of venture investors in comparison with the location of high-tech activity, on theoretical grounds as well as from empirical data drawn from the Israeli experience in the last decade. In general terms, we expect to show the following patterns:

1. There generally is an accumulation effect of high-tech factors and of venture investments factors, leading to a greater concentration of venture investments in comparison with a concentration of high-tech activity.
2. The concentration patterns of venture investments are not necessarily similar to those of high-tech activity; venture investments may adopt a pattern of "dispersed concentration", choosing focal places as a function of the necessities of the role of investors as entrepreneurs or managers.
3. Different types of venture investors may require different location patterns.

For the purpose of the study, data on venture investments over the past decade in Israel (1995-2004) were used, and their spatial distribution as compared to high-tech distribution was analyzed.

### **High-tech concentration: a general background**

Knowledge-based economic activities, particularly high-tech firms, have a strong tendency to cluster, primarily around metropolitan locations and in the satellite urban ring around the main metropolitan area (see for example Bar-El & Parr, 2003; Capello, 2002; Cooke & Schwartz, 2003; Frenkel, 2001; Frenkel & Shefer, 2001; Schwartz, 2006). The main factors behind such a concentration include knowledge accumulation and knowledge spillovers,

relational capital, tacit knowledge, external learning and processes of knowledge acquisition, and innovation networks, as described briefly in this section.

Knowledge accumulation and knowledge spillovers (Quah, 2002) refer to the positive externalities firms receive in term of knowledge from the environment in which they operate. Spillovers are evidently “spatially bounded” (Baranes & Tropeano, 2003) and should be examined in terms of geographical location (Wallsten, 2001).

Relational capital (Capello & Faggian, 2005) refers to the relationship established among firms, institutions, and people "that stem from a strong sense of belonging and a highly developed capacity of cooperation typical of culturally similar people and institutions." (p. 77). Tacit knowledge (Howells, 2002; Maskell & Malmberg, 1999) refers to the knowledge that is not coded and is for the most part embedded into the nature of the economic activity. It is primarily transferred through close ongoing contacts within a certain location. Geographical proximity is important because of interactive collaboration and the significance of social and cultural bonds. When such embedded tacit knowledge is codified it can be more easily transferred, and therefore becomes “tradable”, leading to a decrease in the importance of location, concentration, or proximity to other firms. The importance of tacit knowledge may be higher in cases of academic spillovers (see Adams, 2002, for US R&D, and Kaufmann et al., 2003, for bio-tech industry in Israel).

The process of knowledge acquisition refers to channels of knowledge acquisition from external sources to the firm. Zellner and Fornahl (2002) identify three kinds of knowledge acquisition channels: recruitment of personnel, external information networks of employees, and formal cooperation between the firm and other institutional agents. The type of knowledge required in each firm determines the attraction level of specific locations. A study on mechanisms of external learning by Almeida et al. (2003) reveals that external learning actually increases with start-up size, but this may be offset by the lower motivation for informal learning. Smaller firms

use more informal mechanisms for external learning, and therefore there is a higher expectation for them to locate closer to other related firms. Proximity assists in the establishment of trust between actors of the regional network. Network interaction is embedded in social settings, allowing the development of trust. Trust between actors, according to Gössling (2004) is an efficient functional economic tool for transactions, it is equivalent to contracts, guarantees, insurances, safeguards, etc. However, Gössling claims that that this does not necessarily produce moral spill-over effects.

There is general a consensus, as described by previous studies (Harmaakorpi & Melkas, 2005; Sternberg, 2000) that innovation networks are important to business success and to the economic performance of a region. Innovation networks (Collinson & Gregson, 2003, Cooke, 2004a, 2004b) provide firms with accessibility to external resources. This is particularly important for small and medium firms, as it helps them overcome some of the disadvantages of their limited size (Havnes & Senneseth, 2001). The spatial proximity of the partners in the network is important for the establishment of innovative linkages between the partners (Sternberg, 1999). In his paper for the Canadian innovation data base, Therrien (2005) analyses whether establishments' innovation performance and innovation strategies differ according to the size of the city in which they are located. His conclusion is that the rate of innovation is not correlated with city size, but in cases where the innovation measure takes into account the importance of innovation, the size of the city does matter.

Gebauer et. al. (2005) emphasize that the investigation of the regional network has to take into account all the actors involved in the network – not only horizontal and vertical relations among firms, but also the contacts with universities and other research institutions. In addition, the role of government agencies and interest groups that provide financial support, as well as commercial and technical information, should be considered. They concluded that for the German states, regional technology policy measures have been more successful in economically better-off

large cities than in the rural areas. The basic conclusion derived from this brief survey is that knowledge economies, particularly high-tech activities, are highly spatially skewed towards metropolis regions and the urban ring around them.

### **The role of venture investors**

Venture investors are an important component in the development of start-ups and the regions where such investments are made. One of the biggest challenges for young high-tech firms in starting a new venture is building a resource base that will allow them to develop their innovation into a product with commercial potential, and to survive over the long term. The challenge is particularly difficult when the innovation is very risky in term of technology and/or market. The new venture firms encounter difficulties in securing financial resources for such investments, but even more important, they also lack managerial and business resources. The firms, often initiated by technological entrepreneurs, are in many cases characterized by inexperienced management, lack of accessibility to business networks, and immature organizational systems. According to Allen (2002, p. 189), they constitute a "liability of newness". The venture investors are expected to provide these resources.

Venture investors are not merely suppliers of capital for the new ventures – they also act as entrepreneurs and managers. Their expertise is in their ability to select firms with growth potential (Jain, 1999; Riquelme & Watson, 2002) and to improve the quality of the firm in which they invest, by providing them with the resources they generally lack and by increasing their accessibility to external resources – financial and otherwise.

The development process of start-ups is characterized by repeated efforts to secure multiple rounds of financing from various ventures investors. Frequently the investors syndicate investments. Gompers (1999) explained that syndication may be a "mechanism through which venture capitalists resolve informational uncertainties about potential investments, and/ or

mechanism through which venture capitalists exploit informational asymmetries and collude to overstate their performance to other investors." (p. 185).

