Samuel Neaman Institute
For Advanced Studies In Science And Technology

Innovation of Foreign R&D Centres in Israel: Evidence from Patent and Firm Level Data

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Abstract

This research sets out to investigate the impact of multinational companies (MNCs) on the Israeli economy in terms of demand for innovation. Two main impacts are analyzed: (1) positive spill-overs to the national economy stemming from the collaborations of MNC subsidiaries (foreign R&D centres) with local Israeli firms. (2) Potential loss to the Israeli economy from the utilization of locally produced IP and know-how by MNC subsidiaries. Firm level data, containing information on the characteristics of local and foreign companies was linked to EPO's PATSTAT database in order to capture the scope of innovation activity by these firms. In addition, unstructured questionnaires, aimed at understating the IP policy of foreign R&D centres and exploring the ties between the centres and local Israeli firms, were sent to representatives of foreign R&D centres. The findings of the research show that the rate of transfer of Israeli IP, know-how and technology to the possession of MNCs has substantially increased in the past decade. There is an increasing trend of obtaining Israeli IP by means of acquisition of Israeli firms and start-ups. The potential loss of locally produced IP to foreign MNCs was found to be more severe in the case of MNCs that operate relatively small R&D centres in Israel. Innovation and knowledge flows were found to run in a two-way direction, exerting positive impact on the Israeli economy. The activity of MNC subsidiaries was found to spur demand for locally produced goods and services, to promote technological spill-overs to local firms (especially start-ups) and to expose the junior and senior levels of Israeli management to the organizational culture of giant multinational firms.

1. Introduction

In the past few decades, globalization trends have led to a rapid growth in international business activity and foreign direct investment (FDI). Multinational corporations (MNCs) have become key actors in this process, mainly due to their ability to efficiently shift capital and activities internationally according to changing demand and costs. The unique centralized structure of MNCs (control on subsidiary companies worldwide) and their ability to commit to large capital investments have provided them with competitive advantages over local companies.

MNCs also play a major role in the internationalization of R&D and innovation due to their growing R&D investments abroad. Through investment in R&D abroad, MNCs aim to improve their existing holdings and to acquire or create completely new technological assets. While the majority of R&D investments and decision making are still concentrated in their home-countries, often close to the MNCs' headquarters, the role of foreign affiliates of MNCs is becoming increasingly significant (Feath, 2009; OECD, 2007). Policy makers are interested in the direct and indirect value that new

investments by MNCs may bring to their country. By enticing multinationals to establish local affiliates, decision makers in host countries hope to attract capital, create jobs and encourage a process of technology transfer that may benefit domestic firms and the local economy at large.

A knowledge spill-over is defined as the spread of knowledge stemming from R&D activities among various firms in an uncontrolled, unguided manner that leads to or supports technological improvements. Such spill-overs can take place in diverse ways such as: adoption of new technologies, cooperation agreements, transition of employees between firms, etc. (Griliches, 1998).

In this paper, we seek to focus on two important spill-over effects that MNCs exert on the economies of host countries: (1) their relationship and impact on local firms (2) utilization of locally produced IP and know-how. First we'll review the literature concentrating on spill-over effects of MNCs. Second, we'll review the activity of multinational companies in Israel and explain why these two spill-over effects are especially important in the case of Israel. Third, we'll provide qualitative and quantitative analyses, based on patent data, firm-level data and open-ended questionnaires probing the impact of these spill-over effects on the Israeli economy.

2. Direct and indirect impacts of MNCs on the national economies of host countries

2.1 Location factors

MNCs are central actors in the global innovation process. As a result, domestic innovation activities in host countries are affected by the location decisions taken by these global firms. There is a growing interest among countries to formulate policies aimed at attracting MNCs, especially those specializing in high-technology and R&D activities.

A considerable volume of evidence exists in the economic literature regarding the importance of supply-side processes in attracting MNCs and FDI investments. Faeth (2009) classifies these government incentives into three main categories: fiscal incentives (e.g. tax exemptions and credits, etc.); financial incentives (grants, subsidies, etc.) and other incentives (e.g. subsidised services and infrastructure, preferential treatment). A great deal of debate exists among experts as to whether the use of public funds is economically justifiable. Critics argue that government support merely reflects private interests, and that consequently the costs to the host economy are larger than the benefits (Greenstone and Moretti, 2004). The argument in favour of government intervention in attracting international investment is largely based on the existence of

externalities – the unintended benefits or spill-overs from MNCs to local firms that result in productivity growth in host economies (Caves, 1996).

The UNCTAD's[1] World Investment Prospects Survey 2009–2011 provides interesting and contradictory findings to the ones reported above regarding the role of supply-side incentives in attracting FDIs by large transnational corporations (TNCs). The survey included a sample of company executives who were selected among the largest non-financial TNCs. The executives were asked to rate a set of location factors crucial for TNCs when considering new investments (UNCTAD, 2009). An interesting result of the survey which was repeated across industries was that government incentives are a relatively minor factor in the location decisions of TNCs relative to other ecosystem location advantages which are more market and environment based. An additional survey held in North Carolina, a state which has developed one of the most aggressive programs in the United States for attracting multinational corporations confirms this finding (Rondinelli and Burpitt, 2000).

The above findings do not imply that government incentives are not important factor for investment, but rather that there are other important location factors. These factors are related to the host country's technological infrastructure, to the presence of other firms and institutions that may create benefits which investing firms can absorb and to the existence of appropriate infrastructure needed for conducting R&D activities. Additional important location factors and investment considerations identified in the economic literature include: access to highly skilled human resources (Von Zedtwitz and Gassmann, 2002; Chung and Alcacer, 2002); the stock of private R&D capital in host countries (Erken and Kleijn, 2010); access to high quality scientific infrastructure (Abramowsky et al., 2007; Karlsson and Anderson, 2005); existence of agglomeration economies and economies of scales (Head et al., 1999; Head and Mayer, 2004); tapping informal networks of knowledge (Von Zedtwitz and Gassmann, 2002); market size, e.g. China and India (Kumar, 2001; Shimizutani and Todo, 2008; Friedman 2011); the cost of R&D resources (UNCTAD, 2005; Ernst, 2006) and the degree of IP protection in the country (Athukorala and Kohpaiboon, 2005).

2.2 Impact of MNCs on the economy of host countries

The role that MNCs play in the economic development of host countries is subject to vast debate. On the one hand, MNCs may help emerging economies in the modernization of their economies and industries by transferring technology, know-how and skills. MNCs may also provide host countries access to export markets, intensify competition, and offer local markets better or cheaper goods and services than those of

[1] United Nations Conference on Trade and Development

local producers (De Mello, 1999). On the other hand, MNCs may stifle economic development by limiting host economies to low value- added activities and by crowding out local investments and jobs. Furthermore, anti-competitive practices of MNCs may reduce consumer welfare and build consumption patterns that are unsuited for host countries (Caves, 1996; Buckley and Ghaury, 2002; Cypher and Diez, 2004).

2.2.1 Impact of MNCs on local firms

The positive spill-over effects that may arise from the interaction of MNCs with local companies and industries constitute a decisive factor in the decision of governments to attract MNCs to host countries. Spill-over effects arise from direct and indirect mechanisms (Scott-Kennel and Enderwick, 2005). Indirect spill-overs result from labour turnover and enhanced competition, and thereby affect the behaviour and performance of domestic firms (Castellani and Zanfei, 2006). Direct spill-overs are created as a result of direct relationships between MNCs and local firms. These linkages can be organized into three main groups: (1) Supply chain linkages with suppliers, customers or agents; (2) Collaborative linkages with other firms such as alliance partners or competitors; (3) Institutional linkages with governments, research institutes, industry organization and universities (Giroud and Scott-Kennel, 2006). Direct spill-overs induce improvement in quality and efficiency of local firms by creating demands necessary for attaining economies of scale and providing access to advanced resources (Saliola and Zanfei, 2009).

There are different channels in which MNCs may influence local companies. One of these impacts can result from the **movement of employees** from MNCs to local firms. MNCs invest in human capital through the training of local workforce. Highly skilled individuals may move to locally owned firms or start their own entrepreneurial businesses while taking the “tacit knowledge” acquired from their work in the MNCs with them (Fosfuri et al., 2001). Studies on successful local firms found that many entrepreneurs and top executives had prior links to MNCs (Fosfuri et al., 2001; Glass and Saggi, 2002). Labour mobility from multinationals to host firms occurs predominantly in more developed countries, where multinationals do not have substantial advantage over host firms (Glass and Saggi, 2002; Bloom, 1992; Pack, 1997).

Additional positive processes that may arise from the backward and forward linkages between MNCs and local firms **are the growth in the activity of local suppliers and final-goods-producing firms.** Foreign firms often purchase intermediate goods from domestic suppliers, a process which can create spill-overs through several mechanisms. MNCs may improve the productivity of local firms by providing **technical**

assistance and **employee training** to increase the quality of produced goods, by **coordinating management and organization of tasks** and by assisting local firms with the **purchase of raw materials** (Markusen and Venables, 1999; Rodriguez-Clare, 1996). MNCs may set **higher standards** regarding product quality and service-oriented aspects such as “just in time” delivery. These standards may provide incentives for improving product quality and the production process. At the same time, FDI may increase demand for intermediate goods, thus allowing local suppliers to achieve scale economies (Smarzynska 2002). Finally, MNCs use their financial and organizational strength to push for further **development of the commercial infrastructure and regulation** in the host country, a measure that may also benefit local firms (Rugraff and Hansen, 2011).

