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Unveiling the High-Tech Cluster Phenomenon in Israel: Exploring the Dynamics of Globalization and Innovation

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Abstract

Over the past few decades, Israel has emerged as a global leader in innovation. The present thesis delves into the intricate interplay between globalization, innovation, and the formation of high-tech clusters within the context of Israel. The emergence and consolidation of high-tech clusters have become a noteworthy characteristic of the global economic landscape, with Israel standing out as a remarkable exemplar. This study aims to comprehensively explore the dynamics that drive the development of high-tech clusters in Israel, shedding light on the multifaceted relationship between globalization and innovation.

Drawing upon a blend of qualitative and quantitative research methodologies, this research investigates the key factors that have propelled the rise of high-tech clusters in Israel. By examining the role of government policies, educational institutions, research and development initiatives, and international collaboration, this study uncovers the intricate mechanisms that foster innovation and entrepreneurship within these clusters. Furthermore, this research scrutinizes the global dimension of Israel's high-tech clusters, elucidating the ways in which they are intricately interconnected with the global economy. Through case studies of prominent high-tech clusters in Israel, the study analyses how globalization has influenced their growth trajectories, facilitated knowledge exchange, and shaped their competitive advantage on the global stage.

In conclusion, this thesis offers a comprehensive analysis of the high-tech cluster phenomenon in Israel, underscoring the intricate relationship between globalization, innovation, and economic development. The findings contribute to a deeper understanding of the mechanisms that drive successful high-tech clusters and provide valuable insights for policymakers, researchers, and businesses seeking to harness the transformative potential of these clusters in an era of rapid globalization and technological advancement.

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Introduction

Globalisation and innovation have emerged as essential variables determining the economic landscape of nations in an increasingly linked and technologically driven globe. The emergence of high-tech clusters, defined as geographical concentrations of interconnected enterprises and institutions functioning in a specialised industry, has gotten a lot of attention because of their ability to encourage innovation, drive economic growth, and boost global competitiveness. The Israeli high-tech ecosystem stands out as a noteworthy case study, exemplifying the complex interplay between globalisation and innovation.

Israel, despite its tiny size in terms of both territory and people, has emerged as a global powerhouse in technology and innovation. Despite geopolitical hurdles and limited natural resources, Israel has developed a thriving high-tech sector that has drawn major international investment and attention. The phenomenon of the Israeli high-tech cluster offers a once-in-a-lifetime chance to investigate the complicated link between globalisation and innovation, since the country's astounding successes highlight the transformational potential of this connectivity.

This thesis aims to shed light on the varied dynamics of Israel's high-tech cluster phenomenon, with a special emphasis on the intertwining impacts of globalisation and innovation. The study's core point is that the success of Israel's high-tech cluster is due to a complex interaction between local conditions and global forces, rather than to isolated domestic causes. This research aims to provide a comprehensive understanding of how globalisation and innovation coalesce to propel the Israeli high-tech ecosystem to the forefront of global technological advancements by analysing the intricate web of interactions among key stakeholders such as government agencies, research institutions, multinational corporations, venture capitalists, and entrepreneurial start-ups.

The thesis begins with a detailed assessment of the literature, in which we dive into the rich tapestry of current information on high-tech clusters. We look at the concept of clusters, the benefits they provide, and the possible drawbacks they may have. Furthermore, we investigate high-tech clusters, their distinct traits, and the variables that promote their growth.

In Chapter 2, we delve into the foundational theories underpinning cluster development. We assess the opportunities presented by cluster theory and the pivotal role of innovation in nurturing these hubs. Additionally, we examine the profound impact of globalization on high-tech clusters, shaping their dynamics and global competitiveness. Chapter 3 takes us deeper into the core of high-tech clusters by analysing innovation dynamics within these ecosystems. We investigate the processes of knowledge creation and diffusion, explore the vibrant entrepreneurial culture and start-up ecosystem, and scrutinize research and development initiatives that underpin innovation. Turning our attention to the Israeli landscape, In Chapter 4, we examine the Israeli high-tech landscape. We investigate the high-tech industry, dive into Israel's Open Innovation Ecosystem, and thoroughly examine the legendary "Silicon Wadi" to extract lessons from these thriving clusters. Finally, in Chapter 5, we summarise our results and have a thorough debate. We examine the essential aspects influencing high-tech cluster performance in Israel, evaluate the influence of government policies, examine initiatives such as the Magnet and incubator programmes, and emphasise the necessity of international cooperation.

This thesis invites you to accompany us on a voyage into the dynamic world of high-tech clusters—a world where innovation, cooperation, and policy interventions intersect to promote economic growth and regional development. We contribute to a deeper understanding of the role these clusters play in influencing the future of industries and regions as we untangle their intricacies and find the keys to their success.

Chapter 1

Literature Review

1.1 Research Design

The technique used in this study was meticulously devised to investigate the high-tech cluster phenomena in Israel in depth. This section provides a summary of the study's research strategy and techniques, building on previous literature and presenting illustrative examples. A detailed search of the relevant literature has revealed certain procedures and approaches that have been effective in previous investigations, which has influenced the methodology used. This study intends to contribute to a better understanding of the processes of globalisation and innovation inside Israeli high-tech clusters by harnessing insights from the literature.

A thorough examination of the literature will be carried out in order to identify significant ideas, concepts, and frameworks linked to high-tech clusters, globalisation, and innovation. This review will lay the groundwork for the development of a theoretical framework and the refinement of research issues. For example, research on "cluster theory" [1] (Porter, 1998) has been frequently employed to analyse regional industry competitiveness. Multiple case studies will be done to get empirical insights into Israeli high-tech clusters. The case study technique proposed by Yin (2014) will guide the case selection and data collecting. These examples will illustrate various features of high-tech clusters and may involve well-known firms or localities. A case study of Israel's Silicon Wadi, for example, will dive into the historical growth and innovation dynamics of this well-known cluster. Examining current databases, reports, and official publications will be part of secondary data analysis. Data from the Israeli Central Bureau of Statistics, for example, as well as reports from organisations such as Startup Nation Central, will give significant insights on cluster demographics, trends, and policy efforts.

[1] Cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities

The data will be supplemented by content analysis of online resources such as news stories, policy papers, and industry reports. Content analysis of news items, for example, can aid in tracking the media's representation of high-tech clusters and their impact in the global economy. In summary, this study technique attempts to give a complete knowledge of the high-tech cluster phenomena in Israel, based on an exhaustive literature review and supplemented by multiple data gathering methods. It tries to shed light on the complex interplay between globalisation and innovation inside these clusters by building on existing methodology and theoretical frameworks.

1.2 Cluster Definition

The first scholar to acknowledge the existence of clusters was Marshall (1890). He said that there are several advantages to having concentrated industrial regions. Alfred Marshall introduces the phrase "industrial districts" to explain the benefits of placing enterprises in the same geographical locations. Because enterprises undertake similar or related activities, this type of cluster differs from the idea of urban agglomerations, which comprises companies from numerous disciplines situated in the same metropolitan region. Giacomo Becattini significantly expanded on Marshall's original theoretical examination of the industrial neighbourhood, which was published around a century later. To explain the clusters of tiny Italian businesses that appeared in the late 1970s, Giacomo Becattini revived Alfred Marshall's idea of the industrial district in 1979. A socio-territorial entity known as an industrial district, according to Becattini, is one that is "characterised by the active presence of both a community of people and a population of enterprises inside of a naturally and historically defined area" (Becattini, 1990).

Michael Porter, a professor at the Harvard Business School, popularised the idea of clustering in his book "The Competitive Advantages Nations" in 1990. According to his definition, a cluster is a "geographically close-knit group of businesses and related institutions in a particular industry, connected by commonalities and complementarities." He provided a precise explanation of the term "cluster" along with a list of its traits. A company's performance is now more closely correlated with the network of auxiliary businesses, institutions, and infrastructure that surrounds it. Porter redefines the cluster concept in a new analysis, focusing on the type of relationships that exist between cluster members, “ a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities’’ (Porter, 2000). The latter explanation broadens the notion beyond a single location and considers the impact of global markets.

The work of Krugman (1991) might be seen as a further recognised description of clusters. According to Krugman, "Clusters are seen as dynamic arrangements based on knowledge creation, increasing returns, and innovation in a broad sense, rather than as fixed flows of goods and services." Clusters are dynamic, which is why he emphasised the word "dynamic". They can alter their organisational structure in reaction to shifts in the sectors around them by expanding their market or diversifying their technological base. The process of innovation taking place within the cluster through the exchange of knowledge, skills, and experience is added to the economic ties and product flows in Krugman and Porter's approach. The cluster is defined differently by Morosini, who calls it " a socioeconomic entity characterized by a social community of people and a population of economic agents localized in close proximity in a specific geographic region " (Morosini, 2004).

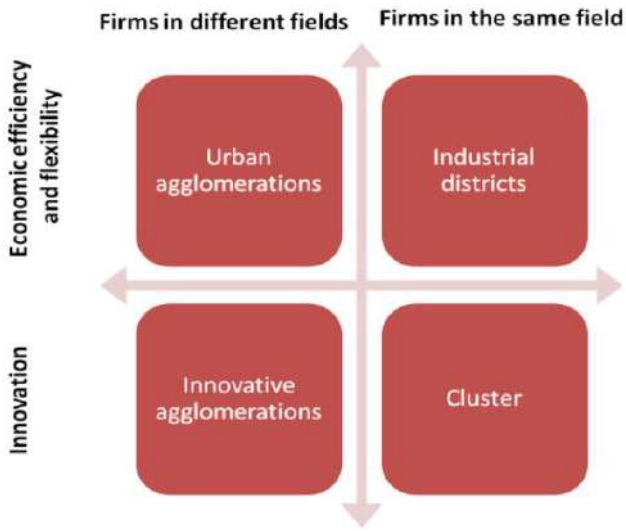
According to these definitions, the term "cluster" can be used to describe regional economic activity that is situated at all scales, including community, geographic area, and the global level. The cluster is an economic phenomenon that occurs in a competitive environment where several enterprises compete and collaborate at the same time to acquire distinct economic advantages. The film industry's Hollywood or Bollywood, the wine industry in California, the information technology sector in Silicon Valley, and Boston are all examples of globally renowned clusters. However, economic research needs to develop models that can be applied at a lower regional level so that economic policy makers can identify or support clusters initiatives.

1.3 Cluster Models

Clusters can be characterised according to their origin, purpose, cluster enterprise size, and market orientation. A manufacturing cluster, for example, is defined as companies within a cluster that manufacture, whereas a service-oriented cluster is defined as firms within a cluster that provide services. Clusters may be classed as SME clusters if the businesses that comprise the cluster reflect the industry's small and medium-sized enterprises (SMEs). Researchers have created many models that consider supplier chains linkages, direct relationships between businesses, and other factors in order to comprehend the cluster model from the perspective of relations between enterprises.

Figure 1 illustrates a typology (Malmberg, Solvell, and Zander, 1996) that depicts four different agglomerations and underlines the conceptual distinctions between clusters and the other three models based on unique features of metropolitan areas and clusters. Clusters are a sort of economic agglomeration produced by enterprises that undertake operations in the same sector and in which innovation is a driving factor that supports rivalry and company development, (Porter, 1998), (Krugman, 1991).

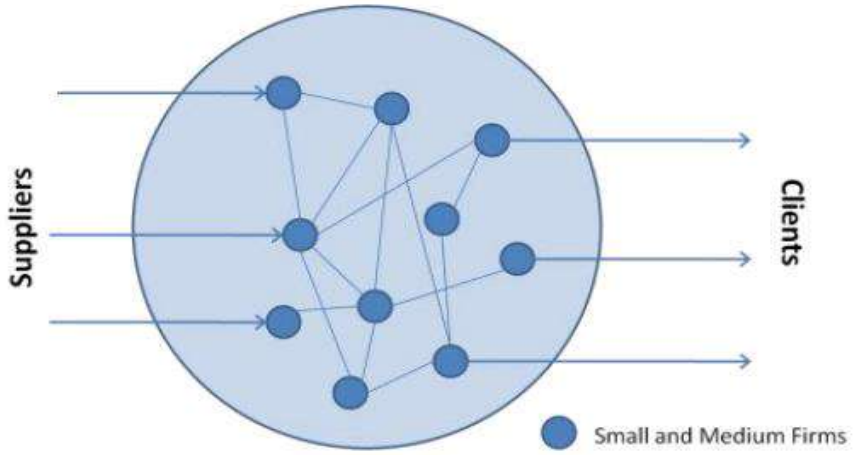
Figure 1. Types of economic agglomerations



Source: (Malmberg, Solvell, Zander, 1996)

Markusen (Markusen, 1996) established four cluster models based on the roles of distinct cluster members and their interactions: Marshallian clusters, Hub-and-spoke districts, Satellite platform clusters, and State-anchored clusters. Markusen contrasts its current cluster models with the Marshal model, figure 2, in which the cluster is quite homogeneous, consisting of tiny enterprises that collaborate, compete, or have a supplier-producer relationship. In this paradigm, no business has the size or power to directly control the cluster, and only the common market and the cluster dynamic dictate its structure and evolution.

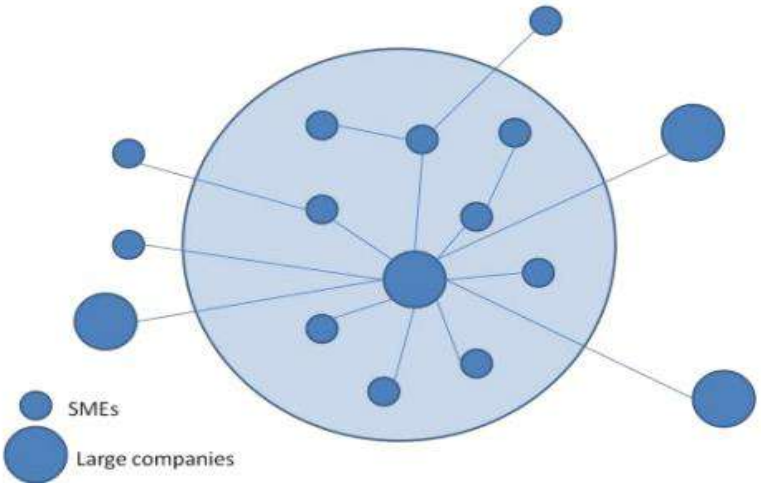
Figure 2. Marshallian cluster model



Source: (Markusen, 1996)

In a hub-and-spoke cluster, as shown in Figure 3 , a small number of dominating enterprises serve as the cluster's centre and are surrounding by numerous minor businesses that are connected to them directly. The majority of cluster enterprises are suppliers of raw materials, providers of externalised services, or experts in a specific stage of the hub's manufacturing process. The small businesses depend on their clientele and transact business directly with the big ones. The dynamics of the cluster and its relationship are determined by the hub firms. In the automobile sector, there are several instances of hub-and-spoke clusters, such as the Detroit Auto cluster, which is centred around the "Big Three" automakers.