Who are these venture investors? Much of the research focuses on venture capital funds and their role in the development of young technology firms. However, although venture capital funds may be important suppliers of venture investments, we find at least three other important types of venture investors. A second important source of financing for start-ups and early stage ventures are private investors, generally referred to as "business angels" (Allen, 2002; Mason & Harrison, 2000; Van Osnabrugge & Robinson, 2000). They tend to invest primarily in the early growth stages and their funding makes it possible for new ventures to move to the stage where they can attract formal venture capital including venture capital funding (Allen, 2002). The angels, who invest some of their own money and experience in entrepreneurial ventures, are relatively heterogeneous in many characteristics and often have entrepreneurial experience (Van Osnabrugge & Robinson, 2000).

A third source of venture investments for the new technology firms is corporate funding. Large corporations, in order to keep their competitiveness, often diversify their product development with technologies outside their core competencies. This is accomplished, among other ways, via investments in young small technology firms (Allen, 2002). In many cases they establish a specialized unit and allocate a special fund for this purpose – Corporate Venture Capital (CVC). The unit in these cases searches all over the world for prospective investments that will add the highest potential added value to the company. However, the most important value added that corporate venture capitalists bring to the new start-ups is in building credibility and capacity, and in providing technical support-growth-focused activities, as compared with venture capital funds, which focus more on finance raising, recruiting key employees and professionalizing the organization (Maula et. al, 2005). A fourth source of investors may be regular investment firms. All four types of venture investors may be either local or foreign.



Another source of financing is the public sector through various programs and schemes such as grants for R&D and technological incubators programs. This topic is beyond the scope of the current paper.

Venture investors of all kinds invest in the young technology firms through equity, and, as partners, play roles that extend beyond those of traditional financial intermediaries in the development process of the venture they back. Through their involvement, they are able to directly or indirectly assist the start-ups in the areas in which they need support.

The involvement of the venture investors may take different forms and can range from minimal periodical review of financial statements and provision of non-financial assistance when needed, to a highly active role in operations (Allen, 2002; Branscomb & Auerswald, 2001; Brierly, 2001; Gompers & Lerner, 1999; Helman & Puri, 2002a, b; Lindstrom & Olofsson, 2001; Sapienza, 1992; Sapienza et al., 1995; Van Osnabrugge & Robinson, 2000; Wang et al., 2002). They are more intensively involved when the need for overseeing is greater (Gompers & Lerner, 1999), such as when top managers are replaced. According to Lulfesmann (2000), their engagement becomes more important as the firm matures. They are active in assisting or rescuing the firms with rescue additional resources from other investors. They have a special role in the process of initial public offering (IPO) (Shepherd & Zacharakis, 2001), in the survival of an initial public offering of firms (Jain & Kini, 2000), and frequently in market capitalization (Lange et al, 2001).

The investors operate by using their own and other resources through their networks. They use their networks not only in evaluating potential deals and access to additional financial resources, but also, importantly, in building companies in which they have invested by providing them with access to networks of contacts, making introductions, and attesting to quality (Branscomb & Auerswald, 2001). Their networks expand beyond the region and can provide the necessary conditions for the new start-ups to grow, since local conditions that generally stimulate

the performance of mature companies may not be appropriate for the development of new ventures (Stuart and Sorenson, 2003).

### **Main factors in the location of venture investments**

Venture investments are part of high-tech activity and therefore they also have a tendency to concentrate (Mason & Harrison, 2002). We do not intend in this article to elaborate on the implications of such a concentration on regional gaps or on the need or efficiency of various public policies that are intended to reduce them (Mason & Harrison, 2003, Murray, 1998). Since venture investors, as partners in the venture, act as entrepreneurs and managers in addition to their role as capital providers, the location of their investments depends on one hand on factors that influence location of capital, and on the other hand on factors that influence location of entrepreneurship and management.

Capital is relatively more mobile than other production factors and is attracted to the location of high-tech activities with the highest return. This is mostly the case in the vicinity of metropolitan centers, as described above. Entrepreneurship and management are subject to a much lower level of mobility. Venture capital investors depend on the physical mobility of the entrepreneurs and of the managers themselves, and therefore tend to locate where most of the activities of the entrepreneurs are concentrated, since proximity is an important factor.

As already explained, it is advantageous for new small high-tech firm to locate in central urban places, in proximity to other high-tech firms. However, in the case of venture investors there is another factor to be considered: they have to remain in frequent contact with the firm they backed, in order to maximize the return on their investment. Geographical proximity of the investors to the location of the firms they back is important, both for the selection process and because of day-to-day commitments. The transaction costs associated with frequent visits and intensive involvement are likely to be reduced if venture investors are close to the firms in their

portfolios. Distance decreases the ability of the venture investors to be actively involved in the portfolio firms. Gompers and Lerner (1999) show that geographical proximity is an important determinant of venture capital funds' involvement in board membership: organizations with offices within five miles of the firm's headquarters are twice as likely to be board members as those who are located more than 500 miles away. Over half of the firms in their sample have venture directors with an office within sixty miles of their headquarters.

Proximity is also important due to the asymmetric information between the investors to the firm and the need of the investors for control in order to reduce the uncertainty of their investments (Allen, 2002). Proximity is important due to the tacit nature embodied in the venture investors' activities (see Zook, 2004, for the internet industry, and Powell et al., 2002, for US biotech firms). They are actually considered to be “tacit information brokers, who acquire and create knowledge about industries, market conditions, entrepreneurs, and companies, through a constant process of Marshallian interaction and observation. This knowledge is then used to select companies and industries with the highest potential returns and assist them in their expansion” (Zook, 2004, pp. 628-629).