The literature suggests that spill-overs effects triggered by MNCs also constitute a cost for MNCs affiliates, as benefits obtained by local firms may materialize into increased competition (OECD, 2011). According to Blalock and Simon (2009), new technology is most likely to be transferred through the “vertical relationships” that MNCs establish with local firms. When business partners do not invest in “relationship-specific assets”, competitive advantage is unlikely to arise from the partnership (Holm et al., 2005). Moreover, local firms that do not provide ‘‘complementary capabilities’’ for MNCs would have less access to the technology of the MNC’s subsidiary (Blalock and Simon, 2009). Hence, given the existence of competitive pressures in the local business environment and the absence of business relationships or complementary capabilities, there are few incentives for the subsidiary to willingly engage in knowledge exchange with its customers and suppliers, since this could undermine the basis for its competitive advantage (Hallin and Holmstrom, 2012).

2.22 Transfer of local IP and know-how to the possession of MNCs

The interests of MNCs are not always in line with local interests. Knowledge is more likely to flow from foreign units to the parent company if the foreign affiliates undertake asset augmenting R&D activities that generate knowledge that is valuable (‘core activity”) for the MNC (OECD, 2008; OECD, 2011; Avidan-Shpalter, 2012). Singh (2007) used patent citation data to examine the way knowledge flows between MNC subsidiaries and host country organizations in 30 countries. His analysis reveals that while local MNC subsidiaries are significant source of knowledge for the host country, they are also very effective as a channel in which foreign MNC gain access to the technology of the host country. Singh found that in technologically advanced countries, MNC subsidiaries gain significantly more than they contribute in terms of knowledge.

This tension is especially evident when MNCs acquire the intellectual property (IP) of

innovative local technologies and develop it in R&D centres outside the country. The income derived from intellectual property is highly mobile. MNCs can hold patents, which are one of the more important forms of intellectual property, at distance to the location where the underlying technology was created and to where it will be applied. In such cases, the country is not rewarded with the taxes received from the sale of products based on the IP (Griffith et all., 2011).

The acquisition of local companies by MNCs has an enormous economic impact on business development and job creation. Development of IP outside the country decreases the growth of demand in the products' value chain, thus minimizing the potential growth of the entire industry. Although governments in host countries receive taxes from IP sales, the amounts are rather small as compared to the economic gains that could have been achieved had larger companies been built based on the IP (Breski et all., 2011).

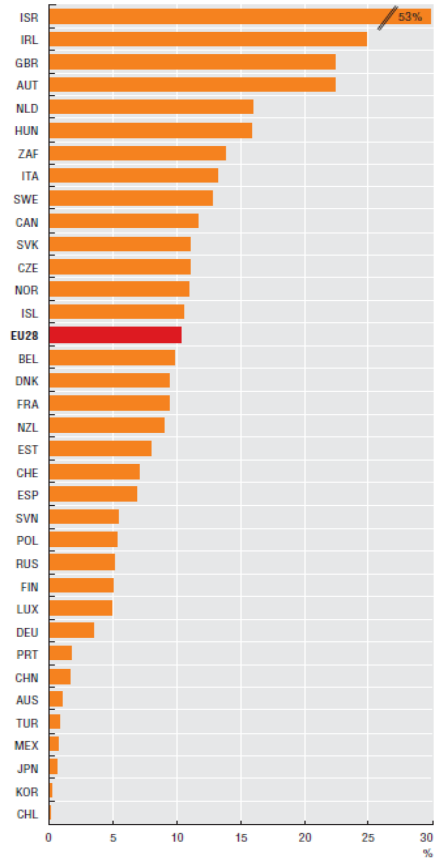
3. The activity of MNCs in Israel

Over the past three decades, the Israeli economy has gone through major structural change, transforming from an exporter of primary sector (agriculture and mineral mining) and secondary sector (mainly diamond polishing) goods to an innovation-driven and knowledge based economy. Gat (2004) has coined this transformation as "moving from oranges to (micro) chips". According to Trajtenberg, the structural changes in the Israeli economy were made possible due to the efforts of the Israeli government which actively supported export-oriented industrial R&D and the harness of spill-overs from the advanced Defence sector to civilian industries. Since the end of the 1970s, a number of supply-side initiatives have been taken by the Israeli government to attract MNCs. These include: tax incentives, policies to stimulate capital investments, and incentives for the development of foreign venture capital (Trajtenberg, 2001). A number of government agencies are involved in attracting foreign direct investments to the country. The Israel Investment Promotion Centre at the Ministry of Economy promotes FDI into Israel, and encourages additional investment by multinationals that already invested in the country. A number of foreign R&D centres in Israel are funded by the Office of the Chief Scientist. These MNCs primarily receive funding on the premise of carrying out joint R&D projects with local Israeli companies, usually start-ups (Kirschberg, 2012).

Due to government incentives and the availability of high level human capital, Israel has turned into an attractive location for R&D operations of leading multinationals. Funding from abroad constitutes today a major portion of Israel's total business enterprise R&D

funding. Recent OECD data (Figure 1) shows that the weight of foreign multinationals in the Israeli economy stands on 53%, as compared to no more than 25% in other OECD countries (OECD, 2013).

Figure 1: Business enterprise R&D funded from abroad, as a percentage of business enterprise R&D, 2011[2]



In 2009, foreign multinational companies were responsible for employment of 132,000 workers through local subsidiaries. The extent of output of Israeli affiliates under foreign control has increased by 121% from 2002 to 2009 and reached $29 billion (14.5% of the business sector output). Exports of goods and services of Israeli subsidiaries of MNCs amounted to $17 billion in 2009, and comprised 28% of total exports. Of these exports, 77% were designated for the parent companies and other affiliates abroad. The share of these companies was high in the manufacture of electronics components (60% of the output in 2008) and in the manufacture of electronic communication equipment (46%). The output of Israeli affiliates under foreign control in the computer and related services and R&D industries was 45% of the industries' total output and their exports constituted 57% of the industries' total exports (Degani and Gorodisky, 2012). Recent data from the "Business R&D survey", carried out by the Israel Bureau of Statistics (CBS), exposed that the average wage rate for full-time R&D positions in local

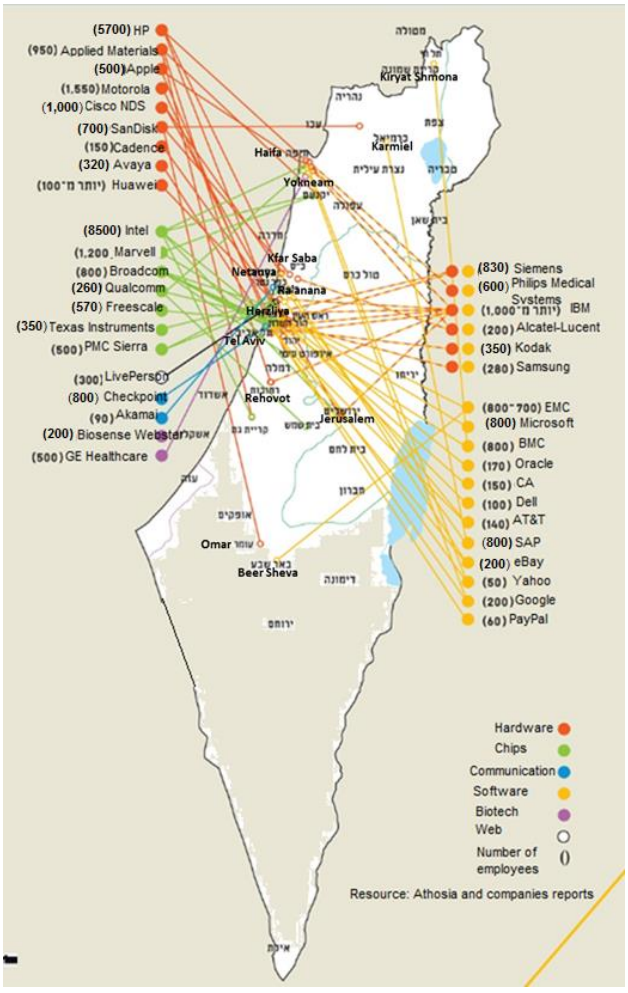
[2] Source: OECD, Main Science and Technology indicators database. www.oecd.org/sti/msti.htm

subsidiaries of multinational companies was 1.5 times higher than similar positions in local companies, as the top layer of Israeli talent is employed in these companies (Kirschberg, 2012).

3.1 Characteristics of foreign R&D centres in Israel

R&D centres are Israeli subsidiaries of foreign multinational firms whose key objective includes carrying out technological research and development activities. These tasks are conducted in facilities based on local infrastructure and local staff of scientists and engineers. According to the Israel Venture Capital Database (IVC), 264 foreign R&D centres are currently active in Israel. Most of these R&D centres are a part of large international firms (mostly in the technological sector) that acquired Israeli companies in the past decade and transformed them into local research facilities. The activity of few R&D centres (e.g. Intel, Applied Materials, Motorola, IBM), spans more than three decades. Figure 2 presents the distribution of key R&D centres by their geographical location, technological sector and number of employees.