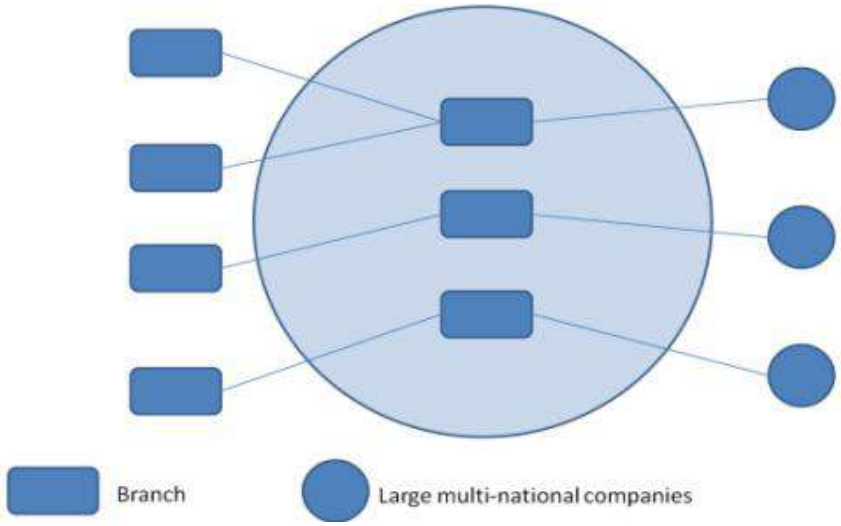
Figure 3. Hub-and-Spoke cluster model



Source: (Markusen, 1996)

In a satellite platform cluster (figure 4), a collection of branch facilities of externally based multi-plant enterprises are situated in a certain geographic area to take advantage of governmental resources or affordable labour and supply prices. The fact that there are no relationships between satellite enterprises and that they are totally under the management of the parent company that is located far away is a unique feature of the satellite platform.

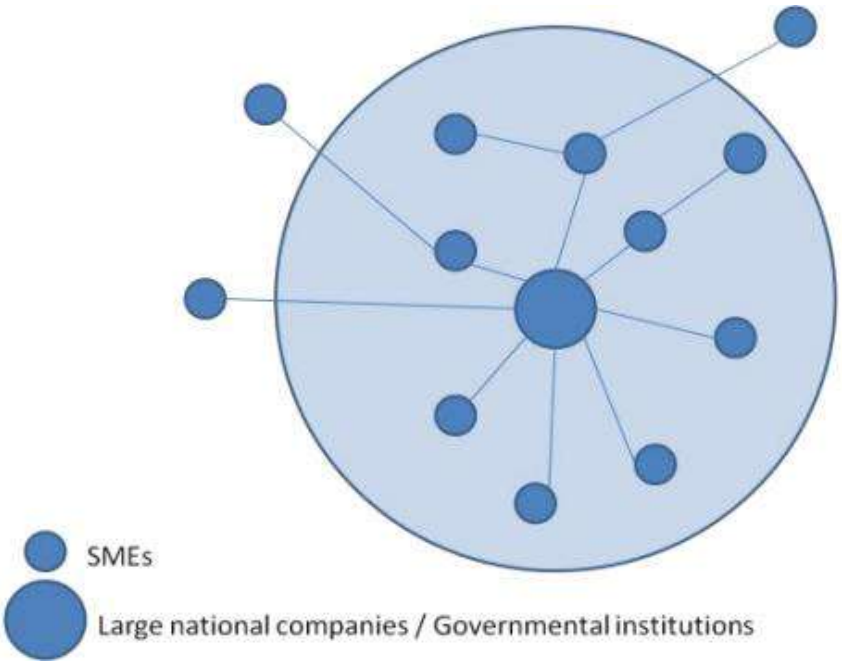
Figure 4. Satellite Platform cluster model



Source: (Markusen, 1996)

The last type, the state-centered cluster (He and Fallah, 2011) or state-anchored cluster (Markusen, 1996), is based on the economic ties between cluster members and a dominant public, governmental, or nonprofit organisation. This entity is surrounded by multiple small businesses that gain from public-private partnerships, and in many US cases, this entity is a sizable military post. A hub-and-spoke cluster with one dominating important participant who is not under private sector control is an analogy for the state-centered kind.

Figure 5. State Anchored / State centered cluster model



Source: (Markusen, 1996), (He and Fallah, 2011)

A successful model of technological clusters like Silicon Valley is described in The Competitive Advantage of Nations (Porter, 1990) research. This model is based on a number of elements that are not included in the traditional theory of economic growth, which is focused on availability and quantity of production inputs. These elements combine to produce the Porter's diamond model, which is seen in figure 6.

Figure 6. Porter's Diamond

Source: (Porter, 1990)

This model is the engine that propels the cluster at the microeconomic level, according to Porter's view, and is characterised by interdependent links between all factors:

- **External factors** The initial resources of the area and the current economic environment; initial resources are not always material but rather a set of circumstances that make it easier to start a new business; additionally, the economic environment is described by the number of businesses operating in a particular industry, the ease with which a new business can be started, and the local entrepreneurial culture.

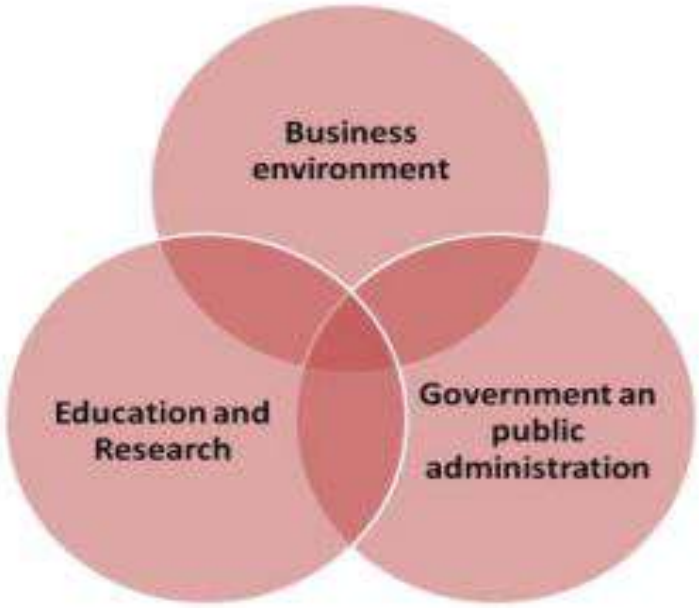
- **Strategy and competition** Companies are forced to contend with an environment of increasing competition, and the effective solution is to evolve, to innovate, and to provide a variety of products and services; as a result, companies' strategies and the competitive environment influence their evolution. Specialised services and products, increased quality, and collaboration are required to meet higher requirements.
- **Market conditions** represent the level of demand for the products and services being offered; in Porter's diamond, the factors are influencing cluster evolution but they are also interconnected and have an impact on one another; in the absence of a need or a client, there won't be any entrepreneurial initiative to see an opportunity in the resources of the region; in the end, the initial market will grow due to the cluster competitive environment
- **Related and supporting industries** define the variables that allow cluster enterprises to evolve and sustain their competitive advantages; in terms of innovation, universities and research institutes that may give new technology needed in manufacturing processes are essential components.

In the Triple Helix model (Etzkowitz, 2002), figure 7, the linkages between three critical determinants of a cluster's development—education, government, and business—define capitalization and knowledge transfer. According to Etzkowitz (2002), there is a connection of the academic-industry-government type among these components, where one is distinct from the others but overlaps in terms of innovation and knowledge transfer. Additionally, each element plays an equal part and has the primary responsibility for generating innovation. This approach contrasts from models where each element is distinct from the other three and there is no discernible connection between them or models where research and education are a part of a wider public system managed by the state.

The Triple-Helix approach is built on tight collaboration among three factors:

- **Education and research** institutions are participating in private-sector-funded initiatives to supply technology, information, and innovate; new businesses can be developed with spin-off technology and financial backing from private corporations.
- The **business environment** fosters private enterprise and includes higher education in research initiatives.
- **Government**-funded research, military research (which in the US facilitates the generation of economic clusters through the outsourcing of various services to private companies), and regional development initiatives and projects that support the development of technological parks can serve as the foundation for future agglomerations that may eventually lead to a cluster.

Figure 7. The Triple-Helix Model



Source: (Etzkowitz, 2002)

1.4 Cluster advantages and disadvantages

The advantages of clusters can be broken down into three categories (Ketels, C.H.M., 2003): (1) companies can operate more effectively by utilising more specialised assets and suppliers with quicker reaction times than they could in isolation; (2) Companies and research institutions may innovate at greater levels thanks to knowledge spillovers, tight customer engagement, and severe competitive pressure from the cluster environment, which decreases the cost of experimentation; (3) The amount of business creation is often higher in clusters since start-ups are more dependent on outside partners and suppliers, whom they may all locate in a cluster. Clusters also lower the cost of failure since entrepreneurs have access to several nearby job prospects at businesses operating in the same industry.

Finding groupings of businesses in similar sectors that are concentrated in one region and have the potential to collaborate to form a new industrial cluster is crucial if one wants to profit from industrial clustering. It is important to undertake an analysis to identify the assets and bases of competitive advantage (such as labour force pools, expertise, academic institutions, and infrastructure) as well as those that operate as roadblocks to greater collaboration and efficiency. The growth of the industrial cluster might have a variety of benefits for the enterprises that make up the cluster as well as the overall area economy. The growth of industrial clusters has the potential to bring a variety of benefits to the participating businesses as well as the overall area economy.

Clusters, however, can occasionally become a hindrance to its members and even hasten the demise of a whole region. The following are the primary causes of this development (European Commission, 2002): (1) In an environment where technology is changing quickly, cluster firms are more susceptible if they are stuck using outdated technologies and if they lack the flexibility to adapt to those changes. (2) When cluster firms depend on a small number of customers or the activity of a single large company or a small number of companies, they risk failing if these latter move or go out of business, even if they remain competitive themselves. (3) At the regional level, the attractiveness of an area should not be overstated because only a few clusters are internationally recognised. Disadvantages may be more obvious during a recession when cyclical unemployment is higher in clusters.

1.5 High-Tech Clusters: Definition and Characteristics

High-tech clusters, also known as "innovation hubs" or "technology ecosystems," are regions where businesses, research organisations, and skilled labour come together to promote innovation and economic growth. These clusters include, but are not limited to, Silicon Valley in the United States, Cambridge Cluster in the United Kingdom, and Hsinchu Science Park in Taiwan. These areas are hotbeds for technical innovation thanks to a culture of cooperation, information exchange, and entrepreneurial spirit. High-Tech Clusters have emerged as a vital driver of economic success and revolutionary change in an age marked by technology advancements and unrelenting innovation. These clusters are geographically concentrated centres where a network of interconnected enterprises, research institutes, suppliers, and supporting entities interact and compete in a particular industry or technical sector.

The significance of High-Tech Clusters stems from their distinct characteristics, which include co-location advantages, knowledge spillovers, collaborative networks, and conducive ecosystems, all of which contribute to fostering innovation and propelling regional and global development. The premise at the core of the argument is that the potency of High-Tech Clusters is derived from the synergy of varied stakeholders co-locating in proximity. The spatial concentration of specialised organisations allows for effective information exchange and resource sharing, enabling for the quick transmission of ideas and technical advances. For example, Silicon Valley in California is well-known for its concentration of technological behemoths, startups, and research institutes that interact and influence one another, resulting in a steady flow of new ideas and discoveries.

In addition, High-Tech Clusters are distinguished by the phenomena of knowledge spillovers. As specialists and professionals from diverse organisations engage inside these clusters, ideas cross organisational borders, resulting in accidental information transfer. This phenomenon, sometimes known as "serendipitous innovation," emphasises the concept that proximity might improve the serendipitous flow of ideas, hence speeding up the creative process. The exchange of tacit information, best practises, and expertise inside the cluster improves collective intelligence, which benefits all participants.

This co-location of varied players not only encourages the exchange of best practises, but also hastens the spread of cutting-edge technology. As a result, high-tech clusters are frequently innovation hotspots, propelling breakthroughs and offering a fertile foundation for the creation of new ideas. .

Collaborative networks are essential in High-Tech Clusters, as they develop a culture of cooperation that extends beyond organisational interests. Companies and organisations in these clusters frequently collaborate on research and development initiatives, pool resources, and co-innovate.

This collaborative mindset encourages idea cross-pollination, catalysing creative solutions to challenging challenges. Furthermore, the ecosystem that surrounds High-Tech Clusters serves as a fostering atmosphere that encourages innovation and growth. The existence of venture capitalists, angel investors, incubators, accelerators, and other supportive organisations provides startups and entrepreneurs with the essential financial and infrastructural assistance. This ecosystem reduces the risks involved with innovation, encouraging people to take risky moves into new technical territory.

High-tech businesses employ more than 10% of the total workforce in the United States and contribute about 20% of the national GDP (Muro et al., 2015). Similarly, the employment proportion of high-tech industries in the European Union (EU) has expanded dramatically in recent years. Eurostat's 2020 target is to grow the percentage of high-tech industries in GDP by 3%, eclipsing competitors such as Japan and the United States (Europe 2020 indicators, 2010).

Their distinguishing features, such as co-location advantages, knowledge spillovers, collaborative networks, and favourable environments, serve as the foundation for their impact on innovation and economic growth. High-tech clusters are dynamic ecosystems that promote technical innovation, economic growth, and the attraction of talent and investment. Their distinct traits, as well as the elements that contribute to their success, make them potent engines of growth. As technology continues to influence our world, high-tech clusters will become more important in defining the future and unleashing the potential of invention.

Chapter 2

Cluster development conditions

2.1 Competition and Cooperation

The delicate balance between industry collaboration and rivalry is a key feature of a "industrial district" (Alfred Marshall, 1927). According to Porter (1998), Martin and Sunley (2003), and Delgado et al. (2010), competition and collaboration are essential concepts for understanding the connections between businesses in clusters.“Clusters promote both competition and cooperation.” writes Porter (1998) in his study Cluster and New Economics of Competition. “Rivals compete intensely to win and retain customers. Without vigorous competition, a cluster will fail. Yet there is also cooperation, much of it vertical, involving companies in related industries and local institutions.”.

According to Porter, the benefits of clusters resulted through corporate collaboration, and competitiveness was a primary driving force. Businesses have a better grasp of developing innovative trends as a result of the cluster's collaboration and enhanced communication, which adds to the diffusion of information and, eventually, the acquisition of a competitive advantage. Furthermore, a high degree of local competitiveness puts additional pressure on enterprises to continually innovate; in other words, rather than being followers in the field of innovation, they will become pioneers. This emphasises the importance of collaboration and competition in cluster development. Cooperation among enterprises within a cluster will allow them to compensate for their constraints while also increasing their flexibility. Within industrial clusters, several types of collaboration occur. Different sorts of collaboration may be determined by analysing the clusters theories (De Toni and Nassimbeni, 1995; Dei Ottati, 1994; Markusen, 1996):

Horizontal cooperation: this refers to related businesses that are involved in the same manufacturing process. Several official or informal agreements will be reached between rivals to share R&D risk or gain access to specific market regions. Unofficial price-fixing agreements among competitors are also possible, as are patents licenced to competitors through cross-licensing arrangements. In Silicon Valley, for example, semiconductor firms freely cross-licensed their patents to competitors in order to ensure the rapid diffusion of technical advances.