Since proximity to the firm portfolio and to the other entities in the region is important, venture investors prefer to invest close to their own location. This is particularly true for venture capital funds who prefer to invest close to the locations of their offices or to locations where they have most of their investment portfolios, and especially for angels who prefer to invest close to their place of residence (Branscomb & Auerswald, 2001). The venture capital funds, as well as the angels, probably prefer to concentrate their portfolio investments in close proximity between each other, reducing the transaction cost associated with distance.

The proximity to the investors' location may be less crucial to corporate venture capital, especially for the foreign companies, which in any case invest far away from the headquarters of the firm. In addition, since they operate in the same or similar industry as the new venture, they

understand the nature of the venture better than the venture capital funds or the angels do. Therefore, information asymmetries are reduced and the corporation is in a better position to control its investment (Allen, 2002).

The ability of venture investors, particularly the venture capital funds and angels, to supply their added value inputs depends upon the regional network and the quality of their networks, and is greatly facilitated by geographical proximity (Zook, 2004). The existence of a focal growth place, institutions or other firms' growth centers, are important because of the wide system of relationships venture capital investors have (Branscomb & Auerswald, 2001; Zook, 2004).

Since syndication between several investors in each start-up is quite common, venture capitalists tend to invest close to each other. The development process of a start-up is an ongoing process of rescue finance from various entities, and it is common that financing involves a "syndication" of two or more venture groups (Gompers & Lerner, 1999). The proximity between the investors facilitates these interactions and facilitates the ability of the investors to be close to the firms which they back.

The conclusion derived from the survey presented above is that the special entrepreneurship and management role of venture investors may lead to a higher level of concentration of start-ups (as compared with high-tech activity), but at the same time it may lead to very specific locations close to the residence of investors, to their offices, to their other activities, or to the location of other investors. We would therefore expect two apparently contradicting phenomena: concentration on one hand, and focalization in a few specific places on the other hand. We shall next test the existence of such geographical behavior using Israeli data.

## **The Israeli context**

Israel has a population of about seven million inhabitants, within an area of about 20,000 km<sup>2</sup>, distributed across six statistical districts which are divided into 15 sub-districts (the West Bank and Gaza are not included in Israeli statistics, with the exception of East Jerusalem, which is included in the Jerusalem District). The main urban center is the city of Tel-Aviv, which, together with a few smaller centers, forms the continuous urban area of Greater Tel-Aviv (the Tel-Aviv District). This has a population of 1.2m, concentrated in an area of 170 km<sup>2</sup>. Thus, almost a fifth of the population is concentrated in less than 1% of the area of the nation, representing a high density of seven thousand persons/km<sup>2</sup>. The Central District includes a wide area surrounding the Tel-Aviv District, with four sub-districts. Its population is greater than that of the Tel-Aviv District (about 1.6m), although it is distributed over an area almost eight times larger. Most of the population is urban, and is distributed among centers located within commuting distance of Tel-Aviv, the largest city being Rishon Lezion in the sub-district of Rehovot, with a population of around 190,000. Compared to the Tel-Aviv District, population density is relatively low (about one thousand persons/km<sup>2</sup>), although it is still greater than that of other districts with the exception of the Jerusalem District.

Other major urban concentrations in Israel are Haifa and Jerusalem. Haifa is surrounded on the landward side by the Northern District. The Jerusalem District includes the capital city and its hinterland. Finally, the Southern District, with 2 sub-districts which cover the majority of the nation's area and includes the Negev desert, has an extremely low population density. Most of its population lives in small towns, and the largest urban center, Beer-Sheva, has a population of about 180,000. It is probably best viewed as an auxiliary metropolitan area, which has the potential to become the focus of a wider urban center, particularly if the current growth of the Southern District is sustained.

Since the beginning of the 1990s Israel has experienced a rapid growth in the high-tech sector, reaching a share of 9% of total employment in 2004, as compared with 6% in 1995. This is a higher share than that of most European countries. Israel has even been called "the world's most vital place for entrepreneurship" (Haour, 2005). This process has been characterized by a rapid increase in the number of start-ups. This trend was also accompanied by growth in the venture capital investor industry: angels, venture capital funds, and others. The number of start-ups grew from approximately 300 in 1991 to over 3,000 to date. The number of VC funds during this period increased from just two to over one hundred (Avnimelech & Teubal, 2004 a, b).

Previous studies have found that the emergence of the venture investment industry in Israel, including emergence of venture capital funds, is considered to be the most successful instance of diffusion of the Silicon Valley model of venture capital outside of North America (Avnimelech & Teubal, 2004a, b; Bresnahan et al., 2001; Carmell & de Fontaenet, 2004). The portion of venture investments as a share of GNP is very high (OECD 2003) – an average of 1.4% during 1999-2004, which is much higher than the US and EU country averages for this period (Avnimelech & Teubal, 2004 a, b). Most of the Israeli venture capital funds are located in the Tel-Aviv metropolitan area.

The Israeli experience has aroused much interest in academic research as well as among the policy makers concerning the role of public policy, the role of the investors who provide non-financial assistance, the role of intense networking, and transfer of military technologies (Haour, 2005).

## **Data and Methodology**

In this article we use two types of data bases: investments of venture investors in start-ups, and employment data.

*The start-up data base:*

We collected venture investment cases in Israeli start ups over the past decade (1995-2004). The development process of start-ups is characterized by repeated efforts to secure multiple rounds of financing. For the sake of this study, the term "case" is used to refer to each time the firm secures financing. In each case, the financing may be provided by several investors, and it may also be allocated by quota. However, in the context of this study it is considered as a single case. In each investment case as defined here, finance may be provided by various sources (such as a private investor and a venture capital fund, or a few private investors). Such investors may act in any investment case separately or in syndication between them.

For each investment case, we collected the following information: identification of the firm in which investment was made, year of investment, amount of investment, location of the firm in which investment was made (the district and the sub-district), sector of the investment, number of employees that are presently employed by the firm, and type of investors that are investing in the current round.