Figure 2: Main R&D centres in Israel: distribution by sector, number of employees and geographic location

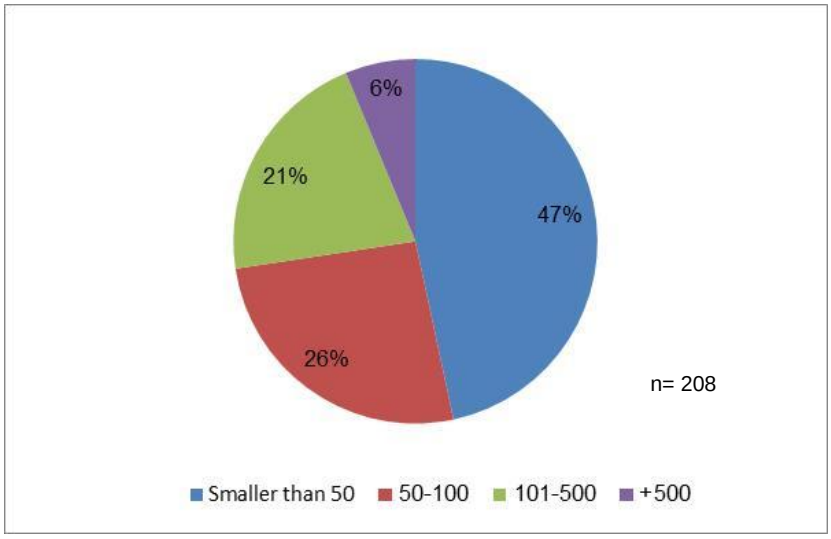


Source: Orpaz, 2013 & the IVC database. Special data processing by SNI.

As can be seen from Figure 2, the activity of most R&D centres is concentrated in central Israel (Tel Aviv metropolitan area). This is due to the fact that the Israeli economy is characterized by clear spatial dichotomy of its industry. Most of Israel's tertiary and quaternary sectors are located in the core, whereas most of its primary and secondary industries are situated in the periphery (Frenkel and Leck, 2014). Shefer and Shefer and Frenkel (1998) attribute the concentration of R&D activity in a region to the existence of "a local innovation milieu". This distinct physical and human environment which constitutes the main catalysis for innovation is prevalent in the Core region. It highly relies on the existence of agglomeration economies, regional spillovers and collaboration among firms.

Figure 3 presents the distribution of R&D centres by firm size. As can be seen from the chart most of the R&D centres are small in size. Approximately 73% of them employ less than 100 workers. Only 6% of the R&D centres employ more than 500 workers (e.g. Intel, Applied Materials, HP, Motorola, IBM, and Marvell).

Figure 3: Distribution of foreign R&D centres by firm size

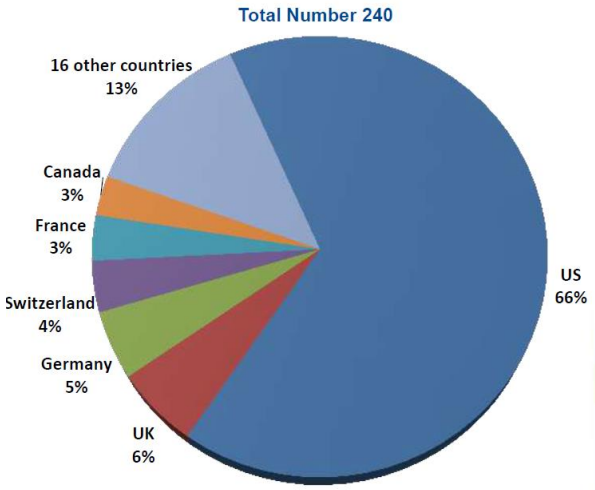


Source: Israel Venture Capital

Figure 4 shows the distribution of the R&D centers by the parent country of origin. Almost two thirds of the R&D centers in Israel belong to American multinational firms. The share of European parent companies holding Israeli R&D subsidiaries stands on 20%. Nearly 27% of foreign R&D centers belong to the IT and Enterprise Software sectors (Figure 5). The Communication, Semiconductors and Life Science sectors constitute approximately 50% of the activity of these firms in Israel (13%-18% each). According to Avnimelech and Teubal (2005) and Avidan–Shpalter (2012) the emphasis placed by MNCs on these four sectors in Israel stems from the country's relative

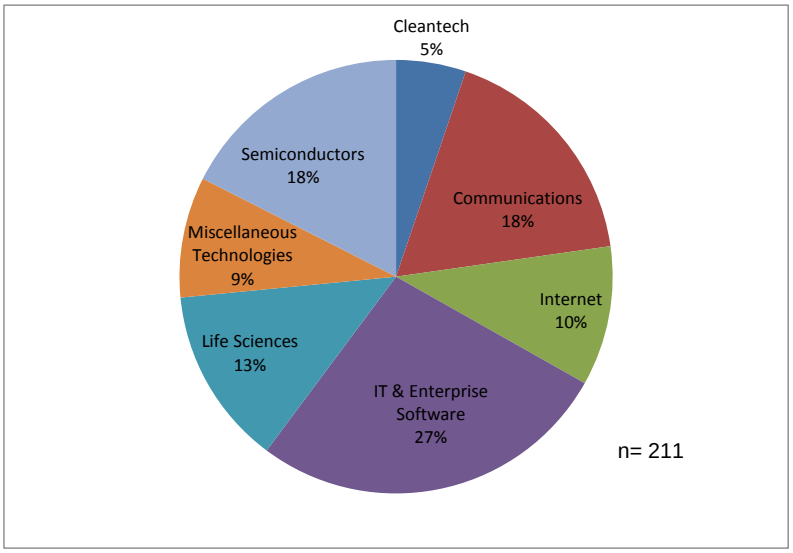
advantage in scientific infrastructure, skilled labour force and entrepreneurial culture. These important factors strongly foster R&D activity.

Figure 4: Distribution of foreign R&D centres by country of origin



Source: IVC-ONLINE. Analysis: Invest In Israel (2011)

Figure 5: Distribution of Foreign R&D Centres in Israel by Sector



Source: IVC Database

Table 1 presents the key innovations developed by foreign R&D centres in Israel.

Table 1: Key innovation of foreign R&D Centres in Israel

R&D Centre	R&D Centre Sector (IVC classification)	Number of R&D Centres in Israel	Establishment Year in Israel	Number of employees in Israel	Key innovations/technologies/products
Apple	Semiconductors	3	2011	500	In the future: development of hardware & chips for I-phone and I-pad
Samsung	Semiconductors & Communications	2	1999	250	Galaxy Camera, eye tracking system for Galaxy S4 smartphone.
Yahoo!	Internet	2	2008	50	TimeTraverer application, smart advertising (market segmentation)
Google	Internet	2	2007	250	Google Autocomplete, Live Results, Google Related, Google Instant, Google Analytics
Intel	Semiconductors	5	1974	8,500	Pentium M microprocessor Sandy Bridge and Ivy Bridge family of processors.
Microsoft	IT & Enterprise Software	2	1989	800	Business Intelligence in the Cloud and in Office, XBOX Analytics: building a novel real-time recommendations platform for the Microsoft entertainment business.
General Motors	Miscellaneous Technologies	1	2011	60	Autonomous Vehicles; Human Machine Interface (HMI); Connected Vehicle;
Qualcomm	Semiconductors & Communications	3	1993	260	Wi-Fi technology and the next generation of wireless LAN connectivity; Mobile enterprise security technologies; Qualcomm Snapdragon Mobile Development Platforms; Digital pen and gestures based on ultrasound technology
HP	Miscellaneous Technologies	4	1994	5,700	Enterprise Swarm; Automatic Print Quality Inspection; Semantic Automation from Screen Capture; HP Indigo Photo Enhancement Server
SanDisk	Semiconductors	3	2006	700	TrustedFlash technology; digital cameras (with Zoran); SSD drivers
IBM	IT & Enterprise Software; Semiconductors	3	1949	1,000+	ECO-2000 Optimized Crew Scheduling System; Websphere Content Discovery Server; mobile shopping app

Sources:
Cohen, S. (12.4.2013). Made in Israel. Yediot Ahronot
State of Israel. Ministry of Economy. Invest in Israel http://www.investinisrael.gov.il/NR/exeres/6D7AC27B-BE48-4C16-A6CB-1BA2F58480BB.htm
The Companies sites

3. Methodology

3.1 Research motivation and objectives

The general trigger for this research stems from the need to understand the potential benefits and possible pitfalls from the activity of multinational companies in Israel. The research addresses two important spill-over effects that MNCs exert on the economies of host countries: (1) their relationship and impact on local firms and the national economy (2) their utilization of locally produced IP and know-how. The main objectives of this research are as follows:

- To Identify and assess of the role and scope of patenting activity of multi-national corporations in Israel.
- To evaluate of the extent of foreign ownership of domestic inventions by the MNCs.
- To provide an analysis of the possible implications to national economy arising from the outflow of Israeli intellectual assets (IP) to the hands of multinational companies.
- To capture the relationship between multinational companies (R&D centres) and local Israeli firms in terms of demand for innovation.
- To identify and analyse the possible positive spill-over effects on the national economy stemming from the activity of MNC subsidiaries in Israel.
- To draft policy implications and conclusions based on the research findings.

3.2 Research data and Design

In order to investigate the impact of multinational companies (MNCs) on the Israeli economy in terms of demand for innovation, a variety of methodological tools were employed. Firm level data, containing information on the characteristics of local firms and MNC subsidiaries was linked to EPO's PATSTAT database in order to capture the demand for local innovation by MNCs. In addition, unstructured questionnaire was formulated and sent to representatives of the foreign R&D centres. The questionnaire was aimed at understating the IP policy of foreign R&D centres in Israel and exploring the ties between the centres and local Israeli firms.

3.21 Unstructured questionnaires

We chose to address the question of the IP policy of foreign R&D centres in Israel and their ties to local firms by conducting on-line survey composed of short open-ended questions. The reason for choosing open-ended questions over close-ended

questions is twofold. First we hope to to provoke an unrestrained and free response on behalf of the respondents that will allow us to better understand the IP policy and the collaboration considerations of MNCs with local firms. Second, we seek to provide qualitative underpinning to our quantitative (patent) data.