Vertical cooperation: This describes long-term contracts and agreements between the supplier and the customer as well as technological partnerships between infrastructure providers and manufacturers with the aim of creating new production infrastructures. Competition is necessary for economic progress and is a necessary component of a market economy. Without competition, a cluster may fail. Competition is impacted by clusters in three main ways: first, by raising the productivity of the individual firms or industries that make up the cluster; second, by raising their capacity for innovation and, consequently, for productivity growth; and third, by encouraging the emergence of new companies that support innovation and grow the cluster. Many cluster benefits depend on external economies or spillovers between different types of businesses and sectors. Thus, a system of connected businesses and organisations that adds up to more than the sum of its parts may be said to form a cluster. Despite the fact that clusters seem to be widespread in economies, their competitive advantages won't be the same across all industries. In general, there are fewer suitable cluster sites the larger the benefits of clusters and the more tradable the products and services involved. Because clusters become more significant as competition becomes more sophisticated, they tend to become more prevalent as economies grow.

Personal connections, in-person contact, and interaction among networks of people and institutions all play a role in each of the three major cluster-based impacts on competitiveness. While such associations are more likely to form and become successful once they do, the process is far from automatic in the presence of a cluster.

The most crucial factor in determining a company's positioning success and its ability to successfully compete on a global scale and turn threats into opportunities is its competitive edge. However, by connecting businesses in clusters, competitiveness may be attained. Competition between businesses inside clusters will promote creativity, productivity, and the growth of new skills.

"Competition in today's economy is far more dynamic," Porter concluded from his investigation (Porter, 1998). Clusters constitute a critical mass of competitive performance for businesses, regions, or nations in a dynamic environment and knowledge-based economy. Competitiveness in the modern era is significantly more "dynamic" since it is focused on productivity rather than the accessibility of resources. In every sector, whether it is electronics, agriculture, or the shoe industry, businesses may be very productive. Competitive advantage is based on the capacity to use available resources more effectively, on cutting-edge technology, resource sharing, knowledge-intensive processes, and the expansion of innovation.

2.2 The Role of Innovation in Cluster Development

Joseph Schumpeter (1934) is largely regarded as the first academic to claim that innovation is essential to the evolution of the capitalist system. Markets are becoming more globally diversified and the ensuing mass of rivalry brought on by higher technical complexity makes innovation a crucial component for businesses, making it more and more crucial to build collaboration networks. Understanding entrepreneurship and competitiveness in the context of a country's economic success at the regional level is crucial.

International competitiveness is a challenging idea in reality. However, despite its influence in terms of value added and productivity linked, the capacity of an industry to compete with foreign rivals pertains to their market performance, patterns of specialisation, and productive dynamics. Collaboration networks have the potential to significantly improve the competitiveness of economies and regions, whether they are used to produce novel initiatives or new technologies, or to provide access to resources, talent, or cost savings. Innovation now focuses on clusters that bring together businesses from various industries, academic institutions, and other organisations rather than R&D centres of huge corporations.

The link between innovation and entrepreneurship was established by Schumpeter's (1934) emphasis on new combinations - new commodities, new techniques or processes, new markets, or new industrial organisation - introduced by entrepreneurs. "New combinations are, as a rule, embodied, as it were, in new firms" (Schumpeter 1934:66). High-technology clusters vary from other industrial clusters in that they are more closely linked to the early phases of industry life cycles, and regional resources encourage development and innovation (St. John and Pouder 2006). As a result, what constitutes "high tech" evolves throughout time, covering inventive fields that provide new prospects. The primary activity of technology-based industries is research, and knowledge is their primary input and product. Firms can maximise prospects for collective learning and exploitation of entrepreneurial potential by locating near sources of information (such as universities and research centres) and clustering in specialised labour markets (Audretsch et al. 2006).

As a result, high technology is commonly regarded as innovative and assessed by R&D investment and the employment of scientists, engineers, and technicians (Hecker 2005). Schoales (2006) broadens the idea of newness to cover all businesses with relatively short product life cycles, encompassing various service sectors such as advertising, design, fashion, finance, and others. Stoneman (2010) also cites 'creative industries' items, which include culture, media, and the arts, as instances of soft innovation, which emphasises aesthetic rather than technological features. Finally, Knowledge-intensive Intensive Business Services (KIBS) are a high-tech "hidden engine" (Probert et al. 2013). We have come to see high-tech industries and areas as inventive and enterprising over several decades. We discovered that innovation and entrepreneurship may be found in many, but not all, areas by examining inventive entrepreneurship not just in notable high-tech districts, but also in other locales.

Because of their economies of density and the opportunities given by cities as the centre of wider networks, both local and global, urban places provide favourable settings as incubators for creative enterprise (Nijkamp 2003). Much study has been conducted to determine what is prevalent in the most inventive places. Can the circumstances be generated, grown, or transported to other locations once they are known?

To minimise confusion while discussing cluster policy, it is vital to define the several ideas that are usually employed in this sector. Cluster policy is defined as a "broader set of specific governmental policy interventions aimed at reinforcing existing clusters or facilitating the formation of new ones." Cluster policy does not take a specific and targeted action against single corporations, but rather focuses on how these companies function and interact with one another. In other words, the cluster policy seeks to establish or enhance a network of enterprises based on collaboration and interaction. Furthermore, depending on the precise activity of interest that is meant to be increased, the cluster policy might take on several characteristics. In order to maximise the efficacy and efficiency of cluster policies, policymakers typically resort to the formation and growth of cluster organisations and cluster initiatives. In reality, when used in tandem, these technologies enable the support and implementation of cluster policies. Cluster initiatives, in particular, can be characterised as "coordinated efforts to increase the growth and competitiveness of clusters within a region, involving cluster firms, government, and/or the research community."

Cluster organisations fit into this setting since they serve cluster supporters by providing a variety of services. Cluster organisation may be defined as "the legal entity engineering, steering, and managing the clusters, including usually participation and access to the cluster's premises, facilities, and activities."

One of the most notable distinctions is based on two distinct cluster policy approaches: cluster formation vs cluster leveraging. Following the first approach, policymakers should "directly impact economic geography and the emergence of clusters" by creating incentives that encourage enterprises to "co-locate in order to create more externalities." Cluster policies, on the other hand, can focus on existing clusters in the region and move to utilise them. The goal in this situation would be to "internalise the existing externalities and thus drive activities that make better use of the potential from co-location." The second divide is between government and industry, which is the topic of the cluster effort. In practise, the distinction involves the priority for action of the two subjects, which results in two distinct foci. On the one hand, a cluster effort initiated by the private sector "focuses on issues most relevant to firm competitiveness," while on the other hand, the public sector would play an active role in "promoting collaboration to build trust where otherwise only competition would occur." Finally, examining the link between cluster and cluster policies empirically leads to another important distinction: in economics, there are three sorts of combinations. Specifically:

- Clusters that arose and evolved spontaneously and naturally, without any form of support.
- Clusters that are the outcome of particular and effective cluster policies.
- Cluster policies that failed in the endeavour to create clusters.

An alive local or regional "entrepreneurial ecosystem" has the synergy required for a self-sustaining area (Bahrami and Evans 1995). The inventive environment of Silicon Valley is a classic example of an Entrepreneurial Regional Innovation System (ERIS) (Cooke, 2004). It might be claimed that the unusual ecosystems present in and around Boston (USA), Cambridge (UK), and Southern California serve as "regional incubators" (Clarysse et al. 2005: 213). Such habitats and ecosystems are more commonly referred to as Regional Innovation Systems (RISs).

According to Asheim and Gertler (2005) and Cooke (2004), RISs are the institutional traits that impact innovation at a scale lower than the National Innovation System (NIS) at the regional level. According to Acs and Szerb (2009), innovation often rises as economic development grows, in an S-shaped pattern. Regional policy is constrained by the NIS and national policies, which have a significant impact on the character of university entrepreneurship (Uyarra and Flanagan 2010).

Looking for biotech and nanotech success, almost all areas strive for it; while few will do so in the immediate term, many will increase their capacity for development and future inventive potential. Because innovation and clusters are intricate processes, there are numerous and diverse policy alternatives. New research campuses being built in Abu Dhabi and New York City indicate a sustained desire for public expenditures in R&D worth billions of dollars. Policymakers are also focusing on developing stronger networks between researchers, entrepreneurs, and investors as well as small-scale incubators and accelerators for new technology-based businesses or university spinoffs in order to promote innovative entrepreneurship in the region. On the other hand, innovation policy is not an island unto itself. Policies that don't take into consideration the cultural contexts in which they are implemented are likely to fail. Instead, policymakers need to design new programmes that take into consideration the cultural outlooks of the area, such as their tolerance for the risks involved in leaving a secure job to run a startup. The presence of successful, innovative entrepreneurs can inspire others to follow in their footsteps, while an economic downturn can result in a retrenchment where the risks of innovation and entrepreneurship seem increasingly unaffordable. Policymakers must keep in mind that culture is dynamic.

2.3 Globalization and its Impact on High-Tech Clusters

Globalization has played a pivotal role in the evolution of high-tech clusters. First, regarding access to international markets: the simplicity of access to international markets is one of the most important benefits of globalisation. These clusters' high-tech businesses have access to a global clientele, which enables them to grow quickly. These clusters have become launching grounds for entrepreneurs wanting to go global from the outset thanks to their worldwide reach. In the Competitive Advantage of Nations, Porter first articulated his conceptual framework for competitiveness, emphasising the importance of geographic location as a factor in determining a company's productivity. Adapting national economic institutions and systems to create a discernible increase in the global scale is the competitive challenge for nations.

The European Union contends that the success of its economy depends on its ability to compete on the world market. In this alignment, competitiveness produces the fundamental building blocks for long-term growth and development, new industrial activities, jobs, and a higher standard of living. Knowledge is the key to sustained growth, along with creativity, clustering, and networking as contributions to productive and effective entrepreneurship. Regional industrial clusters can be understood as groups of businesses in the same industry that are concentrated in one particular region.

Even though social preconceptions might play a role in the learning process, collective learning has been seen as a vital component of effective clusters. In these situations, the collective attitude of distrust and competitiveness can be reproduced. It is frequently hypothesised that proximity to one another in industrial districts or clusters improves access to information for businesses as well as their own competitiveness. Academics, business analysts, and policymakers have become more interested in the development of regional clusters, particularly small and medium-sized firms (SMEs), across Western Europe and North America during the past several decades.

Regional groups of SMEs are often considered to be more competitive than major corporations in particular industries. New strategies, however, have emphasised the significance of nonlocal networks for empowering businesses, enhancing learning, and increasing inclination to innovate. In summary, three key concepts—geographical proximity, actor structure and relationships, and trust between network partners—can be derived regarding the impact potential of cooperative networks, with advantages for regional competitiveness.

The geography of production in the new economy is characterised by a "paradoxical consequence of globalization"—the concurrent rise in significance of the locality as a location for innovation. This is true despite the increasing integration of national economies into a global economy. With its focus on information and creativity, the production paradigm of the new economy is heavily reliant on localised, or regionally oriented, innovation (Morgan, 2004). Regional clusters that share a similar knowledge base and the additions to that knowledge base frequently sustain innovative capabilities. In the last decades of the 20th century, Silicon Valley had a rapid expansion that coincided with the rise of the Information and Communication Technology (ICT) paradigm and inspired a surge in interest in cluster development. The capacity of Silicon Valley to reinvent itself via consecutive waves of innovation and the growing ambitions of other countries and locations to imitate the Silicon Valley model have both contributed to this fascination (Kenney, 2000; Lee et al., 2000).

In a nutshell, the potential and difficulties of globalisation are being quickly exposed to services that were previously non-tradeable by digital technology. "Telemigration" is a term used to describe this new kind of globalisation, which describes employees who are based in one country but often collaborate with remote teams in offices in another. "White-collar robots" is one term for the automating algorithms, which include RPA, chatbots, virtual assistants, and advanced AI tools like IBM's Watson. These robots are automating jobs in the service industry at the eruptive pace of digital technology, propelled by machine learning on the one hand and, on the other, by the decreasing cost of collecting, transmitting, storing, and processing the enormous datasets required to train the algorithms.

According to Baldwin we can use the term ‘’Globotics’’[2] to describe this phenomenon. This phrase, which combines the words "globalisation" with "robotics," describes how technological developments, notably in the areas of automation, artificial intelligence (AI), and digitalization, are changing the nature of the labour market and the global economy. The development of AI and robots is crucial to the globotics phenomena. The automation of jobs that were previously thought to be the sole responsibility of human workers is now possible thanks to increasingly advanced automation technology. In some labour marketplaces, this causes rivalry between human employees and machines. Baldwin argues that as digital technology advances, more tasks can be outsourced and automated. As a result, there is a "gig economy" where people are recruited on a task-by-task basis, frequently from a distance. By enabling people to operate remotely from anywhere in the globe using high-speed internet and digital tools, geographic barriers are blurred.

Globalization has reshaped the landscape of high-tech clusters, transforming them into dynamic and interconnected hubs of innovation. These clusters have reached unprecedented levels of technical innovation and economic growth thanks to the benefits of access to international markets, talent mobility, cross-border collaboration, and supply chain integration. However, they also have difficulties including increased competition, sensitivity to economic changes, growing expenses, and worries about intellectual property. High-tech clusters must use the advantages of globalisation while adjusting to its realities in a world that is becoming more linked. These clusters must strike a balance between global participation and local resilience if they are to succeed in the high-tech ecosystem, which is constantly changing.

[2] Baldwin's concept of globotics is often associated with what he calls "Globalization 4.0." In his view, this phase of globalization is characterized by the integration of digitally driven services with global labor markets. Unlike previous waves of globalization that focused on the movement of goods and manufacturing, Globalization 4.0 centers on the movement of services, especially those that can be digitized, such as data analysis, coding, design, and customer service.

Chapter 3

Innovation Dynamics within Clusters

3.1 Knowledge Creation and Diffusion

This chapter will discuss the idea of knowledge and the function it plays in the survival and growth of the economic system, enhancing quality, stimulating innovation, and boosting competitiveness, especially in localised regions like districts and clusters. Innovation and economic development must be examined using a new method based on the significance and hierarchy of the networks that serve as the foundation for the spread of information, knowledge, and know-how in the current economic and social context, which is heavily influenced by relationships and the exchange of knowledge.

According to Porter's theory, a cluster is a complex ecosystem of interrelated enterprises and organisations in continual contact, enhanced by geographical closeness. Furthermore, businesses and institutions continually communicate information with one another, resulting in a steady flow of ideas that serves as a healthy environment for the development of skills, knowledge, and creativity. In any case, a cluster should not be reduced to a simple association of businesses who operate in the same region and may take use of their close proximity to cut expenses. In addition, it is a far more complicated system of interconnected agents in which knowledge and abilities are anchored to the area where a collective learning process occurs (Lawson and Lorenz, 1999). However, before starting with the investigation of the knowledge generation process, it is vital to grasp the primary distinctions between tacit and explicit knowledge. The phrase "knowing-that" sums up explicit knowledge.

Knowledge that can be codified or digitalized in books and papers can facilitate activities. It is simple to recognise, communicate, and apply. One distinguishing quality of explicit knowledge is that it is objective, logical, technical, and, most importantly, documented. Because tacit knowledge exists in everyone, it might be difficult to extract, capture, and express it via books or other written resources.