Based on this information, we calculated for each district and for each sub-district the Venture Investments (VI) in start-ups during the investigated period, the total investment, and, by investor categories, the number of companies in which the investment was made, and the number of employees in these firms. The data for each investment include all the obligations of the investors to the venture in the current round (include the initial payment and future milestone payments of the current round).

The information used in the study for the start ups is drawn from the IVC Online database. This is a unique data base conducted by the Israel Venture Capital Research Center.

Definitions:

For the sake of this study, we define start-ups as young small- and medium-sized high-tech firms that develop a highly advanced, innovative technology or device through their investment in extensive research and development activity. We define young firms as those that were established after 1991, and the definition of small- and medium-sized firms was adapted from the Small and Medium Business Authority in Israel – firms with less than 100 employees (as of May 2005). A firm is considered as Israeli, following the IVC definition, if it is registered in Israel or has at least one of the following characteristics: headquartered in Israel, has an R&D center in Israel, has a senior Israeli management, or receives funding from an Israeli company.

We divided the venture investors into categories, based on the IVC classification:

- (1) VC – Venture Capital Funds that supply finance and other business services to start-up firms and small businesses with exceptional growth potential.
- (2) CVC – A subsidiary of a large corporation that makes venture capital investments.
- (3) PRI – These are private investors, such as angels, key executives, service providers, and other private equity investors.
- (4) INV – Investment, holding, and management companies. Investment companies are firms that invest the pooled funds of retail investors for a fee. Holding companies are companies that own enough voting stock in another firm to control management and operations by influencing or electing its board of directors. Management companies are firms that organize, manage, and administer a mutual fund.

We excluded from the analysis investment cases of institutional investors such as technology transfer companies and governmental bi-national funds.



*The employment data base:*

We collected data on employment in each district and sub-district: total employment in all sectors (ET) and employment in high-tech sectors (EHT), as defined by the Israeli Central Bureau of Statistics (CBS).

The definition follows an ISIC classification and includes two main groups (a wider definition of "knowledge based economy" is provided by Cooke et al., 2001 and OECD, 1999). The first is manufacturing: manufacture of office, accounting, and computing machinery (30) (the number appearing in parentheses is the ISIC definition), manufacture of radio, television, and communication equipment and apparatus (32), manufacture of medical, precision, and optical instruments as well as watches and clocks (33), and manufacture of aircraft and spacecrafts (353). The other group is services, e.g., telecommunications (642), computer and related activities (72), and R&D (73).

Employment data is based on the labor force surveys conducted by the CBS. A special sub-district analysis for 1995-2003 was performed for this study by the Israel Social Science Data Center of the Hebrew University of Jerusalem. The data for 2004 was not available for this specification.

*Geographic definition:*

Israel, according to CBS, is divided into six districts (the West Bank and Gaza are not included and not defined as Israeli territory). Four of those districts are considered "centers": Tel-Aviv, Central (actually a suburb of Tel-Aviv), Jerusalem, and Haifa. The two other districts are considered to be part of the "periphery": the Northern and Southern districts.

Each district is divided into sub-districts, for a total of 15 sub-districts: Eight in the center and seven in the periphery. Three of the sub-districts in the Northern district (Zefat, Kinneret, and

Golan) were joined into a single group, as they are very small in terms of population and investments.

### Methodology

We test the level of regional concentration of start-up (SU) activities in comparison to that of high-tech activities (HT) and that of total economic activities (T) first by using their distribution between the six districts of Israel ( $i=1 \dots 6$ ), and at a further stage between the 13 sub-districts. We begin with employment data, comparing the share of each district (sub-district) in total employment in the country for each type of activity:

$\%ET_i$ : the share of district  $i$  in total employment.

$\%EHT_i$ : the share of district  $i$  in high-tech employment.

$\%ESU_i$ : the share of district  $i$  in employment in start-ups that enjoyed any level of investment in the research period.

In addition, we calculate the share of each district in investment in start-ups:

$\%ISU_i$ : the share of district  $i$  in investments in start-ups during the research period.

Using these basic distributions, we evaluate regional concentration levels by using location quotients to compare between couples of distributions:

$LQ(EHT/ET)_i = \%EHT_i/\%ET_i$  is the location quotient of high-tech employment in district  $i$  in relation to total employment in that same district. A value higher than 1 would naturally indicate a district with a relatively higher level of concentration of high-tech employment in comparison to its share of total employment. Similarly:

$LQ(ESU/ET)_i = \%ESU_i/\%ET_i$  is the location quotient of employment in start-ups in which investment was made in the research period in district  $i$ , in relation to total employment in that same district.

$LQ(ESU/EHT)_i = \%ESU_i/\%EHT_i$  is the location quotient of employment in start-ups in district  $i$ , in relation to employment in high-tech activities in that same district. If the start-ups' activity follows the same regional pattern of high-tech activity, we would find here a value of 1 for each of the 6 districts, in parallel with a similar distribution of start-ups' employment and high-tech employment.

$LQ(ISU/EHT)_i = \%ISU_i/\%EHT_i$  is the location quotient of investments in start-ups in district  $i$ , in relation to employment in high-tech activities in that same district. Higher levels of this parameter in comparison with the preceding one would indicate the existence of higher levels of investment per worker in that district.

Finally, we use two measures for the global concentration of each of the activities:

CV: the coefficient of variation of each distribution, as defined by the ratio of the standard deviation of each distribution by the average regional value.

LC: the location coefficient for each distribution, as defined, for example, for the distribution of employment in start-ups in relation to employment in high-tech:

$$LC(ESU/EHT) = \Sigma(\%ESU - \%EHT)/200.$$

While the CV is a pure measure of distribution between districts, LC takes into consideration the relative level of employment in each district: a relatively high level of concentration of start-ups in a "small" region would have a lower impact on LC than on VC.