Table 2: Open-ended questions in the unstructured questionnaire

Theme	Question
	Name of respondent
	Respondent's job title
	Name of R&D centre
	Name of parent company
Collaborations and ties between R&D centres and local Israeli firms	List the types of collaborations that exist between your R&D centre and local Israeli firms.
	List the types of collaborations that exist between your R&D centre and foreign firms.
	Are the main collaborations of your R&D centre conducted with Israeli or foreign firms?
	State the main considerations for choosing Israeli or foreign firms as the suppliers of products or services to your R&D centre.
IP policy of foreign R&D centres in Israel	Are the patents of the R&D centre being registered under local (Israeli) or foreign (e.g. parent company) ownership?
	In case of registering the patents under foreign ownership, what are the main reasons for it?
	Will Israeli ownership on the IP increase the chance for further R&D or production (services/products) in Israel?
	List the necessary conditions needed for carrying out additional stages of R&D or production Israel.
	What is the "added value" your R&D Centre to the Israeli economy?
	Additional remarks regarding IP policy and collaborations between R&D centres and local firms.

We used a web-based online survey platform (OPINIO software) to approach senior representatives (mostly at the CEO, General Manager and VP Business Development level) of multinational firms that hold an active R&D centre in Israel. The on-line questionnaires were sent to the respondents on September 15, 2013 and remained open to response until October 30, 2013. A total of 40 full questionnaires were obtained.

The questionnaire included nine open-ended questions (Table 2) relating to the types of collaborations that exist between the R&D centres and local firms and the main

considerations for choosing Israeli or foreign firms as the suppliers of products or services to the R&D centre. A number of questions referred to the IP policy of the MNCs (the question of patent ownership and its impact on the activities of the firm). Additional questions addressed the spill-over effects (added value) that arise from the activity of the R&D centres in Israel and the conditions (supply or demand side) that will enable these firms to expand their activities in the country in terms of further R&D and industrial production.

3.21 Patent and Firm Level Databases

Patents comprise a unique source for technological knowledge. They are considered to be a good proxy for invention skills, R&D activities and for the scope of technological innovation of countries, regions, sectors and firms. The use of patent statistics makes it possible to track technological changes and to examine knowledge transfer and R&D cooperation between various sectors and countries. Patent statistics can serve as a powerful and efficient tool in the analysis of innovation ecosystems, processes, networks, structures and trends at the macro and micro levels.

In the past decade, substantial methodological progress has been made in the field of patent statistics. This progress can be mainly attributed to the extensive research activity conducted within universities (e.g. KUL Leuven) and in international research organizations such as Eurostat[34] and the OECD[5]. The outcome of this innovative research activity has resulted in the development of new methodologies, databases and tools that vastly improved name harmonization, data retrieval, data segmentation and data analysis capabilities.

The state of the art in patent statistics today involves linking patent data to complementary databases in an attempt to supply additional information on the patent's assignees. In this research, a firm-level dataset is linked to the EPO's PATSTAT database in an attempt to Identify and analyse the inventive activity conducted by foreign R&D centres in Israel.

3 Du Plessis, M. Van Looy, B. Song, X and Magerman, T. (2009) Data Production Methods for Harmonized Patent Indicators: Assignee sector allocation. EUROSTAT Working Paper and Studies, Luxembourg.

4 Peeters B. Song X. Callaert J. Grouwels J. and Van Looy, B. (2009). Harmonizing Harmonized Patentee Names: An Exploratory Assessment of Top Patentees. EUROSTAT Working Paper and Studies, Luxembourg.

5 OECD HAN database, July 2011

The firm-level dataset used in the research is the ***"Foreign R&D Centres in Israel dataset"***, a specially tailored data subset extracted from the IVC (Israel Venture Capital) database. The main variables covered by this dataset are: Company name, prior name of company (e.g. the name of Israeli company or start-up acquired by the foreign R&D centre/MNC), technological sector and subsector, number of employees, geographical location, main markets targeted by the foreign R&D centre, sales and contact information (names and e-mails) of key figures representatives (mostly at the CEO, General Manager and VP Business Development level).

The EPO ***Worldwide Patent Statistical database (PATSTAT)*** constitutes the "backbone" of the research data. It includes data on patent applications and granted patents. PATSTAT is a "snapshot" of the EPO master documentation database (DOCDB) with worldwide coverage (more than 100 patent offices are covered), containing 20 tables including bibliographic data, citations and family links (DOCDB and INPADOC patent families).

An important complementary patent database used in the study is the ECOOM-EUROSTAT-EPO Person Augmented Table for PATSTAT (EEE-PPAT). The **EEE-PPAT** database, developed by the Catholic University Leuven (KUL) is aimed at harmonizing patent applicant names and allocating them to respective sectors (e.g. companies, universities, hospitals, government and NGO's and individuals).

An improved version of the EEE-PPAT database for Israeli patents (built by SNI) was used to identify all foreign owned applications (non-Israeli assignees, Israeli inventors) attributed to the business sector. The resulting data subset was linked (by company name) to the ***"Foreign R&D Centres in Israel dataset"***, encompassing information on the characteristics of 220 foreign R&D centres in Israel. The outcome of the matching procedure has allowed us to:

- Identify and evaluate the role and scope of patenting activity of multi-national corporations in Israel (matching the patent database with the Israel Venture Capital database).
- Evaluate the extent of foreign ownership of domestic inventions by the MNCs.
- Learn about MNC connections with local firms (through mergers and acquisitions data).

The unit of measurement for inventive activity in this research is “distinct invention” – the earliest (priority) filing of the same application anywhere in the world. The distinct invention indicator is based on the EPO's DOCDB family and is aimed at neutralizing

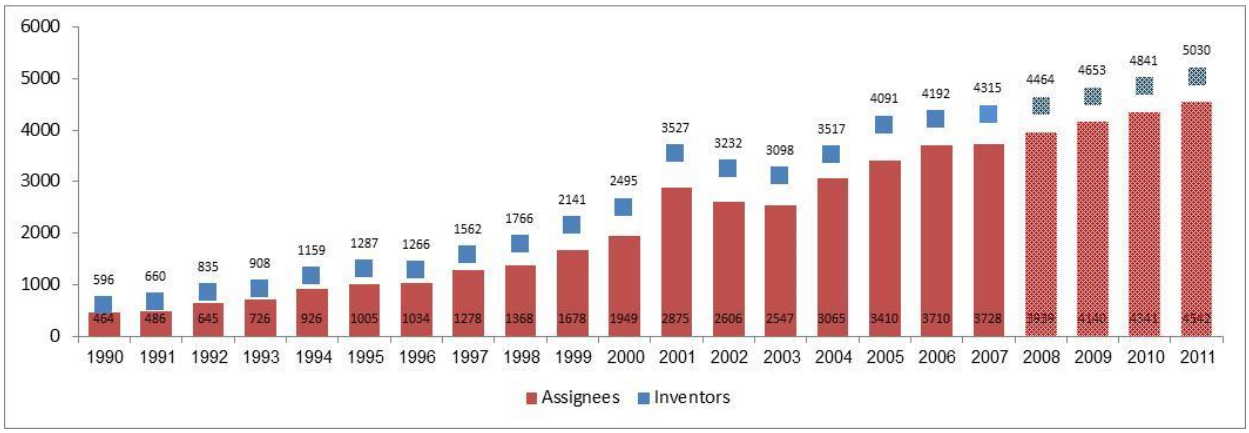
double counting of identical patent applications (inventions), as a result of their filing in different patent offices.

4. Research findings

4.1 The inventive activity of foreign R&D centres in Israel

We start by a description of the overall Israeli inventive activity in the past two decades, pertaining to the total number of inventions and to their sectorial distribution. Figure 6 presents the number of distinct inventions (DOCDB family) filed by Israeli inventors and Israeli assignees during 1990 to 2011. As can be seen from the graph, the number of distinct inventions has increased sharply in the past decade. In 2011, the number of distinct inventions filed by Israeli inventors was estimated at 5030, while the number of distinct inventions filed by Israeli assignees was estimated at 4540 (Figure 6). Data analysis shows that in the past three years (2008-2011), 58%-59% of Israeli distinct inventions were attributed to the business sector, 26%-30% to individual assignees, 10%-12% to universities and approximately 2%-3% to government institutions and hospitals (Figure 7). The sectorial distribution data pertaining to the patent's assignees does not include the inventions filed in by foreign R&D centres, as these patents are considered as foreign owned domestic inventions.

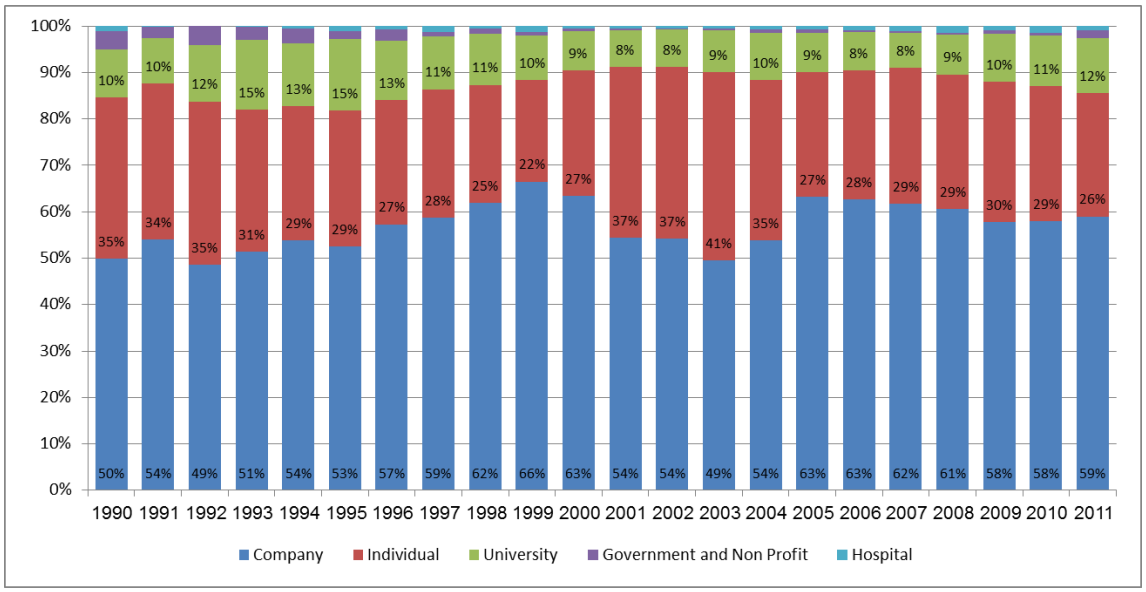
Figure 6: Distinct inventions (DOCDB family) filed by Israeli inventors and Israeli assignees, 1990-2011[6]



Source: PATSTAT. Data processing by SNI.