It is now possible to locate a complex network of companies with a distributed division of labour, where each firm covers one or more supply chain passages, considering the cluster's environment, as was previously stated. For any specialist business, it is also possible to find a group of competent people who have gathered and integrated through time a wealth of knowledge that helps the firm to achieve the greatest value added in the particular manufacturing process that is covered. This indicates that each company has a distinct set of tacit knowledge that it has accumulated through many years of experience, either domestically created or obtained from other sources (such as the labour market). This data allows the company to obtain a competitive advantage. Besides, in order to understand the lines of relationships between the numerous agents engaging in the process of knowledge creation inside a cluster, the horizontal and vertical dimensions of the cluster must be divided.

The horizontal dimension investigates the interaction between a company and its direct or indirect competitors. Specialisation and cluster development are crucial in terms of a firm's ability to gain any sort of competitive advantage, particularly in the early phases of a cluster. Companies, in particular, may benefit from co-location with direct competitors while monitoring and comparing. Firms have the opportunity to capture important information that will allow them to draw a concrete picture of the surrounding network and understand the strengths and weaknesses of firms located in the same geographical area by analysing the products and processes of other players in terms of quality and efficiency (Bathelt, 2004). We examine a sort of collaboration between businesses and suppliers or service providers in the vertical dimension. The information is sent directly from one participant to the next in this scenario via swiping. When an idea develops inside the confines of a particular organisation, it gets picked up by the other 15 participants in the cluster and, from there, a new one can emerge, becoming a source of fresh information and innovation, to further draw on Marshall's concept of knowledge stimulation and production.

Additionally, because businesses often specialise early on in a cluster in order to boost their competitiveness, the atmosphere created in the area fosters the growth of additional specialist service providers and suppliers. As a result, there is a new exchange of information across businesses, and proximity and symbiosis are once again key factors, resulting in a certain level of knowledge connection (Cano-Kollman et al., 2016). Any network structure with connections between different players has the ability to provide the process of knowledge creation a new boost. Processes of resource combination and recombination that are based on the flow of information created by multiple links and shared knowledge assist the ecosystem's ability to develop new knowledge and innovation.

The job market also provides a source for the creation of new knowledge. As was previously said, a cluster is defined by the presence of skilled individuals who surround themselves with a collection of implicit and explicit knowledge accumulated through time. Every employee may be thought of as an expert due to the high level of expertise in every business in the cluster. There is a robust labour market and a potential flow of people because of the fierce rivalry among workers, which leads to a flow of knowledge, skills, and expertise. The exported information package is additionally combined and recombined, enabling the ecosystem to once again produce new ideas and innovation. Since each business may benefit from the web of links, the final outcome of these activities may be seen as an enhancement in both the competitiveness of the cluster as a whole as well as the competitiveness of the individual enterprises where there is a skill inflow. Firms are able to benefit from connections and take part in a process of collective learning that promotes the growth of the cluster, notably in terms of innovation, as well as the competitiveness of individual firms, by doing this.

For all entrepreneurial undertakings in clusters, knowledge and its generation serve as the essential building blocks with the goal of creating and expanding resources that provide competitive advantage. These clustered organisational structures were specifically developed with the goal of creating a network that allows for the interchange and generation of new knowledge.

As a matter of fact, the internal network of the cluster network is crucial for both the creation and transfer of information since, in contrast to district innovations, science-based innovations are dependent on specialist knowledge, necessitating glaring interventions and R&D activities (Pavitt, 1984). Informal and uncodified knowledge disseminates more successfully at the local level. As a result, the creation of new knowledge—which is nothing more than a combination of internal (firm-specific) product knowledge and partner/network specific knowledge that is transferred and absorbed among localised companies—begins the innovative process in clusters present in science-based sectors, as opposed to the production of innovative knowledge in industrial districts, which is the result of knowledge transfer and absorption activities.

According to Schiavone, information concentrated in a cluster that fosters creativity and value may emerge as (Schiavone, 2008):

• ***Firm-specific***: if it is held by the company and influenced by its resources, experience, and internal R&D activity;

• ***Partner-specific***: if it is generated by the relationships that the clustered companies undertake among themselves, by the mutual sharing of knowledge in order to create new knowledge through recombination;

• ***Network-specific***: In the case of internal cluster knowledge, public organisations, research institutions, and universities only make this knowledge available to internal local players.

The first phrase relates to the information that identifies the company and gives it a long-term advantage (from an information-based standpoint). This kind of knowledge is the result of internal operations, or the subject-specific learning done within the organisation. As a result, internal social elements including cultural setting, degree of education and employment, and professional experiences influence this knowledge. Although they are not a universal process, R&D activities and the creation of new firm-specific knowledge are adjusted based on the local environment of the cluster. In any event, universities, research institutions, and public and private institutional organisations work closely with the local reality to commercialise the fundamental knowledge that the region possesses while also actively taking part in the development of professional figures.

3.2 Entrepreneurship and Start-Up Culture

Today, startups are seen as an innovative form of business, whose growth is becoming more and more popular among aspiring business owners. The notion incorporates not only the conventional business idea but also the socioeconomic and cultural growth of the relevant environment. Startups are actually concepts that bring about socially important transformations in particular societal groups. Entrepreneurship is sometimes viewed as an economic innovation since the procedures involved in starting an entrepreneurial activity frequently employ innovation at various points in the project development, such as in technique or the production of a good or service. Understanding the invention process and finding the policies that support the formation of rapidly expanding businesses are two topics covered by entrepreneurship theory. The startup idea is defined as one of the economic engines of the twenty-first century by recognition of the vital role that entrepreneurship plays in society and its reputation in the field of innovation.

Promoting entrepreneurship is a crucial component of attaining economic progress in society that is sustainable. Entrepreneurship is seen as the catalyst for innovation, rising productivity, competitiveness, economic expansion, and job creation. A fascinating and particularly current phenomena relating to creative entrepreneurship has gained public attention in recent decades. Entrepreneurship is consistently cited by authors as a significant source of innovation and growth in both advanced industrialised nations and emerging economies. Startup businesses play a significant part in the adoption of innovative technology. According to intellectuals like Audrecht , the importance and procedures around innovation have undergone a drastic transformation as a result of developments in technology, globalisation, and other reasons. One of the primary functions of creative entrepreneurship is to provide economic assistance to both established and emerging economies. The authors discover an intriguing perspective in the conceptual development of innovative entrepreneurship, claiming that if entrepreneurship policy arose from a policy for small and medium-sized enterprises, then innovation policy arose from technology development, particularly research and development policy and development.

In their research, for instance, they find a positive relationship between entrepreneurship and innovative capacity in developed countries, where next - the more the initiation of entrepreneurial activity in developed countries, the more the production of innovations that become import - researchers of innovative entrepreneurship are increasingly united around the idea that formulates its origin and development in societies where the entrepreneurial culture is above average. Additionally, the fact that different countries have different levels of approval for entrepreneurship and innovation policies should also be considered a key growth driver.

According to Gabr and Hoffman, there are five key drivers of entrepreneurship that may be limited: opportunities, abilities, money, incentives, and culture, each of which is controlled by a plethora of policy tools. The development of innovation is caused not just by increased competition in local and global markets, but also by the detection of market trends. Today, the idea of creative entrepreneurship encompasses a commercial vision in the sphere of high technology. Entrepreneurship is defined as an individual's capacity to transform his ideas into action. Young people have viewed entrepreneurship as a major trend during the past ten years, using it to express their creativity and increase their self-assurance and freedom of action. Because of the method of thinking that alters the general entrepreneurial climate in more and more nations throughout the world via creativity and innovation, innovative entrepreneurs are most frequently referred to as paradigm changers by writers. The so-called new entrepreneurs or innovators are running away from the well-established stereotype of the entrepreneur that has existed for decades by coming up with whole new concepts for business development.

Entrepreneurial ventures are increasingly being spurred by social or environmental incentives rather than a desire for their own advancement. These decisions cannot be postponed, and politics is unable to act quickly enough in response. What gives the entrepreneur an edge in developing a notion of initiative is the quest for opportunities beyond the resources we presently have. Entrepreneurship fosters innovation as a form of creative activity, but not innovation in the sense of anything novel or unheard-of, but rather innovation in the sense of a technological advancement that makes the world a better place.

3.3 Research and Development

The results and impacts of policies promoting private R&D have been thoroughly covered in the literature. In this regard, Becker (2015) offers a thorough assessment of the available empirical findings. By offering actual data that shows how the private rate of return to industrial R&D is typically lower than the societal rate of return, Griliches (1979, 1998) adds to our understanding of the need to assist R&D. Using panel data on American businesses, Bloom et al. (2013) examined the impact of technological spillovers and discovered that the gross societal returns to R&D are at least twice as big as the private returns. The amount of public funding for R&D that should be established in order to prevent the crowding out effect of private investment is a hotly contested issue. Older empirical investigations point to evidence of corporate and public R&D funding substitution. Wallsten (2000) provided evidence that several publicly listed, young, technologically advanced businesses decreased their R&D expenditures in the years after receiving a Small Business Innovation Research grant in the US. Similar to this, Busom (2000) found that in around 30% of the Spanish enterprises she studied, governmental support totally replaced privately sponsored R&D.

The precise estimated elasticities vary depending on the data, estimation technique, and model specification. However, more recent work tends to indicate positive impacts on private R&D expenditure backed by public assistance in the form of tax credits or direct subsidies. Using panel data on the manufacturing industries of OECD nations, Bloom et al. (2002) calculated a long-run elasticities of R&D with regard to its user cost of around -1,0. Similar findings were found by Harris et al. (2009) on a panel of manufacturing facilities in Northern Ireland. Klette and Moen (2011) came to the conclusion that R&D subsidies efficiently targeted businesses that considerably raised their R&D spending and found that there was no evidence of crowding out in their sample of high-tech Norwegian enterprises.

Based on a panel data of German service businesses, Czarnitzky and Fier (2002) disputed the concept of a full crowding-out effect. The crowding-out effect was similarly disproved in two distinct studies by Duguet (2004) and Carboni (2011), which looked at samples of French and Italian businesses, respectively. The research of Lach (2002), which used information on Israeli manufacturing companies in the 1990s, found evidence that the R&D subsidies provided by the Ministry of Industry and Trade had a significantly positive impact on company-financed R&D expenditures for small firms, is particularly important for our analysis. However, although not statistically significant, the effect was adverse for large enterprises.

According to the study, each Israeli Shekel (NIS) of subsidy resulted in small businesses spending an additional 11 NIS on their own R&D. The average effect of each NIS of subsidies received, however, is a statistically negligible 0,23 extra NIS of corporate financing because the bulk of subsidies were given to large enterprises. We concentrated on the R&D Fund for the analysis since it is the main budget item and investment mechanism that the Israeli Innovation Authority (2019) has adopted during the study period and at the now. The program's primary goal is to promote innovation and technical advancement by giving qualifying businesses that are engaged in R&D projects financial aid. Companies must submit a project proposal stating the goals, objectives, and anticipated results of their R&D project in order to access the fund.

These ideas are evaluated, taking into account things like market potential, technological viability, and the company's ability to carry out the project effectively. In the event that the application is accepted, the firm is granted up to 50% of the declared R&D costs. If the application is accepted, the firm will earn a grant equal to up to 50% of the project's declared R&D expenditure. Additionally, the firm is qualified for an extra 10% support [3] if it is situated in one of the country's Development Zones. If the idea is financially successful, the company will recoup the subsidies through royalties. According to location, the table I summarises the requirements for funding.

[3] If the company is located in the areas around the Gaza Strip the additional support increase to 25%. Moreover, in recent years, preferential funding terms for startups corporations owned by minority population and/or women were implemented. We omitted these cases in the analysis for semplification.

Chapter 4

Case Studies: Exploring Israeli High-Tech Clusters

4.1 The high-tech sector

From many aspects, Israel's high-tech sector [4] has grown increasingly important in the country's economy. Figure 1 illustrates the share of total GDP contributed by the high-tech industry. This proportion has climbed by more than 4% in the last decade, reaching 18.1% in 2022. According to the Israel Innovation Authority (2023), the high-tech sector's production has grown the most in recent decades, making it the greatest contributor to the economy in 2022. In comparison, the high-tech industry in the United States will account for 9.3% of GDP in 2021. The effect of the high-tech sector on Israel's GDP is roughly double that of the US, indicating a strong reliance on this sector.

Examining the balance of payments highlights the importance of this sector to the Israeli economy. Figure 2 shows the value of high-tech exports by industry and their proportion of overall exports. High-tech exports more than quadrupled from $34.3 billion in 2012 to $71.1 billion in 2022. This rise was driven mostly by high-tech services, which increased by 327% during the decade. During the same time span, high-tech commodity exports increased by only 18%. During the Covid-19 crisis in 2020, the percentage of high-tech exports in overall exports crossed the 50% mark for the first time. Due to the general economic recovery and greater contributions from other sectors, its relative contribution will fall to 48.3% in 2022 (Israel Innovation Authority, 2003).

[4] There are several definitions of the high-tech industry. The most widely accepted definition, which is referred to below, is provided by Galindo-Ruenda and Verger (2016), who present the current OECD taxonomy of economic activity based on R&D intensity. Manufacturing and non-manufacturing sectors are classified according to their level of R&D intensity, as assessed by the R&D to value added ratio within an industry. The sectors are divided into five categories based on the average and median R&D intensity of each business within the sector: high, medium-high, medium, medium-low, and low R&D intensity.

Finally, as indicated in Figure 3, it is relevant to evaluate the number of employees in the high-tech industry and technological positions in other industries. The number of employment in this industry has steadily expanded over the last decade. Tech occupations accounted for 10.6% of all jobs in Israel in 2014, and they have expanded by approximately 3.5% in the last eight years, reaching 14% in 2022, employing over 500,000 people. Various empirical studies emphasise the relevance of these employment to the economy and their influence on the local labour market. .

According to an investigation undertaken by the Israel Innovation Authority (2023), there is a "employment multiplier" at the firm level that varies based on the type of organisation. For every person in a technology position, a full-fledged software company employs 2.55 in non-technology occupations. This impact is only 0.32 in the case of startups. Nonetheless, it is clear that the high-tech industry contributes significantly to the development of non-technological jobs both inside the sector and throughout the economy.

Israel has shown to be an extremely inventive economy during the previous decade. Initially concentrated on the defence industry, R&D spending quickly grew to embrace the whole economy during the 1970s and 1980s. Figure 4 shows that in 1991, R&D spending as a percentage of GDP was in line with the OECD average (2.1%). Since then, there has been a steady growth, which may be attributed in part to a succession of government measures established to boost R&D in the country. .

By 2021, Israel will have attained the world's highest proportion of R&D investment as a part of GDP (5.6%), becoming the first country to do so in 2019. .

This record, however, is being challenged by South Korea, which has seen a more recent but continuous improvement in this measure, reaching 4.9% [5] in 2021. .

Other economies fall well below these levels, with the United States, the leader, reporting 3.5% growth in the same year and the entire OECD average recorded at "only" 2.7%. Another intriguing element of R&D in Israel is the entities that undertake it. Figure 5 depicts the ratio of total R&D expenditure by the corporate sector and funding organisations in 2020. In that year, Israel had the greatest percentage of R&D expenditure undertaken by the private sector (90.4%) among OECD nations.