### **Concentration levels of venture investment backed start-ups**

The population includes 2695 investment cases in 1239 firms. The total number of employees in these firms in May 2005 was 29,668 employees. We have the information of the amount that was invested for 83% of the investment cases, reflecting a total investment of \$10,942 billion (467 investment cases – for 17% of the cases the information is missing). The

average number of employees per firm is 23.95 (standard deviation of 21.86). The average amount of investment (per case) is \$4.91 million (standard deviation of 6.12).

We begin by analyzing the regional distribution of venture investments backed start-ups with that of high-tech employment and that of total employment. The main results for the distribution by districts are shown in Table 1.

Insert Table 1 about here

The findings of the table illustrate the well-known phenomenon of concentration of high-tech employment in and around a metropolitan region, in this case of Tel-Aviv (Cooke & Schwartz, 2003): about 63% of all high-tech employment is located in two districts, the district of Tel-Aviv and the nearby Central district, as compared with about half of total employment. In general, the concentration of high-tech activity does not necessarily have to be in or around the metropolitan center. It is, however, the case in Israel, where the city of Tel-Aviv and its surrounding sub-districts have developed as a cultural, social and economic center. Other urban centers such as Haifa and Jerusalem play a relatively minor role in high-tech activity. The more interesting phenomenon we can see in terms of  $LQ(EHT/ET)$  is the fact that the heaviest relative concentration is actually in the district of the Center, near Tel-Aviv but not in the district of Tel-Aviv itself: we find there the highest location quotient of 1.49, while in Tel-Aviv the quotient is quite close to 1, showing a frequency of high-tech employment which does not differ significantly from the frequency of total employment. This perfectly fits the concept of Metropolitan Based Region (MBR) as shown by Bar-El and Parr (2003), explaining the existence of a process of transition of economic activity from the core of Tel-Aviv to the nearby region. All other districts show a location quotient of less than 1 – in the urban centers of Jerusalem and Haifa as well as in the peripheral Northern and Southern districts.

The next columns in the table quite clearly support our thesis that the districts with the higher relative specialization in high-tech activity (higher than 1 value of  $LQ(EHT/ET)$ ) enjoy an

even higher level of concentration of start-ups: the values of  $LQ(ESU/ET)$  are higher than those of  $LQ(EHT/ET)$  for all the districts where those are higher than 1 (Center and Tel-Aviv), and lower for almost all the districts where they are lower than 1 (with the slight exception of Jerusalem). The fact that start-up investments lead towards a higher level of concentration can also be seen in the values of the coefficients of variation (CV of 0.65 for start-ups against 0.34 for high-tech) and of the location coefficients (0.24 as compared with 0.13).

This same trend can be seen in the columns of the location quotient of start-ups (employment as well as investments) in relation to high-tech ( $LQ(ESU/EHT)$  and  $LQ(ISU/EHT)$ ). A similar regional distribution of start-up and of high-tech activities would have resulted in a value of 1 for all districts. Instead we again find higher values than 1 for the districts with the highest concentration of high-tech employment. The consequence is a concentration of about 73% of all start-up employment and investments in the two districts of Tel-Aviv and the Center (compared with 63% for high-tech and 50% for total employment), and much lower frequencies in the other urban centers and in the peripheral districts, especially in the relatively remote Southern district: 2% of start-ups, compared with almost 10% of high-tech and 12% of total employment.

The conclusion of this section is that there actually is an apparent accumulation of location effects: those that explain the concentration of high-tech activity and those that explain the concentration of venture investments, as described above. The concentration of high-tech activity is explained by arguments such as spillovers or tacit knowledge, and beyond those, the concentration of venture investments is also intensified by the argument of the entrepreneurial role that has to be played by investors and by the importance of their proximity to the firms. The empirical results of the analysis of the regional distribution of high-tech activity as compared with the regional distribution of venture investments in Israel actually illustrate the existence of such patterns.

## **Dispersed concentration vs. concentrated concentration**

After having shown the existence of a heavier concentration of venture investments in start-ups in comparison with high-tech activities, our next goal is related to the pattern of concentration of such investments. We check now the hypothesis that the concentration of start-ups is not necessarily constrained to the Central metropolitan core, but is rather distributed in a few focal points that are not necessarily all focal points of high-tech activity. In order to test the existence of such a pattern, we divide the districts above into their sub-districts components (a total of 13) and apply the same parameters to the smaller geographical units. Results are shown in Table 2.

Insert Table 2 about here

The results of Table 2 indicate the existence of quite clear differences between the patterns of location of high-tech activities and those of the start-ups backed by venture investors. High-tech activity seems to be following a pattern of "concentrated concentration": the concentration of high tech activity in the district of the Center at a near proximity to Tel-Aviv covers most of the area of this district, but one of the sub-districts, Sharon, has a quite poor relative representation of high-tech activity. On the other hand, as can be seen in the column of LQ(EHT/ET), none of the other sub-districts in all other regions has a location quotient of 1 or more. We therefore defined this situation as a "concentrated concentration", where only four out of all sub-districts (including the district of Tel-Aviv which includes only one sub-district) specialize in high-tech (in terms of possessing a higher than 1 location quotient), all of them in the metropolitan region, and all of them form a continuous homogeneous geographical area, as can be seen in Figures 1 and 2.

Insert Figure 1 and Figure 2 about here

In the analysis of the data at the level of whole districts, the spatial behavior of start-ups (as defined by venture capital backed firms) has shown an apparent pattern of intensified

"concentrated concentration" (higher levels of location quotients in comparison with the spatial behavior of high-tech activities). However, an analysis of the detailed sub-district data shows a completely different picture, as can be seen in Table 2:

- Start-ups are relatively much more highly concentrated in only two of the high-tech intensive sub-districts, Petah Tikva and Tel-Aviv (remembering that Tel-Aviv itself has a level of relative concentration of high-tech which is only slightly higher than the average).
- Start-ups show a quite low relative frequency in the sub-district with the highest concentration of high-tech employment, Ramla. A location quotient of start-ups of less than 1 is also found in Rehovot, one of the concentrations of high-tech activities.
- Some sub-districts outside the metropolitan area, in which we find low levels of relative frequency of high-tech employment, are clearly prioritized by venture investors: Sharon, Yizre'el, and Hadera. This last sub-district has a location quotient of only 0.62, but this is much higher than the location quotient of high-tech employment (0.23).