[6] Data for the years 2009-2011 are estimated.

Figure 7: Sectorial distribution of distinct applications filed by Israeli assignees, 1990-2011[7]



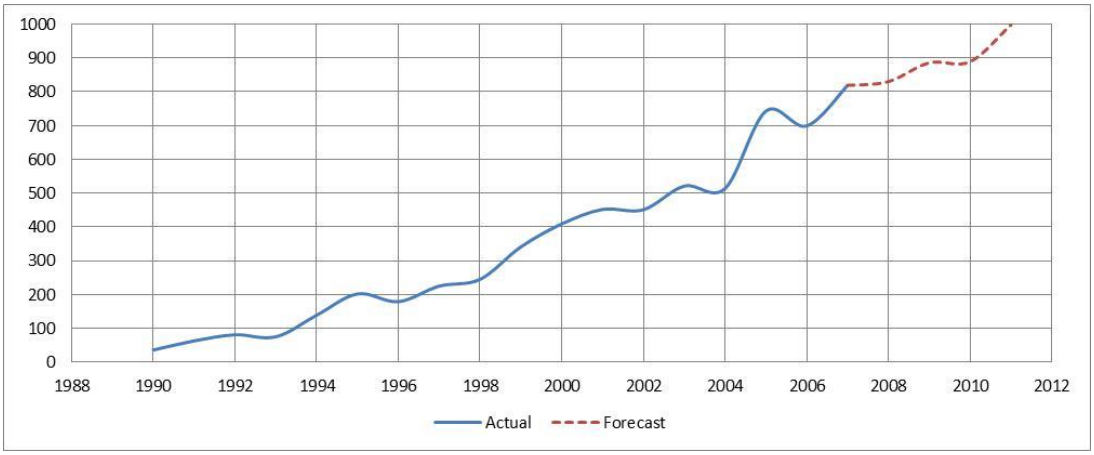
Source: PATSTAT, KUL EEE-PPAT & SNI sectoral distribution tables. Data processing by SNI.

In order to identify the patents of the **foreign R&D centres**, we used a "specially tailored" firm-level dataset providing information on 220 multinational companies that established local branches in Israel. This dataset, an extract of the Israel Venture Capital database, was linked to EPO's PATSTAT patent database. As the patents of local MNCs subsidiaries are considered as “foreign ownerships of domestic inventions” they are not credited to Israel as the patent owners (assignees). Therefore, we extracted from PATSTAT all Israeli inventor addresses that are associated with the foreign (non-Israeli) business sector. Using computational and manual name harmonization procedures (on the firm names) we linked the two datasets together.

Figure 8 presents the results of this exercise, showing the total number of distinct inventions filed by the R&D centres since 1990. As can be seen from the chart, in the 2001-2011 time period, foreign R&D centres in Israel have filed at least 9,800 distinct patent applications. In the past decade the inventive activity of foreign R&D centres has risen by 144%.

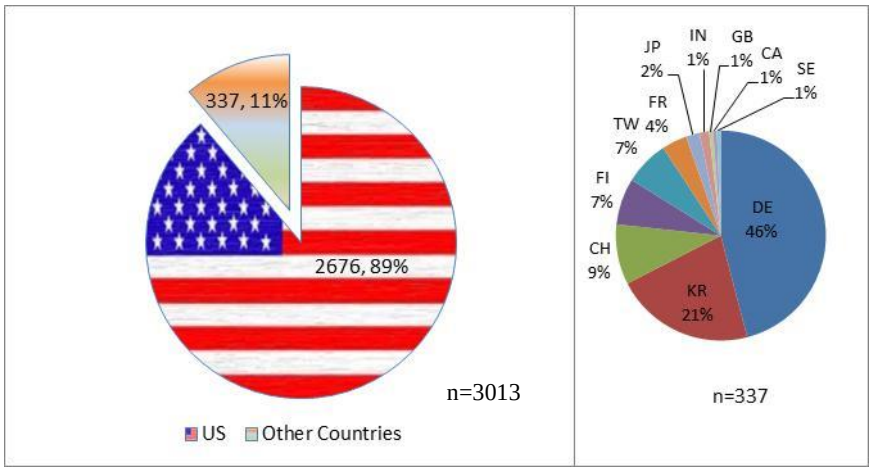
[7] Data for the years 2009-2011 are estimated.

Figure 8: Number of distinct inventions filed by foreign R&D centres[8]



Source: PATSTAT, KUL EEE-PPAT & SNI sectorial distribution tables, IVC. Data processed by SNI.

Figure 9: Distribution of distinct inventions Filed by foreign R&D centres by country of origin (2006-2010)

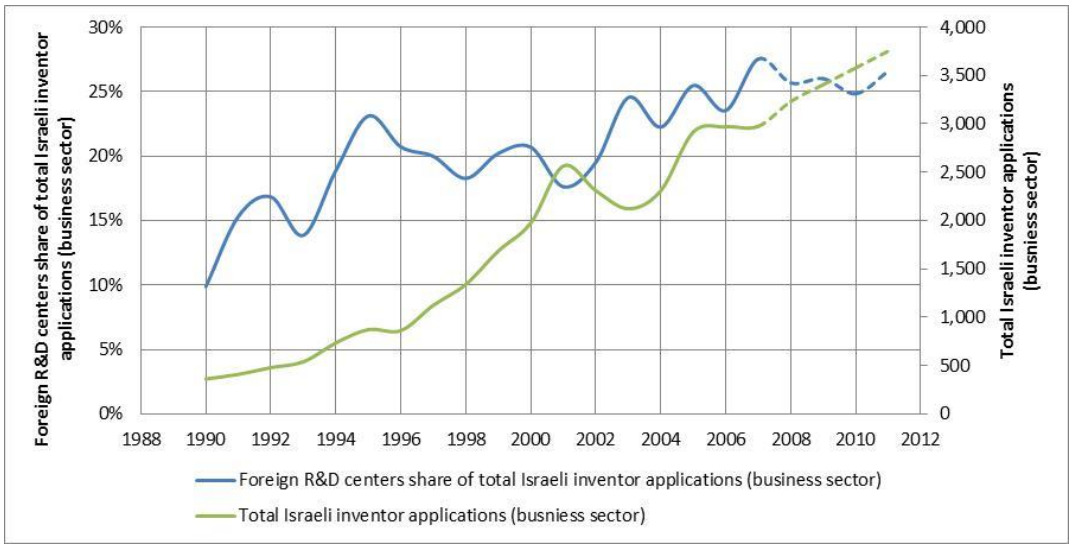


Source: PATSTAT, KUL EEE-PPAT & SNI sectoral distribution tables, IVC. Data processed by SNI.

The data shows that 89% of distinct inventions filed by foreign R&D centres in Israel are attributed to American firms and only 11% belong to European and Asian multinational companies, mostly German and Korean firms (Figure 9). In 2011, the inventive activity of foreign R&D centres in Israel constituted 27% of total Israeli distinct inventions (Figure 10) and 61% of total foreign owned distinct inventions attributed to the business sector (Figure 11).

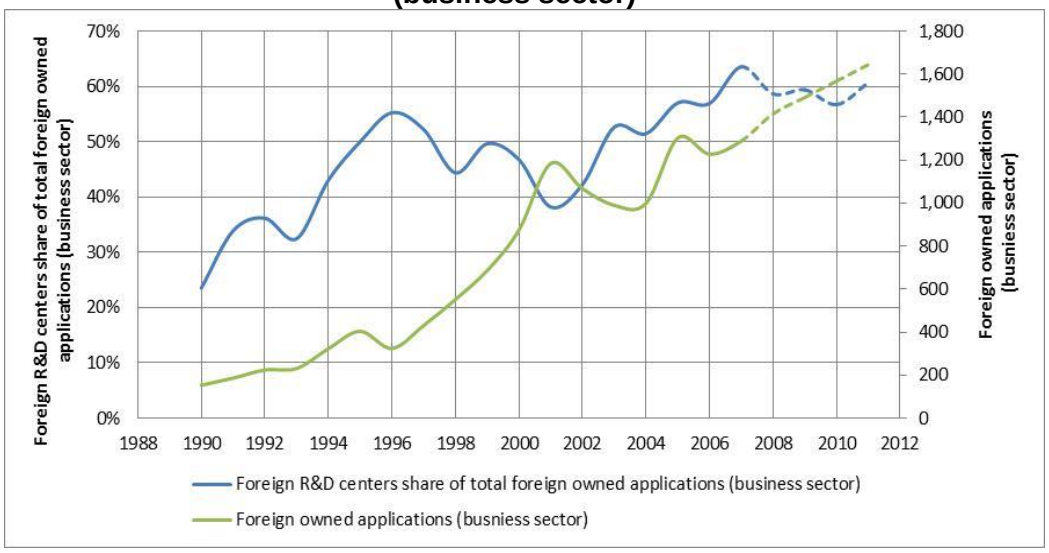
[8] The data for the years 2007-2011 (broken lines) is forecasted due to patent application publication lag.