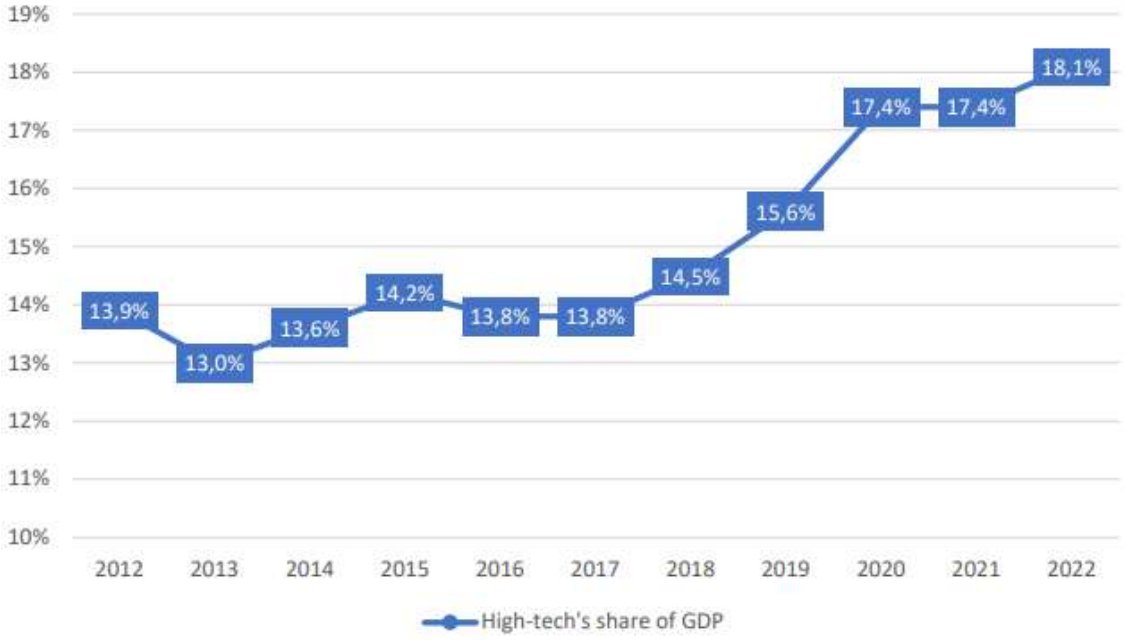
[5] OECD Main Science and Technology Indicators (MSTI) database.

By 2021, this ratio had risen even further, reaching 91%.These figures show how far the local market has progressed and how much trust investors have in it. They do, however, underline Israel's reliance on the private sector for finance and R&D. This reliance becomes more clear when the financing composition is examined. Foreign investors provided 54% of the cash spent by the private sector for R&D in 2020. In terms of investment allocation for innovation development, Israel stands out worldwide, with foreign firms providing more than half of the private sector's R&D financing - an unparalleled situation among OECD member nations. In contrast, just 40% of R&D in Israel is funded by the local private sector, the lowest share among all OECD nations. For startups, this dependence is much more evident. According to an Israel Innovation Authority (2023) review based on IVC data, international investors accounted for at least 75%-80% of Israeli venture capital in 2021-2022. The Israeli high-tech industry's reliance on private sector investors, particularly international investors, poses a substantial risk to Israel. The more these international investors are put off by political instability or other potential changes in the country, the more likely it is that investments in Israeli high-tech will be delayed or slowed, affecting the medium and long-term growth of the Israeli economy as a whole.

Furthermore, these conditions expose the country's investment level to swings in other economies. In Israel, the amount of innovation and R&D investment is not uniformly dispersed across the country. Figure 6 depicts overall R&D spending in Israel by district during the last two decades. The majority of the growth in R&D spending has clearly been centred in the Tel Aviv and Central regions, which cover the seaside metropolis. By 2020, these two areas will have accounted for roughly 70% of overall R&D spending in the country. Tel Aviv, in particular, saw the greatest increase in R&D expenditure, more than doubling over the last five years from around $4 billion in 2015 to $9.4 billion in 2020 (42% of total R&D expenditure [6]). Because of the country's great geographical concentration, there are enormous differences in income and job prospects, as well as unsustainable imbalances in the real estate market. One of the targets mentioned in the Israel Innovation Authority's (2023) action plans for the next years is the decentralisation of high-tech industry activity.

[6] Elaborations of the author on Central Bureau of Statistics (CBS) data.

Figure 1. High-tech share of total GDP

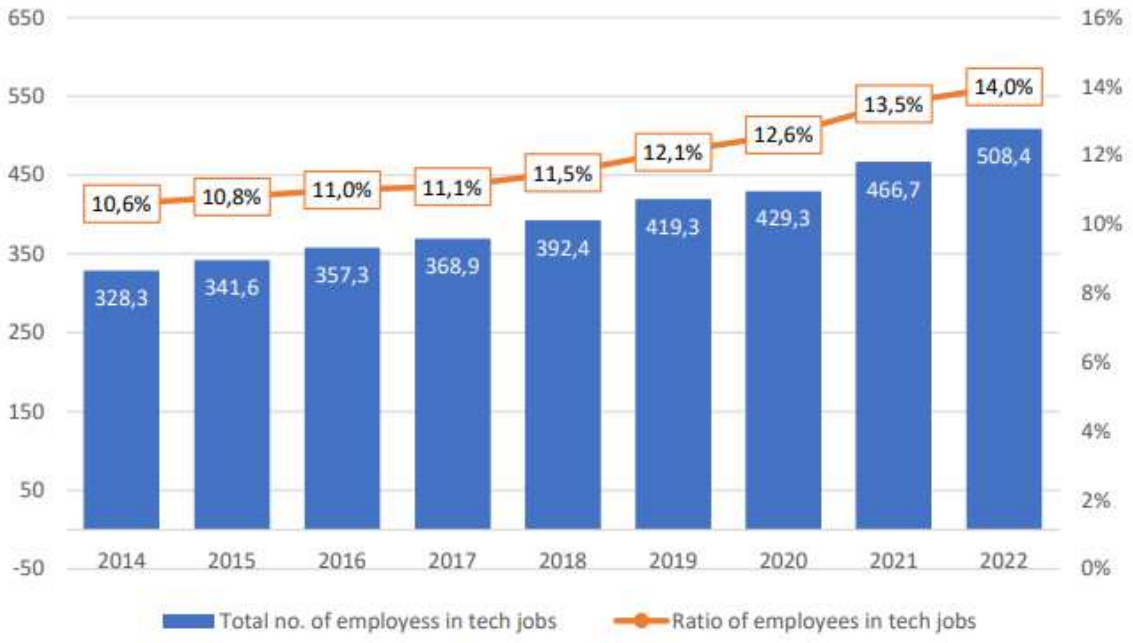


Source: Israel Innovation Authority (2023)

Figure 2. High-tech exports by sector in USD billions and its share of total exports

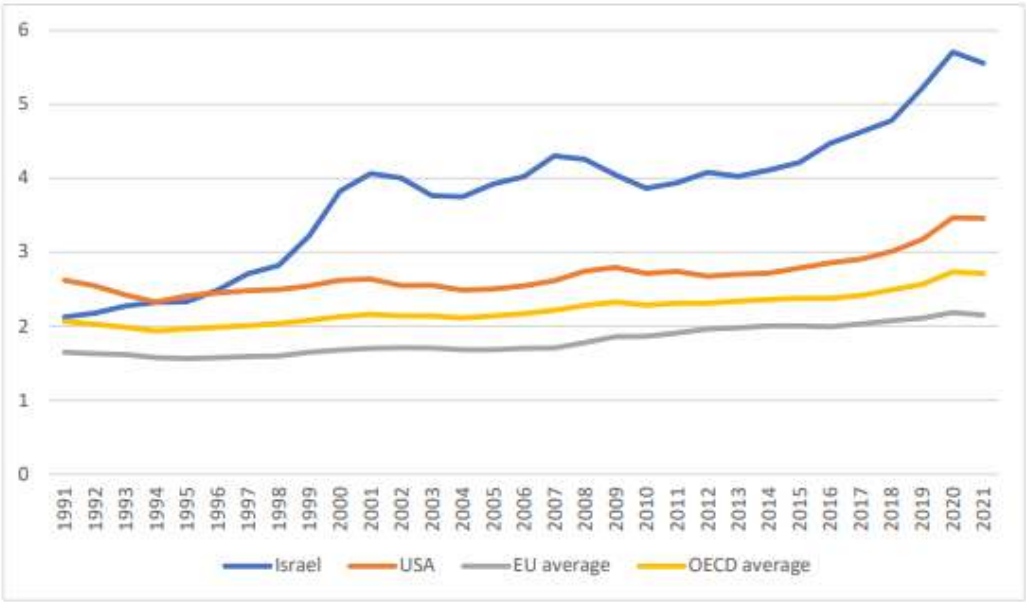
Source: elaborations of the author on Central Bureau of Statistics (CBS) data

Figure 3. Numbers of employees in the high-tech sector and technology jobs in other sectors in thousands and their ratio of all employees



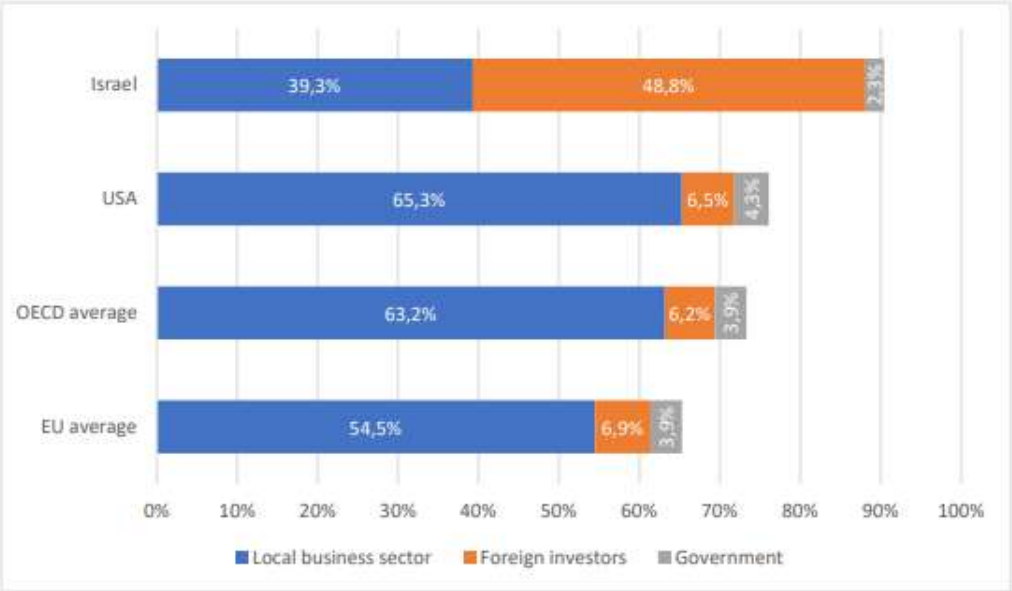
Source: elaborations of the author on Central Bureau of Statistics (CBS) data

Figure 4. Gross domestic expenditure on R&D as a percentage of GDP



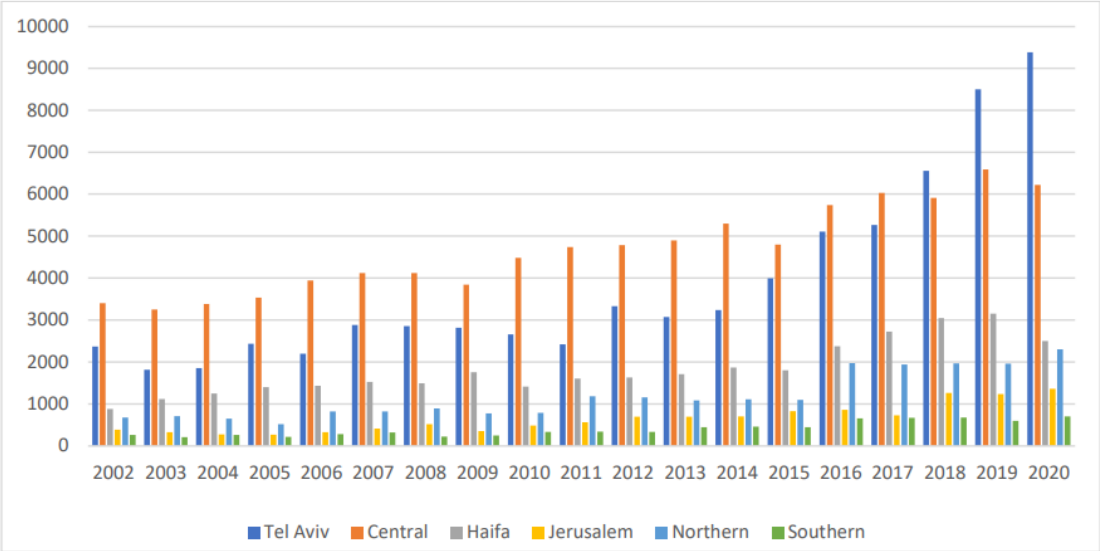
Source: OECD Main Science and Technology Indicators (MSTI) database

Figure 5. Ratio of R&D expenditure performed by the business sector and distribution of funding entity in 2020



Source: OECD Main Science and Technology Indicators (MSTI) database

Figure 6. Total R&D expenditure by district in USD million 2017 prices



Source: Central Bureau of Statistics (CBS) Time Series databank

4.2 The Open Innovation Ecosystem in Israel

The growth of open innovation (OI) activities, processes, functions, and practises in the Israeli entrepreneurial ecosystem from 1993 to 2022 is examined in this chapter to provide light on the emergence of an high-tech ecosystem in Israel. The data demonstrate a progression through three distinct phases from isolated internal patterns of creativity to widespread open patterns of innovation in the ecosystem. The Israeli ecosystem saw irregular, low-intensity, and narrowly focused OI activity throughout Phase 1 (1993–2003). Phase 2 (2004-2014) saw a large growth in the number of companies implementing OI activities, which led to OI activities being more structured, specific, and diversified.

The creation of the Israeli entrepreneurial ecosystem and the venture capital business marks the start of Phase 1 (1993–2003) (Avnimelech & Teubal 2006). A surge in new startups and venture capital firms during this time period affected the Israeli entrepreneurial ecosystem, which resulted in a co-evolutionary process of cumulative growth driven by supportive feedbacks, group learning, scale economics, and network effects (Avnimelech & Teubal, 2006). Few companies sometimes engaged in low-intensity OI activities with a constrained selection of OI functions, processes, and practises during this time. The majority of OI activity was still generic and represented unorganised search. Three major events in Phase 2 (2004-2014) significantly influenced open innovation in MNCs (multinational corporations) . The first was the publication of "Open Innovation: The New Imperative for Creating and Profiting from Technology," by Henry Chesbrough, in 2003. This book was crucial in popularising and formalising the idea of open innovation. As a result, businesses were able to implement OI concepts that were more organised, specific, and defined, which helped them diversify their innovation practises.

The venture capital (VC) industry's comeback from the 2001 bubble implosion was the second event. As a result, businesses now have more funding options to create new innovation-related activities. The third event was an effort to maintain technological collaboration after many MNCs lost their market dominance in the 1990s as a result of competition from fresh entrepreneurs. This prompted them to search for fresh methods to boost their inventiveness, and open innovation appeared as a viable remedy.