These results are strongly emphasized by the location coefficients of start-ups in relation to high-tech, which reveal much higher values than the analysis based on districts. Both the coefficient of variation and the location coefficient are much higher for sub-districts than for districts, indicating a high level of variation. Furthermore, we find that the coefficients based on investments (last column) show in most cases higher values than those based on employment, indicating higher levels of investment per worker in those sub-districts that are preferred by venture investors.

We define as "dispersed concentration" this pattern of spatial distribution of venture investments, where a few sub-districts are strongly preferred over others. Those sub-districts are not necessarily all located in the metropolitan center, and there is not necessarily any geographical continuum between these locations. However, in spite of the relative "dispersion" of the venture investments, they are quite heavily concentrated in a few sub-districts that are not spread all over

the country. There is a quite clear location pattern which can be formulated in the following way: *Venture investments tend to locate in places with a high level of accessibility to the Metropolis of Tel-Aviv, but not all places with a high level of accessibility to the Metropolis are necessarily preferred by venture investors.* Even the sub-district of Yizra'el, formally defined as part of a "peripheral" district (the Northern district), is located at a quite accessible distance from Tel-Aviv (and from Haifa). On the other hand, bigger urban centers such as Haifa and Jerusalem, as well as remote locations in the Southern and Northern districts, do not enjoy a high relative level of attractiveness for venture investments.

These results actually demonstrate the strength of influence of "entrepreneurial" factors on the location of venture investments, much beyond the high-tech location factors. There is a clear concentration of venture investments, but they are mostly found in focal places, as a function of the needs of the venture investors. The next section will be dedicated to explaining the selection of such places.

## **Location patterns and types of venture investors**

In general terms, we explained the tendency of venture investments to be more concentrated and focalized as a function of the "entrepreneurial effect": venture investors actually play the role of entrepreneurs or of managers in the firms in which they invest, and therefore they would prefer that their investment projects be located closer to their living place or to the place where they have other investments or other partners (all this, above and beyond the traditional location factors of high-tech activity). However, as described above, we find various types of venture investors, and each of them may have different considerations regarding the location of their activities.

In this section, we shall therefore try to understand the location patterns of venture investments as a function of the same specific characteristics of ventures investors: the tendency



of syndication between various investors that may imply concentration, the share of Israeli Venture Capital Funds and of private investors that may lead to a heavy concentration within the Metropolis, and the share of corporate investments and foreign Venture Capital Funds that may be less sensitive to central locations.

We define seven types of venture investors:

- a. VC.is: Israeli venture capital funds.
- b. VC.fo: Foreign venture capital funds.
- c. CVC.is: Israeli corporate firms that make venture capital investments.
- d. CVC.fo: Foreign corporate firms that make venture capital investments.
- e. INV.is: Israeli investment firms.
- f. INV.fo: Foreign investment firms.
- g. PRI: Private investors (otherwise called "angels"), mostly Israeli.

The following table shows the share of total venture investments in which each type of investors was involved. An investor may invest alone in a start-up, but he generally invests in syndication with or in addition to other investors, from one or more other types. The total of investments therefore does not equal 100%.

Insert Table 3 about here

The first column of the table shows the percent of investments out of the total (about 11 billion dollars) in which each venture was involved. As an example, we can see that Israeli Venture Capital Funds (VC.is) participated in 68% of venture investments during our period. This means that if we take all cases in which a venture investment is made, and select those in which the Israeli VC took part, these would represent 68% of total investments made. This does not mean, of course, that the Israeli VCs invested 68% of all venture investments, since a significant part of such investments are made together with other investors, whether they share the transaction and syndicate for this purpose, or they operate separately (unfortunately there is no

access to data on the exact sums invested by each investor in each project). We can see that the Israeli VCs are in fact the leading group of investors in start-ups, showing that only about a third of all investments are made without their participation. The next biggest groups of investors are the private (PRI) investors (or "angels"), with an involvement in 41% of all investments, and then the foreign VCs with an involvement in 37% of all investments.

The next columns show the various combinations between types of investors, and the share of total investments in each such combination. The figures on the diagonal (in bold font) show the share of investments made by one type of investor alone with no participation of others (although this may be a joint group of investors of the same type). Both sides of the diagonal are naturally symmetrical. The total of each row is always higher than the total shown at the first column, since shared investments may involve more than two groups of investors. For example, the first row, showing a participation of Israeli VCs in 68% of all investments, actually adds up to 117%, because every investment in a specific start-up made by two or three investor types, for example, will appear twice or three times.

The figures on the diagonal (in bold font) give us an indication of the leading role of Israeli VCs and of private investors: there are quite few investments that are made by a certain type of investors with no participation of other types of investors (29%, the total of the diagonal), but most of them are Israeli VCs (12%) or private investors (9%). All other investor groups seldom make any investments without cooperation with others. The great majority of investments (71%) are made by participation of various types of investors. Even among the 29% of investments made with no participation of other types of investors, we may find participation of investors within the same type: it is common that two or more Israeli VCs, or two or more "angels", collaborate in one investment. As explained earlier, those investors do not only play the role of finance suppliers, but also one of entrepreneurs and active participants in the management

of the start-ups: this collaboration leading pattern requires almost day-to-day interaction between them, and therefore implies the concentration of most of the partners in focal points.

The various types of investors do not necessarily act simultaneously. The private investors (angels) probably are more dominant in the early phases of the start up development, and are followed by other investors in the later financial rounds (Allen, 2002). A separate calculation of the share of each type of investors at various phases of the start-ups development actually shows that private investors are involved in about half of the investments in the first year of the start-ups, and their share decreases in later years when other types of investors join them. The Israeli VCs show an inverse pattern: although they are heavily involved even in the first year of the start-ups activity (about half of the investments), their share grows to the heaviest rates at later stages (three quarters of investments in the fifth year).