Figure 10: Foreign R&D centres' share of total Israeli distinct inventions (business sector)[9]



Source: PATSTAT, KUL EEE-PPAT & SNI sectorial distribution tables, IVC. Data processed by SNI.

Figure 11: Foreign R&D centres' share of total foreign owned applications (business sector)[10]



Source: PATSTAT, KUL EEE-PPAT & SNI sectoral distribution tables, IVC. Data processing by SNI.

The data shows that distinct inventions filed by IBM, SanDisk and Intel comprised 39% of the total inventive activity of foreign R&D centres in Israel during the 2006-2010 time period (Table 3).

[9] The data for the years 2007-2011 (broken lines) is forecasted due to patent application publication lag.
[10] See above

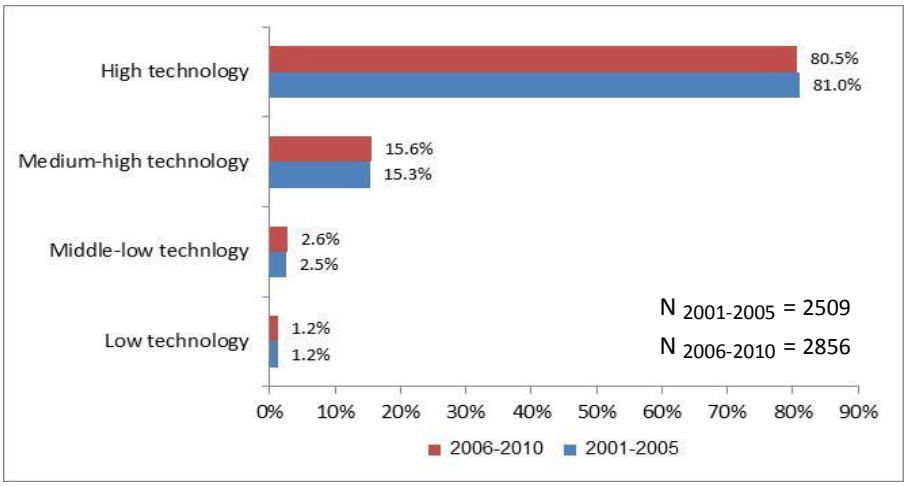
Table 3: Distinct inventions filed by foreign R&D centres (top assignees)

Foreign R&D centre	2001-2005	2006-2010
INTERNATIONAL BUSINESS MACHINES	491	463
SANDISK	75	394
INTEL CORPORATION	484	321
HEWLETT PACKARD	172	168
MICROSOFT CORPORATION	66	142
QUALCOMM/QUALCOMM ISKOOT	55	121
FREESCALE SEMICONDUCTORS	77	116
APPLIED MATERIALS	254	113
SAP	51	92
TEXAS INSTRUMENTS	61	86
MOTOROLA/ MOTOROLA SOLUTIONS	153	83
EASTMAN KODAK	18	75
SAMSUNG	17	72
MARVELL/ MARVELL DSPC	90	57
GENERAL ELECTRIC COMPANY	22	52
MICROSEMI	24	48
ZORAN	22	43
DEUTSCHE TELEKOM	-	36
KLA TENCOR CORPORATION	29	35
SAIFUN SEMICONDUCTORS	70	34
TESSERA	7	32
Total distinct inventions filed by foreign R&D centres	**2679**	**3016**

Source: PATSTAT, KUL EEE-PPAT & SNI sectoral distribution tables, IVC. Data processing by SNI.

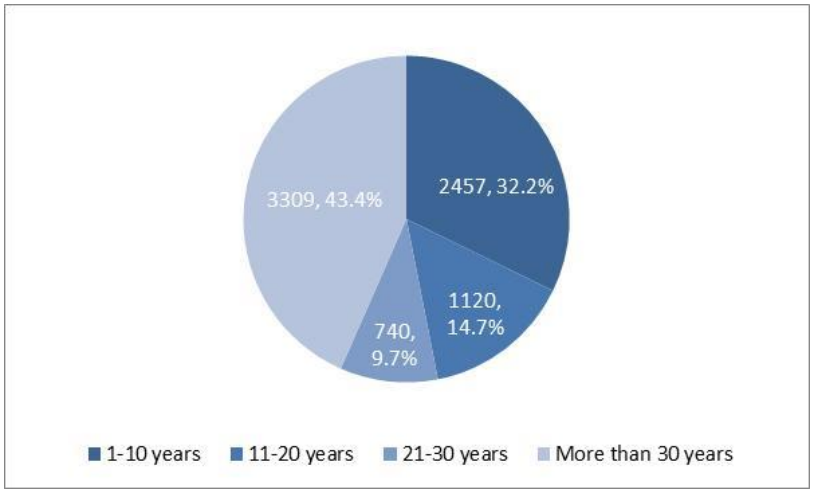
Further data analysis reveals that more than 95% of distinct inventions are attributed to the high technology and medium-high technology sectors (Figure 12) and that 75% of the inventive activity of foreign R&D centres (Figure 13) is conducted by well established firms (more than 30 years, e.g. Intel, IBM) or by new R&D centres in Israel (1-10 years, e.g. Qualcomm, Samsung).

Figure 12: Distribution of distinct inventions by technological intensity, 2001-2010



Source: PATSTAT, KUL EEE-PPAT & SNI sectorial distribution tables, IVC. Data processed by SNI.

Figure 13: Distribution of distinct inventions filed by foreign R&D centres by years of activity in Israel.



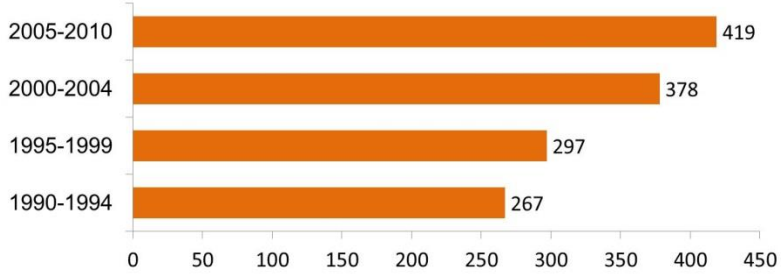
Source: PATSTAT, KUL EEE-PPAT & SNI sectorial distribution tables, IVC. Data processed by SNI.

4.2 The impact of MNCs on the Israeli Economy

4.21 Transfer of Israeli IP and know-how to the possession of MNCS

In previous sections we discussed the possible implications of local IP transfer to the possession of MNCs. We have mentioned the fact that most R&D centres are a part of large international firms that acquired Israeli companies (usually small sized firms or startups) in the past decade and transformed them into their local research facilities. Linking patent data to acquisition & mergers data, can provide important insights regarding the loss of local IP and know-how to the hands of multinational firms. As can be seen from the analysis of the data, in the 1990-2010 time period, at least 1361 distinct inventions were transferred from the ownership of Israeli companies or start-ups to the possession of foreign R&D centres due to acquisitions or mergers (Figure 13, Table 4). These 1361 distinct inventions constitute approximately 13.5% out of the total patent portfolio of the R&D centres.

Figure 13: Number of distinct inventions acquired from Israeli firms by foreign R&D centres as a result of acquisitions or mergers



Source: PATSTAT, KUL EEE-PPAT & SNI sectorial distribution tables, IVC. Data processed by SNI.

Table 4 presents a list of the leading multinational firms which acquired Israeli IP. Generally, we can differentiate between two groups of acquirers. The first group is composed of large multinational firms that are well established in Israel (e.g. HP, Sandisk, Dell)[11] and chose to expand their investment in the country by buying additional R&D centre. The second group of acquiring firms are large (e.g. Roche) or mid-sized (Microsemi, Stryker) MNCs that their purchase of local Israeli firms constitute their first investment in the country.

Table 4: Distinct inventions acquired from Israeli firms (top acquirers).

Name prior to acquisition/merger	Current R&D center affiliation	Number of applications
INDIGO	HEWLETT PACKARD/HP INDIGO	134
MEDINGO	ROCHE	70
ALADDIN KNOWLEDGE SYSTEMS	SAFENET DATA SECURITY	60
MSYSTEMS	SANDISK	53
ANOBIT TECHNOLOGIES	HDC APPLE	45
POWERDSINE	MICROSEMI	37
SIGHTLINE TECHNOLOGIES	STRYKER GI	26
MEDIGUIDE	MEDIGUIDE NAVIGATION SYSTEMS	24
CELLETRA	UNITY WIRELESS ISRAEL	21
TRANSCHIP	SAMSUNG SEMICONDUCTOR	21
COPPERGATE COMMUNICATIONS	SIGMA DESIGNS HOME CONNECTIVITY BUS	20
FINJAN	M86 SECURITY	19
MEDIMOP MEDICAL PROJECTS	WEST PHARMACEUTICAL SERVICES	19
EXANET COMPANY	DELL ISRAEL R&D CENTER	16
XTELLUS	OCLARO	14
COGNITENS	HEXAGON METROLOGY	13
PORTAUTHORITY TECHNOLOGIES	SECURITY SOFTWARE WEBSENSE	13
IMAGEID	ZETES INDUSTRIES	10

Source: PATSTAT, KUL EEE-PPAT & SNI sectoral distribution tables, IVC. Data processing by SNI.

With regard to the potential loss of local IP, the differentiation between these two groups of MNCs is important. The first group of MNCs is heavily invested in Israel and therefore more committed to the country in terms of maintaining their operations. The loss of potential IP to the hands of these MNCs is mainly expressed by fact that the very best Israeli talents are employed in the local R&D centres of these multinational firms. Although the Israeli economy benefits from the presence and activity of the MNCs subsidiaries (e.g. employment, tax revenues from sales), the advantages are relatively small when compared to the potential economic gains that could have been achieved had larger Israeli companies been built based on this IP.