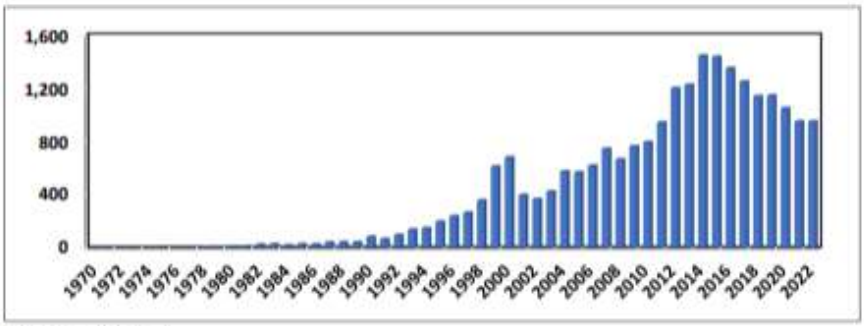
Phase 2 therefore witnessed a considerable growth in both the quantity of businesses engaging in OI operations as well as their level of intensity. This growth is evidenced by the rise of OI positions in Israeli companies, which went from 154 at the conclusion of Phase 1 to 970 at the end of Phase 2 (See table 3). However, the majority of these operations were classified as 100% inbound OI with little contact between startups and corporations. Additional OI activities, such as corporate incubators, corporate open laboratories, corporate accelerators, and entrepreneurial communities started to emerge in addition to the three main models that were prevalent in Phase 1. The majority of the current OI models entered the market in phase 2.

Phase 3 (2015–2022) saw a considerable increase in scale-up businesses and VC investment, but with a decline in startup development since 20161. Along with growing Open Innovation (OI) activities, the emphasis has turned to post-startup growth (see Figures 1 and 2). This tendency, which is not specific to Israel, may be linked to advancements in OI activities and the part that established businesses play in the ecosystem of entrepreneurship. The number of businesses engaging in OI activities increased throughout this era, as did the level of activity and the scope of it. A more diverse strategy was adopted in place of the single corporate acquisition of startups and their assets, strengthening the partnership between corporations and startups. These procedures got increasingly organised as businesses constructed whole OI funnels and put into place distinct processes, objectives, and KPIs. Many top MNCs in a variety of industries, including enduring ones like the automotive, supply chain management, and food industries, have made Israel a hub for their worldwide OI centres. The Israeli ecosystem now includes several business incubators, open corporate labs, corporate accelerators and innovative communities.

Corporate organisations appear to be gaining greater clout in the entrepreneurial ecosystem, as seen by the change in innovation efforts and resources towards a more equal partnership between startups and corporations. Corporate organisations appear to be gaining greater clout in the entrepreneurial ecosystem, as seen by the change in innovation efforts and resources towards a more equal partnership between startups and corporations. As a result of a mentality shift from one of creative destruction to one of creative creation, OI activities are now ingrained in their entire strategy and routines (Agarwal et al., 2007, 2010; Agarwal & Audretsch, 2020).

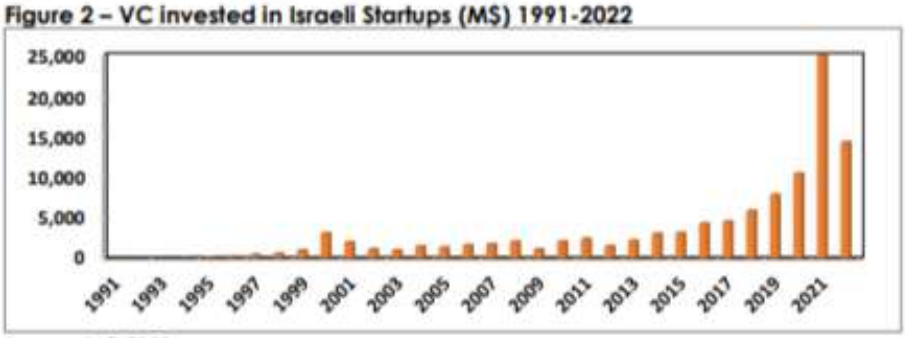
Beginning in 2023, the future years will be crucial for the Israeli entrepreneurship environment. The continuing global economic crisis and the local political crisis in Israel pose two major obstacles that might impede its sustained expansion as a leading ecosystem with a strong OI component and enormous potential.

Figure 1 - Number of startups created in Israel 1970-2022



Source: IVC 2023

Figure 2 – VC invested in Israeli Startups (M$) 1991-2022



Source: IVC 2023

Table 2 - OI activities* in Israel 1970-2022 (source: IVC)

Phase	Years	#M&As	#MNC R&D C.	#CVC	#Corp. Incubators	#Corp. Open Labs	#Corp. Accelerators	#Innovation Communities
0	pre-1993	7 (0.3%)	24 (4.9%)	13 (5.2%)	1 (4.5%)	0 (0%)	0 (0%)	1 (0.7%)
1	1993-2003	316 (14%)	61 (12%)	54 (21%)	3 (14%)	1 (1.0%)	0 (0%)	6 (4.4%)
2	2004-2014	927 (40%)	243 (50%)	135 (54%)	8 (36%)	11 (11%)	17 (20%)	35 26%)
3	2015-2022	1,057 (46%)	487 (100%)	251 (100%)	22 (100%)	105 (100%)	84 (100%)	136 (100%)

Source: IVC 2023

* M&A numbers represent the number of M&As at the specific years. All other numbers of OI activities represent the number of existing OI activities at the end of the period.

Phase (Years)	Number Positions	JV	BD	Innov.	Scout.	DT	Hack.	Partner.	OI	OS	Invest.	Acc.	Ecosys.
0 (Pre-93)	34 (0.4%)	50.0%	41.2%	2.9%	0.0%	5.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1 (93-03)	154 (2.0%)	42.2%	26.0%	9.1%	10.4%	4.5%	0.0%	2.6%	0.6%	1.3%	1.9%	0.0%	0.0%

2 (04-14)	**970 (12.4%)**	25.5%	23.4%	9.9%	10.6%	6.8%	1.8%	6.1%	3.9%	4.9%	1.9%	2.4%	0.8%
3 (15-22)	**6,642 (85.2%)**	11.9%	12.3%	15.2%	10.0%	13.4%	13.1%	7.3%	5.3%	4.5%	1.4%	1.7%	2.0%
Total	**7,800**	**14.6%**	**14.2%**	**14.3%**	**10.1%**	**12.4%**	**10.2%**	**7.1%**	**5.0%**	**4.5%**	**2.0%**	**1.9%**	**1.9%**

Table 3 - Innovation positions in firms operating in Israel (Israeli and MNC) 1970-2022

Source: Linkedin

* Other categories capture 1.9% of positions

** JV=Joint Venture; BD=Business Development; Innov.=Innovation; DT=Digital Transformation; Scout.=Technology and Startup Scouting; Hack.=Internal and External Hackathons; Partner.=Partnerships; OI=Open Innovation; OS=Open Source Development; Invest.=Investments; Acc.=Accelerator or Incubator; Ecosys.=Ecosystem development.

4.3 The "Silicon Wadi"

The term "Silicon Wadi" (meaning Valley in Arabic) emerged in the 1980s, drawing a parallel between the Tel Aviv area and California's Silicon Valley. While the precise geographical boundaries of Silicon Wadi are not well understood, de Fontenay et al. (2004) define the cluster as having three primary centres. These facilities are situated in the urban districts of Jerusalem, Haifa, and Tel Aviv, which have the highest concentration of ICT enterprises. This suggests that the cluster extends from Haifa to Tel Aviv before moving inland towards Jerusalem. The Silicon Wadi region that is being discussed in this thesis is seen on the map in Figure 3. It's critical to comprehend the Israeli industry's development cycles in order to comprehend the current business landscape. Senor and Singer claim that in 2009, the Israeli economy saw two significant phases of growth that were separated by periods of inflation and stagnation. The first jump took place between 1948 and 1970, and the second between 1990 and the present.

A practical government played a significant role in the first phase of economic growth and development. Although the region has a history of technical advancement going back to the founding of Israel, it wasn't until the 1990s and 2000s that it really began to emerge as a worldwide tech powerhouse. The seaside city has grown into a thriving innovation environment and acts as Israel's innovation hub. This ecosystem has expanded significantly recently, as shown in figure 4.

Between 2018 and 2022, the value of all businesses established in Tel Aviv since 1990 will have climbed by 3.5 times. When compared to other innovation centres, Delaroom.co (2023) claims that the expansion of the Tel Aviv ecosystem has been among the most substantial. In the same time frame, Tel Aviv's immediate rivals Paris and London experienced growth of 3.2 and 2.5 times, respectively.

These two European cities, according to the Israel Innovation Authority (2023), present significant obstacles to the development of the Tel Aviv ecosystem. Figures 5 and 6 compare innovation centres around the world based on the worth of their combined companies in EMEA[7] and the number of established unicorns[8].

[7] Europe, Middle East and Africa.

[8] Is considered a unicorn a private startup with a valuation of more than $1 billion.

With a big margin from London, Tel Aviv was the second-largest centre in the EMEA region in terms of the value of its startups in 2022. Notably, Tel Aviv came in sixth place worldwide for unicorn production. In contrast to other centres across the world, Tel Aviv exhibits global competitiveness in building successful businesses, except for the Bay Area, where Silicon Valley is headquartered and continues to be an anomaly with 579 unicorns.

Government, businesses, and universities make up the bulk of the organisations in the Israeli cluster. The Ministry of Industry, Trade, and Labour, or MOITAL, is in charge of organising the majority of governmental assistance and interventions to encourage innovative activities in Israel. The Office of Chief Scientist, or OCS, is one instance under MOITAL that is very significant. Invest in Israel is a subsidiary of MOITAL and promotes the Israeli high-tech sector to foreign investors and corporations. Government actions, laws, and policies have purposefully produced these situations. The Israeli leadership understood early on that human capital would be the most valuable resource for a small nation with few natural resources. Israel Institute of Technology, popularly known as Technion, became the nation's first university when it was founded in 1912. In Israel now, there are seven public universities, six of which are located in the Silicon Wadi region. These include Weizmann Institute, Tel Aviv University, Hebrew University, Israel Institute of Technology (Technion), Bar-Ilan University, and Israel Institute of Technology. In addition to the seven state universities, the nation also has several regional and academic schools and The Open University in Tel Aviv, which focuses on distance learning online and offers open admissions.

Inventions and know-how enterprises play a crucial role as a commercial entity in the cluster when it comes to commercialising R&D. The technological sector has been the engine of growth for Israel's economy in recent years (BDO Israel, Doing Business in Israel 2010). ICT produced $19 billion in revenue in 2009 and 204,000 people were employed by the industry, which generated 17.3% of GDP. This industry's exports came to about $16 billion [9]. Only Silicon Valley has a higher concentration of high tech companies than Israel. Furthermore, it leads the globe in startups, which boost GDP more than any other nation.

[9] Israel Ministry of Foreign Affairs, Economy: Sectors of the Israeli economy, 2010-11-28

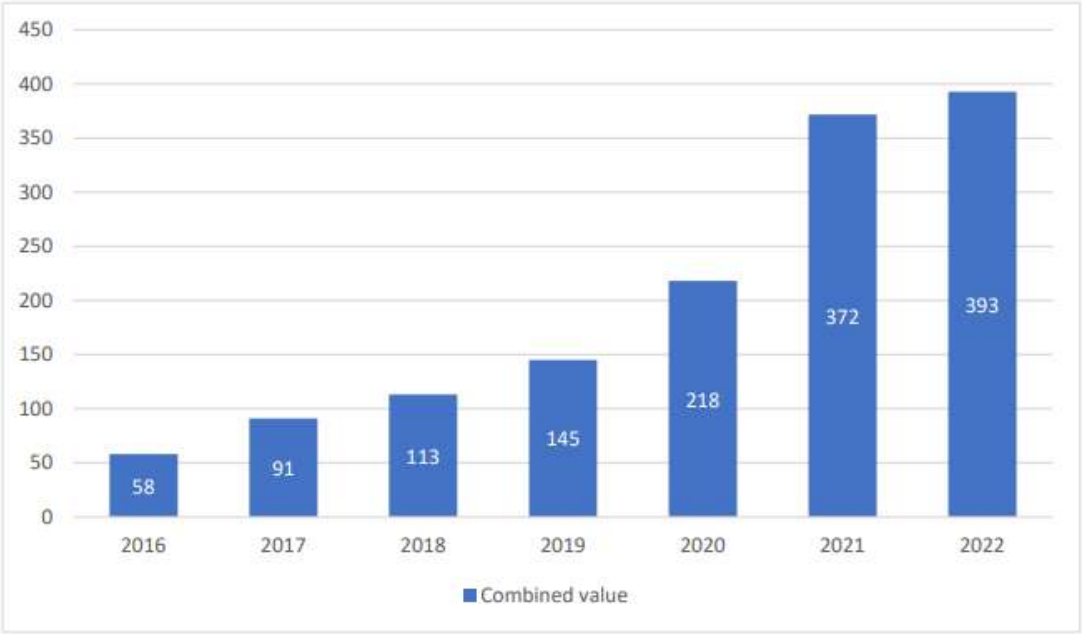
In contrast to many other nations where innovation mostly occurs in giant firms, the United States considers small and startup businesses to be the backbone of innovation. 97% of Israeli companies, according to the Milken Institute (2005), are small enterprises. Small firms are those that have 50 or less workers and an annual turnover of less than $5 million. In addition to the startups, the Silicon Wadi cluster also includes important R&D centres in Israel managed by international corporations including Cisco, IBM, Intel, Microsoft, and QUALCOMM. These international businesses are crucial for the acquisition of smaller innovative organisations, for expanding into new markets, and for financing emerging creative businesses.

According to De Fontenay et al. (2004), the Israeli technology sector enterprises frequently offer their complex technology solutions to advanced corporate clients due to the country's tiny domestic market and the relative dearth of early adopters among consumers. This phenomenon—the relative scarcity of end consumers on a sizable home market—is the cause of the general weakness in areas like marketing and user interface design. Saul Klein of Index Ventures continues to highlight the issue today. In an interview with the prominent technology publication Wired in 2011, he claims that Israel generally has excellent coders but lacks expertise in distribution and design. Companies, partnerships, cooperatives, and non-profit organisations are all considered legal entities in Israel. The most prevalent type of legal entity is a corporation, which can be a private, public, or foreign firm. There are two types of partnerships: general partnerships and limited partnerships.

In conclusion, the Silicon Wadi serves as the hub of the Israeli innovation ecosystem, which has shown to be an incredibly successful location for innovation. While Israel excels in some areas, such as the ratio of R&D spending to GDP or the GDP share of the high-tech industry, a more thorough worldwide comparison offers a more nuanced view. of contrast to the major hubs of superpowers like the US and China, the total worth of the enterprises in its key hub, for example, pales in comparison to other European cities. It is also important to note that it may be inaccurate and biased to compare metropolitan centres with all of Israel, as is done multiple times in the Israel Innovation Authority (2023) study. Furthermore, it is critical to take into account the serious risks and limitations that the Israeli innovation ecosystem faces, such as its disproportionate reliance on foreign investors.