We will now examine the regional distribution of investments in which each of the investors groups are involved. Results are presented in Table 4.

Insert Table 4 about here

The results of the table support to a large extent the expected behavior of Israeli VCs: analyzing the column of the distribution of investments with Israeli VC backing among the sub-districts shows a relatively heavy concentration in Tel-Aviv (37%) in comparison with all other types of investors. This is fully coherent with the findings of Schwartz (2006) showing a heavy concentration of high-tech services activities, and mostly of business services, in the sub-district of Tel-Aviv (VCs are defined as business services), and much less in other urban centers or in the Central district. In fact, the great majority of venture capital funds are located in offices in the sub-district of Tel-Aviv (including mostly the city of Tel-Aviv itself and the nearby city of Herzliya): 112 funds are located there, out of a total of 139. The active role of VCs in the routine management of start-ups apparently leads them to prefer investments in close by start-ups, or to the relocation of start-ups to close-by locations.

Since the Israeli VCs are involved in the majority of investments made by other types of venture investors, they certainly influence the location of most ventures in the same way. Still, we can find in the table different patterns of location in accordance with the various types of investors.

First, the private investors ("angels") are expected to locate closer to their living location. The common pattern in Israel is that employment, especially in business services, is mostly located within the metropolitan center of Tel-Aviv, while housing, especially that of higher classes, is mostly located in the suburban environments within the Central district. The results in the table for the distribution of investments backed by private investors are not quite clear: there actually is quite a relatively high share of investments in one of the Center's sub-district, Rehovot, with 9% of investments as compared with about 6% for the total, but there is no clear pattern for other sub-districts.

A much clearer picture is shown for the investment patterns of foreign investors. Actually, the relatively high levels of venture investments in focal points outside the metropolis (Petah-Tiqva, Sharon, Yizra'el) are due to a large extent to the involvement of foreign investors. These are not linked to a specific location of their offices, but rather to the location of other elements such as other partners, other investments, and the existence of a focal growth place. The relatively high share of venture investments in the regions of Petah-Tiqva and Sharon (as compared with total employment and with high tech employment) is mostly a result of high investment levels of foreign CVFs (we note also the participation of Israeli corporate investments, but these are quite marginal). The relatively remote region of Yizra'el enjoys quite high levels of venture investments from all types of foreign investors: corporate venture capital investors (CVC.fo) that provide the highest share to this sub-district (21.5%), and also foreign investment firms (INV.fo) and foreign venture capital funds (VCF.fo).

Summarizing the findings in this section, we can say that the lack of detailed data about the exact sums of investments made by each type of investors imposes a serious constraint on our ability to show very clear location patterns of various types of venture investors. Still, we can indicate a few signs showing that their behavior at least does not contradict the theories presented above. Israeli venture capital funds do tend to locate closer to their offices in the metropolitan center of Tel-Aviv, while foreign investors seem to be less constrained to Tel-Aviv and locate also at other regions, following focal centers of activity.

### **Conclusion: The encounter between regional macro-economic factors and business administration**

The location decision of firms is naturally influenced by micro-economic or business considerations, the ultimate objective being the maximization of profits. This does not contradict the fact that the spatial distribution of economic activities in a country, and especially that of high-tech activities, has always been heavily influenced by regional macro-economic factors – such as the availability of infrastructures of various kinds, the accessibility to research institutions, the supply of highly skilled labor force, and the existence of agglomeration economies, etc. These and other factors actually lead to a pattern of quite heavy concentration of the high-tech activity, as compared with other types of economic activities, mostly in and around metropolitan centers. This same pattern has also been identified in the case of Israel.

Start-up activities are considered to be a leading engine for the future growth of high-tech activity. In this article, we have tried to initiate some preliminary evaluations of their location trends: Are they following the same trend of heavy concentration, or are they bringing any indication of new trends? Since start-ups are themselves high-tech activities, they are also naturally subject to the same macro regional factors that lead to concentration. However, the results of this article tend to indicate the additional influence of business administration type of

factors. When taking a location decision, every firm naturally considers its micro-business specific needs in the regional environment, but in the case of start-ups there seems to be a new dimension to such considerations: the nature of venture investments is different from that of "regular" financial supply. Venture investors play an important role in entrepreneurship and management of the start-ups, and consequently the location of their investments is apparently heavily biased towards the location of their residence or the location of their other activities. We are probably witnessing here the beginning of a new rule of geographical location, where "personal" considerations may divert the spatial structure. As a consequence, we find a heavy concentration of venture investments, but this was diagnosed as a "dispersed concentration", with a pattern of focal places and with no necessary continuum between them, compared with the "concentrated concentration" of the high-tech activity. The important influence of such personal micro-business considerations in location decision is emphasized by the differences between the various types of venture investors.

Such location behavior may lead to changes in the geographical mapping of high-tech activity and possibly to the increase of regional gaps. This is an important implication because of the suspicion that we may be experiencing here a market failure. The fact that venture investments are found in some focal places does not necessarily imply that other regions do not possess the necessary qualities for the long-term development of start-ups and high-tech activity. This may just be the result of the fact, for example, that venture capital funds are almost all concentrated in one region. Public involvement in the establishment of venture capital funds (this has already been done in the past) in other regions may induce some change in that picture (see Sunley et al., 2005, for the approaches to such a policy in the UK and in Germany, and the failure to achieve a closing of regional gaps).

We can not yet recommend the establishment of such new funds by the public sector, – we are still quite far from having all the required appropriate research conclusions. This article has

attempted to initiate some thinking about the location trends of venture investments that may draw a new economic geographic picture in the coming years. We consider this work mostly as exploratory, since research in this field is still at its beginning stages. Many important issues have yet to be investigated – beginning with the analysis of failure or success of such start-ups at different conditions, through the consideration of the impacts on regional development, and until the development of methodological instruments that could reduce the limitations of location quotients and coefficients.