In the case of the second group of MNCs, the potential for the loss of local IP is more severe. This is due to the fact that these MNCs operate relatively small R&D centres in the country which are more vulnerable to structural shocks. The investment of these MNCs in Israel is usually short-termed and often only aimed at getting access

[11] In addition to Table 4, please see the leading MNCs in Table 3 which belong to this group (Intel, Microsoft, Motorola, IBM, Applied Materials etc.).

to the technology or the IP developed by the local company. A notable example for these types of corporate considerations is the decision made by Roche AG's Diagnostics Division to shut down the operations of its R&D centre in Israel (formerly the Israeli company Medingo, developer of miniature insulin pumps for the treatment of diabetes) after only two years of activity. Roche Diagnostics transferred its Israeli insulin pumps R&D activity to Europe in order to consolidate it with the company's operations. Roche was mostly interested in Medingo's technology and preferred to set up a production facility in a low-cost location. The corporation decided to transfer the marketing operations to the US or Europe, where the markets are (Globes, 2012). Research conducted by the Israeli Export Institute for "The Marker" Business newspaper found that acquisitions made by MNCs of local firms in Israel have not led to the growth of these firms and in most cases brought to their closure. Between the years 2005 and 2007, 160 local firms were acquired by foreign companies. The activities of 56% of these local companies were discontinued. To this date, only 71 companies remain active, in which 48 of them were transformed into the R&D centres of the acquiring MNCs and the remaining 23 continue to operate as independent companies under foreign ownership (The Marker Magazine, 2012).

A common viewpoint held by policy makers and senior business officials is that the acquisition of local high-technology firms, especially in their early stage of development, may be good for local investors and entrepreneurs, but bad for Israel from macro-economic perspective (The Marker Magazine, 2012). In the case of "exits" or the premature sell of promising local companies to MNCs or foreign firms, the loss of IP ownership may negatively affect the Israeli economy in terms of job creation, future business development and decreased demand in the value chain of potential products. In case of selling the local company, but maintaining its operations within the country (R&D centres), the loss of IP ownership may lead to reduction in the growth potential of local industry due to the fact that the best local minds are employed within the subsidiaries of the MNCs.

The question of IP ownership is essential to the MNCs since it provides these firms with the exclusive right to use the invention, to license or sell it to other parties and to determine where to further develop the product or technology in the worldwide markets. It is important to note that in most cases the multinational corporation has sole ownership over the IP, but in some occasions (or in the case of particular MNCs, e.g. Sandisk, Applied Materials) the IP is registered on the name of the local subsidiary. This may be due to tax considerations or stem from the legal agreements between the MNCs and their subsidiaries.

Analysis of distinct invention data reveals that in the 2000-2010 time period, 81% of inventions originating from active R&D centres in Israel were registered under foreign ownership and 19% under Israeli ownership[12]. Data obtained from the R&D centres questionnaire relatively coincides with these figures. The analysis of questionnaires revealed that 75% of the R&D centres in Israel register their IP solely under foreign ownership (parent company), 18% of the R&D centres register their IP under foreign or Israeli ownership and the remaining 7% register their patents solely under Israeli ownership.

The R&D centres survey, based on open-ended questions also provided important insights regarding the IP policy of foreign MNCs in Israel. Most of the R&D centres noted that under the current agreements, the IP belongs to the parent company and that they are required to register the IP under the MNC's name. Since the IP developed in the R&D centres in Israel deals with **the core activities of the MNC**[13], it has high economic potential, thus making it valuable for the parent company.

Most of the top R&D centres executives which responded to the open-ended questions in the survey claimed that there is no connection between the ownership of the IP and the decision to carry out additional activities in Israel (e.g. more R&D, production). These mainly depend on economic efficiency (optimization of capital and resources), labour costs and organizational considerations made by the parent company. Other factors that may increase the chance for expanding the variety and the scope of operations by parent company in Israel pertain to maintenance and preservation of the high quality of the Israeli labour force (ingenuity, creativity, know-how and innovation capabilities).

A minority of the respondents thought that obtaining Israeli ownership on the patents of the R&D centres may have an influence on expanding the scope and variety of prospect activities by the parent company in Israel. According to the executives interviewed, a limited change in the current IP policy of the parent companies will be possible if supply-side steps will be taken by the Israeli government to ensure the protection of Israeli IP rights. Possible steps may include the enhancement of government R&D support (e.g. Chief Scientist grants) and corporate tax cuts given to MNC subsidiaries on the one hand, and on the other hand conditioning these improved benefits by the demand for registering some of the IP under the Israeli subsidiary.

[12] Mainly patents of Sandisk and Applied Materials .
[13] 84% of the survey respondents noted that the IP developed in the R&D center is connected to the "core activities" of the parent company.

4.21 Postive Spillover effects of MNCs on local firms and the national economy

In the previous section, we addressed the question of the predominantly one-way outflow of Israeli intellectual assets to the hands of multinational companies via their local subsidiaries (R&D centres). When analysing the performance of the national innovation systems as a whole, it is important to acknowledge the fact that innovation and knowledge flows run in a two-way direction. In this dual process, MNCs, through their subsidiaries, play a pivotal role in ***stimulating supply and demand for innovation in the local market.***

We asked the senior MNC subsidiary executives who took part in the survey to specify the contribution of their R&D centres to the Israeli economy. Special emphasis was placed on the types and scope of collaborations that exist between the R&D centres and local Israeli firms (creation of demand for innovation in the local market) and to the various positive spillover effects on the local market that arise from the location of MNC subsidiaries in Israel.

In the process of analysing the open-ended questions, five main dimensions relating to knowledge and know-how flows from the MNC subsidiaries to the local markets were identified (Table 5). These include the stimulation of demand for innovation and direct impact on the Israeli economy; Contribution to local knowledge and know-how; Cooperation with the academy and local industry; Exposure to MNC culture and the exposure of Israeli technological capabilities to foreign markets.

MNCs stimulate the demand for innovation in local (Israeli) market through the collaborations of their subsidiaries with local firms. The activity of MNCs spurs demand for sophisticated goods and services, which are partially supplied by local companies. According to the executives who responded to the survey, the main innovation-related collaborations that exist between R&D centres and local Israeli firms are in the fields of software development, algorithm development, product design and supply of computer hardware and communication equipment. Israeli companies also provide MNC subsidiaries with many innovation supporting services such as database consulting, IT and communication consulting, various lab services e.g. microelectronics, product calibration, product and standards testing) and quality assurance services. The purchase of products and services by MNC subsidiaries fosters the creation of jobs and "specialization hubs" in various technological fields that benefit the entire high-technology sector in Israel. In addition to demand-side contribution to local innovation-driven sectors in Israel, the location of MNCs in Israel

Table 5: Dimensions of knowledge and know-how flows from the MNC subsidiaries to the local markets

Dimension	Contribution
Stimulation of demand for innovation in the local markets and direct impact on the Israeli economy.	Creating additional chains of employment - local firms that provide services and supply goods to the R&D centres
	Creation of "specialization hubs" in particular technological fields that benefits the entire industry.
	Employment of scientists and engineers in R&D centres
	Attracting FDIs to Israel
	Strengthening Israeli exports
	Revenues from corporate tax, sales tax and income taxes
Knowledge and know-how Spillovers	Technological spillovers to local firms (especially startups and small Israeli firms).
	Better integrative development capabilities in Israel
Cooperation with the academy and local industry	Joint industry-academy projects (e.g. Magnet Consortia).
	Joint research with universities, enriching technological knowledge among students
Exposure to MNC culture	Exposure to the "organizational culture" of the parent company (its sets of norms, practices and artefacts) has a tremendous impact on Israeli management capabilities at the junior and senior levels
Exposure and reputation of Israeli technological capabilities	Quick exposure and ability for executing joint projects with other firms of the parent company
	Exposure of the R&D team to clients and leading manufacturing firms around the world.
	Connection of the R&D centres to the technological and academic environment that enables exposure to new markets and international clients.
	Empowering the status of Israel within giant multinational firms
	The high quality of the Israeli subsidiaries (R&D centres) strengthens the reputation of Israel as a technological superpower. This fosters further foreign investments in local companies (through acquisitions).
	Good reputation and acknowledgment by the parent company is crucial for carrying out additional activities within the framework of the R&D centre and for the development of additional R&D centres in Israel by the parent company.

was also found to significantly enhance the activity of various sectors providing logistics and administrative support to the MNC subsidiaries (e.g. food and catering services, security, cleaning services, car leasing and maintenance, job-placement services, real-estate managing. The local Israeli subsidiaries of multinational firms also have diverse business relationships with foreign firms located outside Israel. These collaborations mainly centre on prototype and product development, hardware development, expert consulting services and financial services). We have asked the R&D center executives what are the main considerations in choosing Israeli or foreign firms as the suppliers of products or services to the R&D centre. An aggregation of the respondents' inputs has revealed six key factors (policy of the parent company, technological considerations, costs, quality of service, geographical

location and cultural considerations) outlining the main reasons for selecting local or foreign firms as the subsidiary's supplier of goods or services (Table 6).