Figure 3: Map of Israel showing Silicon Wadi

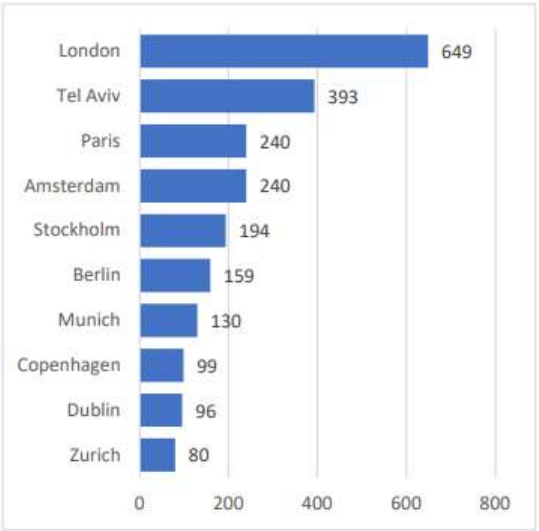
Figure 4. Combined enterprise value of Tel Aviv headquartered and founded companies established since 1990 in billion USD



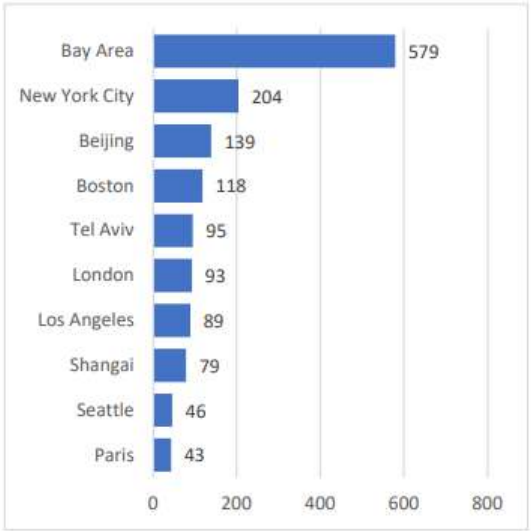
Source: Dealroom.co

Figure 5. Combined enterprise value of all start-ups headquartered and founded in each EMEA ecosystem since 1990 in $billion in 2022

Figure 6. Top hubs by unicorns and $1 billion exits



(*5*) Source: Dealroom.co



(*6*) Source: Dealroom.co

Chapter 5

Findings and Discussion

5.1 Factors Driving High-Tech Cluster Success in Israel

Israel, a tiny nation with adversaries on every border and little natural resources, has managed to develop a world-class cluster. Although there isn't a definite formula for creating a successful ICT cluster, there are nonetheless better and worse methods to go about it. Additionally, the development of a high-performing innovation ecosystem appears differently in various geographic and cultural contexts. This section draws a conclusion on some of the unique and more general variables that contributed to the development of the Israeli innovation ecosystem.

- ***Focused Government Initiatives***

When it comes to innovation policy, the Israeli government has been rather active. According to Harel and Avnimelech (2012), the Israeli government first experimented with several projects and operated in trial-and-error manner. This provided the framework for future work on innovation policies and programmes. The projects have, to a large extent, had a clear objective, a clear approach, and specific targets. When it comes to innovation and R&D, the OCS has served as a "one-stop-shop" and continues to be crucial to the innovation system. Other significant policies and initiatives include Magnet, the Technological Incubator programme, BIRD, LEIRD, Yozma, and LECI. The fact that government programmes have been narrowly targeted may have contributed to their effectiveness. Understanding when to back off and let the market handle things might have also contributed to the success of the various governmental programmes. The various policies have been effective in fostering innovation, capital investments, global connections, and entrepreneurship in the nation.

- ***Well Developed Capital Markets***

Israeli entrepreneurs can access both domestic and foreign finance. The Yozma programme gave the venture capital (VC) sector a boost, and in 2011, 546 Israeli startups raised $2.14 billion. When it comes to commercialising inventions, having access to finance is crucial. From a bank monopoly in the 1980s, there are currently over 70 VC funds in the nation with offices in Israel. Additionally, 220 foreign funds are actively looking for investment possibilities in the nation. Nevertheless, this consistent inflow of funding would not have been feasible without a robust R&D and educational system in the nation, which supplied the raw materials for the innovation process—ideas and innovations. Additionally, it would not have been conceivable without skilled businesspeople bringing the ideas to market. The Yozma programme not only sparked a thriving capital market, but also brought the Israeli innovation system and the opportunities it offers to the world's notice. However, Israel's financial market is almost entirely dependent on foreign money, making it susceptible to global economic downturns.

- ***R&D and Education***

The government of Israel has made significant investments in R&D and education as a result of its early realisation that information would be its most valuable resource. According to the OECD, Israel had the highest public R&D investment in 2010 (4,25%). Investing by international corporations in their research centres in Israel and in R&D for the military should also be considered. The Magnet programme has been crucial in fostering a wide range of precompetitive technological research as well as promoting partnerships between academics, business, and the public sector. The programme continues to operate in conjunction with regulations like LEIRD that also promote government expenditures in R&D. Heavy investments in research and development and education have produced a vast basis of knowledge in university, multinational, and military R&D. In addition, the Israeli government has done a good job of integrating highly educated academics who come to the country as immigrants, adding even another source of R&D. The foundation for innovation processes is the R&D and educational systems.

- ***Military***

A highly distinctive component affecting the Israeli innovation system is military service. In addition to teaching leadership and technology to young people, Israel's thick national network is also built through this programme. There are several ways in which Israel's economic sector reflects the military culture. High levels of cooperation and an experimental, value-neutral approach to performance are two examples. The military has been successful in establishing excellent foundations for new businesses by imparting sophisticated leadership and cutting-edge technological capabilities. It places young adults in very difficult scenarios where a choice might make the difference between life and death for oneself and one's classmates. This type of organisation, which was never intended to promote in young people an entrepreneurial perspective, has succeeded in developing high levels of responsibility, maturity, and a goal-oriented, "do whatever it takes" attitude among the vast majority of Israeli residents.

- ***Israeli Culture***

The competitive ICT cluster in Israel has been significantly shaped by Israeli culture. With its unique characteristics, such as the encouragement to criticise and discuss both peers and authority, the culture looks to be appropriate for entrepreneurship and innovation. The preferences for working in small, adaptable organisations also contribute to the excellent fit between the culture and entrepreneurial enterprises. The communal ideals play a significant role in defining Israeli culture. This may be a result of the country's socialist history. The military, which is now required for both men and women, promotes a sense of community among its members and gives them a sense of purpose. Another cultural factor that keeps everyone alert is the constant tension of being under assault. The dark periods in Jewish history have also created a belief that the people must care for and provide for themselves.

- ***International Networks***

Jews who have recently immigrated to Israel from the Diaspora have been crucial in building connections with markets outside of Israel. Additionally, it has been useful in developing access to cash, financial expertise, assistance, and inspiration from many international locations. Jews from the Diaspora still reside in many different

countries, in addition to those who have returned. This is significant on a worldwide scale as well. Through their ties, these persons may open up worldwide market linkages and provide access to finance.

5.2 The universities

Early on, the Israeli leadership recognised that human capital would be the most valuable asset for a tiny country with few natural resources. Technion, or Israel Institute of Technology as it is commonly known, was the country's first university, founded in 1912. In Israel today, there are seven public universities, six of which are located in the Silicon Wadi area. Bar-Ilan University, Hebrew University, the Israel Institute of Technology - Technion, Tel Aviv University, the University of Haifa, and the Weizmann Institute are among them. Aside from the seven state universities, there is The Open University in Tel Aviv, which focuses on distance education and open admittance, as well as the many regional and academic institutions around the nation. TTOs, or Technology Transfer Offices, are closely tied to universities. TTOs are entities in charge of spreading knowledge, R&D, and innovation from academia to the commercial sector. TTOs are available at all six Silicon Wadi institutions.

With the early recognition of knowledge as Israel's primary asset, the emphasis on commercialising knowledge has been institutionalised through TTOs.
In Israel, universities have a prominent role in developing unique technology solutions fit for innovation. This is clearly expressed in the programmes listed in the section "Important Government Policies and Programmes," where the Magnet programme and its progeny, in particular, have played an important role. The TTOs also play an important role in commercialising university-created technologies, R&D, and know-how. TTOs at the various Silicon Wadi universities are :

• Bar-Ilan University Research and Development

• Yizzum Technology Transfer at the Hebrew University of Jerusalem

• T3 at the Technion Israel Institute of Technology

• Ramot at Tel Aviv University

• Carmel Haifa University Economic Corporation at the University of Haifa

TTOs are university-owned businesses that are completely self-sufficient. They differ in terms of size, profitability, tradition, and business methods, but they all have the purpose of commercialising ideas and generating revenue for universities. They are for-profit businesses that operate independently of the institution. The majority of them employ commercialization tactics like as licencing, forming university spin-off firms, forming joint ventures, and collaborating on research between academia and industry. Furthermore, several universities invest in spin-off enterprises. The technology is often licenced to a startup entrepreneur who further develops the firm and seeks cash investments. Researchers are seldom involved in firm administration or commercialization, preferring to work as expert consultants or in non-managerial positions for a limited time. Furthermore, TTOs offer a variety of services to researchers. Evaluation of the innovation and its commercial feasibility and potential, patentability checks, and counselling through the patent procedure are all common services. The incentive systems are frequently designed such that the innovator receives 30-60% of the royalty payments.

5.3 The role of the government

The administration has been enacting policy programmes with varying degrees of effectiveness. Inbal, Yozma, Magnet, and the Technological Incubator Program were developed to directly promote the ICT industry, according to Harel and Avnimelech (2012). The LECI, or Law for the Encouragement of Capital Investments, the OCS, or Office of the Chief Scientist, the BIRD, or Binational Industrial R&D, and the LEIRD, or Law for the Encouragement of Industrial R&D, have all been significant tools in the creation of the Innovation and Technology Policy, or ITP.

There is broad agreement that government-led policies are essential for developing a thriving innovation ecosystem and a healthy venture capital market in Israel. Lach et al. (2008) offer empirical proof for this claim. Government involvement has effectively handled social concerns and changes in market conditions by utilising a number of mechanisms.

When LECI went into effect in 1959, the government began to fund civilian R&D in the nation. Since then, various revisions have been made. The law favoured projects with significant value addition and marketing potential in both domestic and foreign markets. Companies with qualifying projects were given the title as Approved Enterprises or Beneficiary Enterprises after being approved by a division of The Ministry of Industry, Trade and Labour. They were then in a position to collect subsidies from the government and/or tax advantages in various kinds. The law was purposefully biased in favour of foreign investors to entice foreign businesses to Israel. It worked effectively, allowing businesses like IBM, Motorola, and Intel to develop a foothold in Israel in the 1960s and 1970s. The establishment of the Office of the Chief Scientist (OCS) inside the Ministry of Industry and Commerce was suggested by a government panel in 1968. The OCS's main objective was to provide money to private businesses working on commercial R&D initiatives. Prior to this, the majority of the funding went to national R&D labs, academic research, R&D for the defence industry and agricultural research. Industrial R&D expanded significantly in Israel after the OCS was established.

According to Toren (1990), industrial R&D spending surged at an annual rate of 14% between 1969 and 1987, while high-tech exports increased from just $422 million in 1969 (in 1987 USD) to $3316 million in 1987.

To create a link between American and Israeli businesses, the Binational Industrial Research and Development Foundation, or BIRD, was established in 1977. The goal was to acquire access to the American market through joint ventures in which an Israeli company created and produced the product, while an American company marketed and distributed it. 50% of the research project's anticipated budget was supplied by BIRD. Despite the fact that many of the initiatives were successful, no study of BIRD's effects has been conducted. However, the economy's generally sluggish development implies that BIRD alone was unable to spur economic growth. Senor and Singer (2009), on the other hand, note that BIRD has spent $250 million to far in 780 projects, generating $8 billion in direct and indirect sales.

The "Law for the Encouragement of Industrial R&D" (commonly known as the "R&D Law"), which has subsequently undergone several amendments, was passed in 1984, marking a crucial turning point. This legislation has been essential in determining how the Israeli government approaches industry R&D and has institutionalised government funding for civilian R&D. Its main goals—which were supervised by the OCS—were to encourage the growth of science-based enterprises focused on exports, therefore fostering employment and enhancing the balance of payments. The law sought to advance and take use of the nation's technical and scientific infrastructure as well as its highly qualified workforce in order to accomplish these aims.

The government realised that the research and development (R&D) grants given to the business sector, which had been a crucial part of Israel's innovation policy since 1969, were not adequately addressing the post-R&D phases of the innovation process, including management and marketing capabilities. With an emphasis on areas other than R&D additionality, this realisation led to the designation of venture capital (VC) and assistance for startups as the new national priority for innovation and technology. Two VC-directed programmes were implemented as a result of these convictions: the successful Yozma programme and the failing Inbal precursor programme. Although there was just a one-year gap between the two programmes' start dates and a five-year overlap in their implementation, the two programmes' results were drastically different despite having

comparable aims. The Yozma program's design was extremely important in explaining why it performed better. Promoting the regional stock exchange and creating a venture capital (VC) business in Israel were the two main goals of the Inbal programme.

The program's main goal was to encourage VC funds to make investments by offering a downside guarantee. This guarantee was made available by the government-owned insurance firm Inbal, which offered VC funds trading on the Israeli stock exchange (TASE) a 70% guarantee. The programme did, however, meet certain difficulties. Despite the creation of four funds, the overall success of both the funds and the Inbal programme was modest. The funds confronted bureaucratic challenges and poor stock market values. Additionally, publicly traded VCs had difficulty using their reputation from successful early exits to draw in more funding. Publicly listed VCs lacked the required incentives for considerable expansion, in contrast to limited partnership (LP) types of VC organisations, which could readily secure a second round of capital.

Because of this, all funds finally tried to leave the programme, and they were successful. The former Inbal Funds were incorporated into other holding or investing firms. Avnimelech (2004) and Avinmelech and Tebal (2006) both noted that Inbal needed a method for luring experts in venture capital to the programme. Because of this, it was unable to produce venture capital firms with value-adding skills, particularly those brought in by seasoned investors. It was also susceptible to stock market swings and momentary decisions. However, the authors' interviews have shown that both businesspeople and officials took note of Inbal's underwhelming influence. The difficulties in leveraging the reputation from successful early exits to raise new capital, restrictions on decision-making flexibility and management compensation, and the lack of incentives for upside growth were among the insights shared by publicly traded VCs.