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Table 1: Distribution and location measures of ET, EHT, ESU, ISU by districts

District	Distributions (%)				Location quotients			
	% ET	% EHT	% ESU	% ISU	LQ(EHT/ ET)	LQ(ESU/ ET)	LQ(ESU/ EHT)	LQ(ISU/ EHT)
Jerusalem	10.9	7.4	8.0	8.7	0.68	0.74	1.09	1.18
Northern	13.7	9.6	8.8	9.8	0.70	0.64	0.91	1.02
Haifa	13.7	11.0	7.3	6.3	0.80	0.54	0.67	0.57
Central	21.9	32.6	37.1	38.7	1.49	1.69	1.14	1.19
Tel Aviv	27.7	29.9	36.5	34.2	1.08	1.32	1.22	1.14
Southern	12.2	9.5	2.3	2.4	0.78	0.19	0.25	0.25
Total	100.0	100.0	100.0	100.0	1.00	1.00	1.00	1.00
Absolute total (,000)	2,040	155	30	11				
CV					<i>0.34</i>	<i>0.65</i>	<i>0.42</i>	<i>0.44</i>
LC					<i>0.13</i>	<i>0.24</i>	<i>0.12</i>	<i>0.12</i>

Table 2: Distribution and location measures of ET, EHT, ESU, ISU by sub-districts

District	Sub-district	Distributions (%)				Location quotients			
		% ET	% EHT	% ESU	% ISU	LQ(EHT/ET)	LQ(ESU/ET)	LQ(ESU/EHT)	LQ(ISU/EHT)
Jerusalem	Jerusalem	10.9	7.4	8.0	8.7	0.68	0.74	1.09	1.18
Northern	Zefat, Kinneret,								
	Golan	3.7	1.4	0.2	0.0	0.37	0.07	0.18	0.02
	Yizre'el	5.0	4.5	7.3	8.9	0.90	1.45	1.62	1.98
Haifa	Akko	4.9	3.7	1.2	0.8	0.76	0.24	0.31	0.22
	Haifa	10.4	10.2	5.4	3.7	0.98	0.51	0.52	0.36
Central	Hadera	3.3	0.8	2.0	2.7	0.23	0.62	2.68	3.52
	Sharon	4.2	2.2	5.6	6.9	0.52	1.34	2.57	3.18
Central	Petah								
	Tiqva	8.1	14.4	22.1	23.0	1.79	2.74	1.53	1.60
	Ramla	3.8	8.7	3.6	2.7	2.26	0.95	0.42	0.31
	Rehovot	5.8	7.4	5.8	6.1	1.26	0.98	0.78	0.83
Tel Aviv	Tel-Aviv	27.7	29.9	36.5	34.2	1.08	1.32	1.22	1.14
Southern	Ashqelon	5.4	3.8	0.9	0.9	0.71	0.16	0.23	0.23
	Beer-Sheva	6.8	5.7	1.5	1.5	0.84	0.22	0.26	0.27
Total		100.0	100.0	100.0	100.0	1.00	1.00	1.00	1.00
CV						0.59	0.84	0.84	1.01
LC						0.15	0.27	0.22	0.25



Table 3: Percent of investments by type of venture investors

Venture investor	% of total	together with						
		VC.is	VC.fo	CVC.is	CVC.fo	INV.is	INV.fo	PRI
VC.is	68	<b>12</b>	29	5	11	22	15	23
VC.fo	37	29	<b>2</b>	3	9	9	10	14
CVC.is	6	5	3	<b>0</b>	1	3	1	2
CVC.fo	16	11	9	1	<b>2</b>	4	5	6
INV.is	31	22	9	3	4	<b>3</b>	5	12
INV.fo	18	15	10	1	5	5	<b>1</b>	7
PRI	41	23	14	2	6	12	7	<b>9</b>

Table 4: Distribution of investments backed by sub-districts and by backing investor type (%)

Sub-district	Total	VC.is	VC.fo	CVC.is	CVC.fo	INV.is	INV.fo	PRI
Jerusalem	8.7	7.0	8.6	11.2	8.7	9.8	8.5	9.2
Zefat, Kinneret, Golan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yizre'el	8.9	7.7	10.2	4.8	21.5	11.8	13.5	10.2
Akko	0.8	0.4	0.3	1.2	0.0	1.3	0.0	1.0
Haifa	3.7	3.9	1.5	5.9	1.1	4.8	1.9	1.5
Hadera	2.7	3.3	2.4	3.5	2.9	3.1	4.0	3.0
Sharon	6.9	7.7	8.2	9.5	6.8	5.9	7.9	5.6
Petah Tiqwa	23.0	22.8	26.5	26.1	19.6	20.2	21.0	22.1
Ramla	2.7	2.5	2.0	1.8	1.2	3.6	2.3	2.1
Rehovot	6.1	5.2	3.1	11.2	2.0	7.5	6.9	9.0
Tel Aviv	34.2	37.0	35.2	18.9	35.1	29.0	31.2	34.9
Ashqelon	0.9	0.7	0.0	6.0	0.0	1.2	0.0	0.7
Beer-Sheva	1.5	1.9	2.0	0.0	1.0	1.8	2.7	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0



Fig. 1: Sub-districts with relatively high and extremely high concentration of high-tech activity

District	Sub-District
Jerusalem	11 Jerusalem
	21 Telor
Northern	22 Kiryat
	23 Netan
	24 Hazer
	25 Galila
Haifa	31 Haifa
	32 Hadera
	41 Sharon
Central	42 Peta Dgim
	43 Roneit
Tel Aviv	44 Rehovot
	51 Tel Aviv
Southern	61 Ashdod
	62 Be'er Sheva

— International boundary  
 — District boundary  
 — Sub-District boundary & code



Fig. 2: Sub-districts with relatively high and extremely high concentration of venture investments