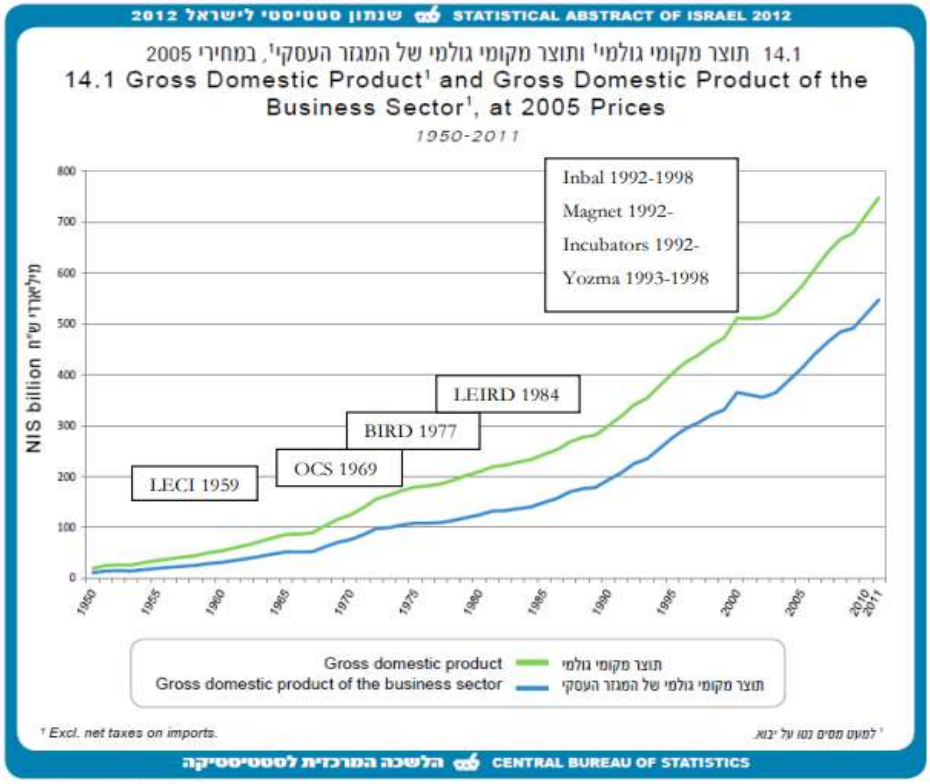
The Yozma programme, which was launched between 1992 and 1997 and means "initiative" in Hebrew, is widely regarded as the catalyst for the development of the Israeli venture capital market. Its stated goal was to lay a solid basis for Israel's competitive venture capital market, one that would be characterised by a sizeable quantity of cash and activity. The programme aims to build a network of global relationships and gain knowledge from foreign limited partners. The programme was built on a $100 million government-owned venture capital fund called Yozma, which had two objectives. First, it entailed investing $80 million in 10 Yozma Funds, private venture capital firms.

Second, $20 million was allotted for direct investments in high-tech businesses. With assistance from the government and participation from reputed overseas venture capital investors, the major goal was to promote the creation of local limited partner venture capital funds that would invest in early-stage Israeli high-tech businesses. Each Yozma fund was required to collaborate with a reputable Israeli financial institution and a foreign organisation as a limited partner. To guarantee a competitive sector free from ingrained financial system routines, the venture capital business itself had to be a brand-new company that was not controlled by any existing financial institution. The government would invest 40% (up to $8 million) of the money earned through Yozma once a fund satisfied these requirements. The $100 million in government funds as a consequence would draw at least $150 million in private funding from both domestic and international sources. Each Yozma fund included a call option on government stock that was exercisable for a five-year term at cost (plus interest). In addition to providing supply and risk-sharing incentives to investors, the structure also offered an upside reward through the purchase of government shares, allowing private investors to double their gains. The government incentive was made more substantial by increased returns, which encouraged the arrival of professional venture capital companies and managers.

The programme also mandated the involvement of international financial institutions, ensuring knowledge development. According to Avnimelech (2004), Yozma's effectiveness as a catalyst for Israel's ICT Cluster may be attributed to four sets of variables. First off, there are certain advantageous background circumstances like a helpful infrastructure, a trained labour, and a friendly business climate.Second, experimentation by policymakers and market forces was important. This made it possible to test and improve the tactics that would ultimately increase Yozma's efficiency. The time was the third element. The programme did, in fact, correspond with the Nasdaq index's expansion and the rising ICT market. The Yozma program's successful development and rollout was the last stage. The Yozma case, as noted by Trajtenberg (2002), is noteworthy because the government quickly addressed a pressing need—the absence of a robust venture capital market to enable innovative companies to find the necessary funds and management skills—and did so in a way that guaranteed a limited and temporary involvement (with a predetermined expiration of 7 years).

Yozma's role was limited to that of a mediator and facilitator in an area where governments normally don't have a competitive edge. However, instead of assuming that the "invisible hand" would carry out its tasks on its own without help, the government took on the role of a one-time entrepreneur to guarantee that the programme was carried out on schedule.

Figure 7 The different governmental programs and policies mapped towards the GDP development in Israel.



Source: Tables 14.1, 14.2

5.4 The Magnet program

Israel's high-tech industry has expanded significantly since the late 1960s, but by the early 1990s it was clear that the country's industrial landscape was dispersed. With a few notable exceptions, the majority of Israeli industrial enterprises were too tiny to keep up with the rising expenses of creating new technology in cutting-edge industries. Israel possessed famous research universities, but they were autonomous of the requirements and advancements of the local industry. Because of this, the enormous economic potential of highly skilled academic labour and academic research was largely unrealized. (1999) Trajtenberg. The Office of the Chief Scientist (OCS) launched the Magnet programme in 1993 in response to this circumstance. The programme sought to aid in the development of consortiums made up of commercial businesses and academic institutions to create precompetitive, generic technology. These consortia got funding covering 66% of the approved R&D expenditure for a multiyear period, usually spanning three to five years, without being required to pay anything back. In addition to Israeli academic institutions undertaking research in scientific fields pertinent to the consortia's technical aims, the consortia were obliged to include a varied collection of industry members functioning in the relevant sector.

Consortium members had to agree to make the resulting goods or services accessible to any interested local party at rates that did not indicate monopolistic control in order to handle any antitrust legislation disputes. When the consortia reached the equivalent of the pilot plant level, support for them was cut off under the Magnet programme, which prioritised promoting precompetitive technologies. In other words, the programme did not support the further R&D necessary for the items to be commercialised. However, member businesses might qualify for ongoing OCS funds for additional growth. The Magnet programme operated on a competitive basis, inviting proposals for the establishment of new consortia, and choosing those judged deserving of funding based on a ranking methodology, in contrast to ordinary OCS financing for industrial R&D 22 projects. There were 18 functioning consortia with a total budget of around $60 million by the end of 1999, along with four other consortia that were in various phases of preparation. These consortiums work in a variety of technical areas, although they mostly concentrate on energy, communications, microelectronics, and biotechnology. The Israeli

Innovation Authority still runs the Magnet programme today, and it receives the second-largest budgetary allotment, after the R&D Fund mentioned above. There are now three different types of consortia. The first is the Industrial Consortium, where innovators in technology from Israeli business work with academic researchers to create significant goods for the Israeli economy. The Knowledge Building Consortium is the second, where academic research is done in areas where industry is not currently actively engaged in R&D but has the potential to expand via the maturing of knowledge. Last but not least, there is the Ma'agadon, where a select group of businesses receive support from university academics for targeted technical development that has a big influence on their company activities. enterprises in these consortia receive up to 66% [10] of the permitted budget, whilst research institutes get 100% of it, 80% of it as a grant, and 20% of it from the consortium enterprises. The work plans for 11 consortia were authorised for funding totalling 175 million NIS (about 43 million USD) in 2021, according to the Israeli Innovation Authority (2022, 2023), while 5 further projects received preliminary clearance. The overall amount of grants authorised in 2022 was considerably larger, coming to 210.5 million NIS (about 56.7 million USD).

[10] In the case of Knowledge-Building consortium the grant is tailored on the companies' needs

5.5 The incubator program

Organisations known as technical incubators offer assistance to budding entrepreneurs, offering them the chance to develop their cutting-edge technology concepts and launch new firms for commercialization. When immigration from the former Soviet Union peaked in the early 1990s, this programme was launched. Numerous of these immigrants were highly accomplished scientists and professionals who gave Israel substantial human capital as well as cutting-edge product concepts. They lacked access to cash, management abilities, knowledge of languages like Hebrew and English, experience with western countries' commercial practises, and other crucial components for company success. Although the programme was first designed with recent immigrants in mind, it is now accessible to everyone. The incubators' main objective is to support inexperienced business owners in the early phases of their technology initiatives by helping them put their ideas into practise and launch new businesses. The basic assumption is that the technical incubator materially increases the chances for the entrepreneur to get more capital, identify strategic partners, and leave the incubator with self-sustaining firms. The riskiest phase is the beginning, particularly in the early 1990s when there were almost no alternative sources of funding for these endeavours in Israel. However, from the middle of the 1990s, there has been an increasing inflow of venture capital, which may have a negative impact on the importance of the risk-sharing role that this programme first supplied. Each incubator offers support in a variety of sectors and may host 10 to 15 projects at once. This include determining the idea's feasibility from a technological and marketing standpoint, creating an R&D strategy, putting together the R&D team, obtaining money, getting ready for marketing, and offering secretarial, administrative, maintenance, procurement, accounting, and legal assistance.

The incubators allegedly oversaw close to 700 enterprises between their formation in 1991 and the end of 1998, according to Trajtenberg (2002). The success percentage of the 500 initiatives that "graduated" from the programme at that time was about 50%, which means that half of them were able to continue on their own while the other half were abandoned. About 200 of the winning initiatives were able to secure further funding, with amounts ranging from $50,000 to several million dollars.

The programme has developed through time and is still in use today. Since 1998, when the maximum award for each project was $150,000, it has grown dramatically, reaching approximately $1 million at the present. Depending on the project type and the location of the incubator, the Israel Innovation Authority contributes up to 85% of the project expenditure for a two-year period [11] . If the initiative is successful, a royalty on yearly sales is expected in exchange. The incubator's managers can cover the remaining 15% of the budget, absolving the entrepreneur of any financial commitment. However, in these situations, ownership of the newly established firms' shares is necessary. In Israel, there are 15 incubators that are currently operating. The entire amount of funds awarded under this programme in 2022, according to the Israel Innovation Authority (2023), was NIS 167.5 million, or around USD 45 million.

[11] In some cases, a further grant for the third year could be approved.

5.6 International cooperation

Israel's high-tech industry's main edge is its technological know-how during the research and development stage. Due to their physical distance from their target markets and their modest size, Israeli high-tech enterprises, nevertheless, encounter substantial difficulties when trying to promote their goods overseas. As a result, working together with foreign businesses that are already established in such areas may help Israeli technology and goods expand internationally. The Israeli government has signed various bilateral agreements for research and development collaboration with other countries in keeping with this goal. These agreements are meant to make it easier for Israeli and international businesses to collaborate on R&D, production, and marketing projects. Foreign businesses stand to gain from having access to cutting-edge Israeli technology and may also benefit from Israel's current free trade agreements with the US and the EU (a luxury afforded by few nations).

The collaboration with the United States is one of several international cooperation agreements that is of great significance. The governments of Israel and the United States came to an agreement in a treaty that resulted in the creation of the Israel-U.S. Binational Industrial Research and Development Foundation (BIRD) in 1977. Its main objective is to encourage and support cooperative non-defense industrial research and development projects that would help both nations' private sectors. BIRD is a standalone organisation, having its headquarters in Israel. A Board of Governors made up of officials from the American and Israeli governments is in charge of it. In order to promote cooperation between American and Israeli businesses, BIRD provides complete support. This includes assisting in the selection of compatible partners for joint ventures through matching services. Additionally, BIRD offers funding for project development expenditures up to $1.5 million, paying up to 50% of the costs. The partnering firms do not grant the foundation any stock stakes. However, BIRD is qualified to obtain pre-tax royalties from the beneficiary if a project is successful, with a ceiling on the amount at 150% of the conditional grant. The firms are only excluded from paying back the grants in situations when a project fails and there are no sales.

The Foundation has authorised investments in more than 1000 projects since its foundation, awarding $390 million in grants to businesses (of which $115 million has been returned), according to BIRD (2023). These initiatives have generated $5,3 billion in direct technological sales. Israel Europe Research & Innovation Directorate (ISERD) is responsible for promoting the two countries' bilateral collaboration with Europe, which will be Israel's first commercial partner in 2022 [12]. The institution, which is run by the Israel Innovation Authority, is in charge of encouraging Israeli companies to participate in European R&D projects. The EU Framework Programme for R&D (Horizon Europe) and a number of bilateral cooperation agreements between Israel and European nations are two of the programmes that support the operation of the ISERD.

The Israeli Innovation Authority (and the Office of the Chief Scientist before it) have established a wide number of supplemental assistance programmes that cover help in almost every element of the R&D process, in addition to the primary programmes already mentioned. For instance, initiatives like the High-Tech Specialisation for First Job Employees encourage the development of a highly trained workforce. In order to help high-tech businesses create staff specialisation programmes, this programme offers funds. The Product Adaptation Incentive Programme for Emerging Markets, which provides incentives to assist businesses adapt their goods and services to target markets, is one example of a programme particularly created to promote exports.

81 active programmes supporting various phases of the invention cycle are now available from the Israeli invention Authority. A thorough explanation of each programme is outside the purview of this study. Even if some of these programmes have lesser budgets, they may nonetheless have played—and are continuing to play—a significant role in avoiding potentially feasible ideas from being neglected and in helping to fully realise the Israeli economy's inventive potential.

[12] Central Bureau of Statistics (CBS) data

Conclusion

Coming to a conclusion , we observed how the globalisation and internationalisation processes of markets and national economies have radically impacted the economic, commercial, financial, and social balances, calling many local socioeconomic entities into question. This last chapter summarises the main conclusions and revelations gleaned from the thorough investigation of high-tech clusters in Israel. The study process started with a detailed introduction, which was followed by a thorough assessment of the literature that dug into numerous high-tech cluster features, including their definition, models, benefits, drawbacks, and distinctive traits.

The research also looked at factors including competition, collaboration, innovation, and the effects of globalisation that are important for cluster growth. The dynamics of innovation within clusters were then investigated, with a focus on information dissemination, entrepreneurship, start-up culture, and research and development as key components. In-depth case studies of Israeli high-tech clusters were used for the empirical part of this study, with a particular focus on the high-tech industry, Israel's Open Innovation Ecosystem, and the iconic "Silicon Wadi." The chapter concludes by presenting the research and discussing its implications for the success of high-tech clusters in Israel, the role of the government, the Magnet programme, the incubator programme, and cross-border collaboration.

The development of the Israeli innovation ecosystem has been greatly aided by the government. The Innovation and Technology Policy (ITP) can be divided into two phases: the first phase (1970–1990) concentrated on the dissemination of R&D throughout the business sector and was characterised by Horizontal Technology Policy (HTP), while the second phase, also known as the Silicon Valley Period, began in 1990 and implemented policies aimed at addressing specific needs for the ecosystem's development, such as the Yozma and incubator programmes. Israel's success has been attributed to the institutionalisation of innovation as a national priority through the R&D Law of 1984, as seen by a defined strategy and long-term thinking in government operations, regardless of political changes.

In conclusion, this thesis has offered a thorough analysis of Israel's high-tech clusters, their growth, and the variables influencing their success. Insights into cluster dynamics have been gained through case studies of Israeli high-tech clusters, which also examined governmental programmes like the Magnet and incubator programmes. Israel's high-tech hubs are proof of the ability of entrepreneurship, human capital, governmental assistance, and cross-border cooperation to spur economic progress. Lessons from Israel's experience can guide cluster development plans in other areas, promoting economic growth via innovation and technology.

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