Table 6: Considerations for selecting local or foreign firms as suppliers of products or services to the R&D centres

	Considerations for choosing local Israeli firms	Considerations for choosing foreign firms (outside Israel)
Policy of parent company (MNC)		The call for choosing a supplier is often not ours (parent company works with a number of fixed suppliers).Global agreement between the parent company and foreign firms may dictate the decision regardless of costs.
		Product/service standards set by the parent company do not make it possible to choose local suppliers.
Technological considerations	Israeli ingenuity, creativity, knowledge, and innovation capabilities (R&D).	Insufficient quality among local firms, especially in hardware development and in production.
	Technological advantage compared to other competitors in the world.	
	The ability to make modifications for local needs.	
	The high quality of the workforce	
Costs	The cost of the product/service.	The cost of the product/service
	Working with local firms saves time and money.	
Quality of service	Local technological support is easily available.	The quality of service is sometimes better with foreign firms chosen by the parent MNC company.
Geographical location	Local service is vital for solving immediate problems.	
	Short response time, quick supply of products or services.	
	Flexibility in delivery time and timetables	
Culture	Closer and simpler interaction with Israelis. Existence of personal and direct relationship with local firms	
	Shared values	
	Ability to better communicate due to common language (Hebrew)	

Some of the MNC subsidiaries interviewed have stated that they are not independent in choosing their suppliers. This decision is often dictated by the parent company and related to various factors such as quality standards set by the parent company and global agreements between the parent company and foreign firms.

Technological considerations are also important determinants in the selection process. The high quality of the Israeli workforce, its ingenuity, creativity, innovation and high-end technological skills and know-how embedded in it constitute important factors in choosing local firms over foreign firms, especially in the supply of complementary R&D services to MNC subsidiaries. Insufficient quality among local firms, especially in hardware development and production of sophisticated goods are the main reasons for selecting foreign firms over local firms. The question of the cost and quality of the product or service provided are also key determinants in the selection process. These two factors are equally important in the selection of local and foreign firms. The geographical location of firms supplying products and services to the R&D centres also affects the decision making process. The R&D executives interviewed stated that they prefer working with Israeli companies due to faster delivery times in the supply of goods or services and their ability to accommodate flexible timetables and solve immediate problems. Finally, cultural considerations were found to play an important role in the decision of some MNC subsidiaries to select local firms over foreign firms. Working with Israeli firms is made simpler due to common values and language and the existence of personal and direct ties.

According to the MNC subsidiary executives who responded to the survey, the R&D centres contribute to the promotion of important spill-over effects between firms and within the high-technology sector in Israel (Table 5). Local start-ups and small firms are the main beneficiaries from these knowledge and know-how flows which promote their integrative R&D capabilities and improve their ability to carry out complex projects. Many R&D centres (e.g. Intel, IBM, Applied Materials) participate in Chief Scientist programs such as the Magnet Consortia. These programs are aimed at providing a competitive edge for Israel's industry with regard to state of the art technologies of worldwide interest. New technologies are developed in a cooperative venture between the industry (local and foreign R&D centres/MNC subsidiaries) and leading academic institutions and provide the basis for new high-tech products and processes. Independent cooperation between the R&D centres and Israeli universities promote knowledge spill-overs in a two-way direction, by enriching technological knowledge among MNC employees, researchers and students. Additional spill-overs effects, which are hard to quantify, but according to the MNC executives constitute one of the most significant impacts of the MNC on the Iocal economy is the exposure of the Israeli high-technology industry to the "organizational culture" of giant multinational firms. The exposure of Israeli firms to the MNCs' sets of norms, practices and artefacts has a tremendous impact on Israeli management

capabilities at the junior and senior levels. Lastly, the MNC subsidiary executives have accentuated the contribution of the R&D centres in exposing Israeli technological capabilities in the worldwide markets and among manufacturing firms. The high quality of the Israeli subsidiaries strengthens the reputation of Israel as a technological superpower. This fosters further foreign investments in the local economy, through the acquisitions of start-ups and the development of new R&D centres.

One of the explicit goals of policy makers with regards to the activity of foreign multinational companies in Israel is identifying the mechanisms and tools that will allow MNCs to expand and ***diversify*** their activities and investments in the country. In this respect, we asked the foreign R&D executives what are the key measures that can be taken to promote these ends. According to the MNC subsidiary executives, steps that could be taken to achieve the above mentioned goals include attaining the government's support for the manufacturing industry, expanding the current incentives (chief scientist grants and corporate tax cuts) for the support of existing and new R&D centres and the promotion of long-term investment in technological education which is vital for the survival and fortification of the high-technology industry in Israel. Additionally, the strength of the local currency hinders Israel's ability to compete in the worldwide markets and places obstacles on its ability to export. Interestingly, the MNC subsidiary executives placed much emphasis on structural measures that could be taken by the R&D centres themselves to expand and diversify their activities in the country. These steps include improving the organizational efficiency, promotion of leadership and high quality management, nurturing personal relationships between management and workers and the maintenance of high innovation performance. Some of the executives interviewed have accentuated the need to focus on relevant industrial fields that Israel has relative advantage in such as the semiconductor industry, production of medical equipment and digital printing. Increasing the basket of "goods or services" produced by the R&D centres and lowering development and production costs were identified as key measures that could enable the R&D centres to better compete in the market (especially with leading R&D centres in the Far-East and India).

5. Summary and policy conclusions

The research investigated the impact of multinational companies (MNCs) on the Israeli economy in terms of demand for innovation. The research focused on two main impacts: the positive externalities to the national economy stemming from the

activity of foreign R&D centres in Israel and the potential loss to the economy due to the utilization of locally produced IP and know-how by MNC subsidiaries.

The findings of the study reveal that in the past decade the rate of transfer of Israeli IP, know-how and technology to the possession of foreign R&D centres has substantially increased. There is a significant rise in the absolute number of distinct inventions filed by foreign R&D centres and in their respective share out of total Israeli inventive activity. There is an increasing trend of obtaining Israeli IP by means of acquisition of Israeli firms and start-ups. Acquired patents are becoming a substantial share out of the total patent portfolio of foreign R&D centres in Israel. The potential loss to the local economy was found to be more significant in the case of small R&D centres which their activities in Israel are not deep-rooted. The investments of these MNCs in Israel are usually short-termed and are often aimed solely at getting access to the technology or the IP developed by the local company which they acquire. Although large and well-established MNCs also utilize locally produced IP, they exert significant spillover effects on the Israeli labour market and the national economy.

The findings of the research show that MNCs play a pivotal role in stimulating demand for innovation in the local market. The activity of MNCs spurs demand for sophisticated goods and services, which are partially supplied by local companies (especially in the fields of software development, algorithm development, product design and supply of computer hardware and communication equipment). R&D centres contribute to the promotion of important spill-over effects between firms and within the high-technology sector in Israel. Local start-ups and small firms are the main beneficiaries from these knowledge and know-how flows which promote their integrative R&D capabilities and improve their ability to carry out complex projects. Additional important externality stemming from the activity of MNCs in Israel is the exposure of the Israeli high-technology industry to the "organizational culture" of giant multinational firms. This exposure was found in many studies to be a key factor in improving the competitive edge of the firm and in contributing to its over-all performance and efficiency (Schein, 1985: Hatch, 1993).

In concordance with the "competent demand pull hypothesis" put forward by Antonelli and Gehringer (2014), our research found that investment in advanced 'competent' agents (MNCs) activate derived demand for innovative activity in the local market. The research findings highly supports their assertion that "public intervention should be aimed at identifying competent customers that are able to activate the key user-

producer mechanisms of knowledge governance, making external knowledge available to producers" (e.g. providing incentives and practical instruments for collaborations between MNCs and local firms).

The empirical evidence stemming from our report suggests the following polices and instruments that could be implemented to support demand-driven innovation:

- Implementation of standards specifically targeted at raising the quality of the local industry and local firms (especially in hardware development and in production). High quality standardization will enable local firms to better compete with foreign firms (located outside Israel) in supplying the MNCs sophisticated goods and services, thus raising demand for local innovation.
- Expanding chief scientist programs (e.g. Magnet consortia) fostering collaborations between MNCs, local companies and the academia that are specifically aimed at advancing the local high-technology industry. These types of collaborations are beneficial both for MNCs and for local firms due to the externalities and knowledge spill-overs which they promote.
- Provide targeted support for local firms dealing with technological domains that could provide complementary support (in terms of goods and services) to the activity of foreign R&D centres and MNC subsidiaries.
- Lowering development and production costs that will enable the R&D centres located in Israel to better compete in the global market (especially with leading R&D centres in the Far-East and India).
- Improving organizational efficiency, promotion of leadership and high quality management.
- Promotion of long-term investment in technological education which is vital for the survival and fortification of the high-technology industry in Israel.

Some measures are needed to be undertaken to better safeguard Israeli IP and make efficient use of Israeli government investments (grants and tax incentives given to MNCs). We propose the following steps:

- Conditioning tax incentives given to MNCs by the implementation of offset agreements (e.g. such as the ones employed in the Defence industries) in which MNCs agree to make complementary purchase of products or services from local firms.
- In recent years there is a significant growth in the direct collaborations between MNCs and the academia. This cooperation often results in a disproportionate

transfer of technology and know-how (with relatively low compensation) to the hands of MNCs. An effort should be made to contain this cooperation under a more controlled environment (e.g. Magnet consortia).

- The nature of the rights over the IP is often decided in the early negotiation stage between the government and the MNC. Greater effort should be placed by the government in the early negotiation stage to better protect local IP and know-how.
- Conditioning government support to R&D centres (tax incentives, direct grants) by the demand for registering some of the IP under the Israeli subsidiary.

It is important to note that the implementation of the proposed policy tools should not be sweeping and encompass all MNCs. They should be targeted at the specific industries, technological domains or know-how which is most vital to protect and to ensure the survival and growth of local firms.

A final note regarding the limitation of this research: The assessment of the effect of multinational companies on the Israeli economy in terms of demand for innovation was investigated through the analysis of mergers and acquisition data pertaining to patents and by unstructured questionnaires directed to MNC executives. Prospective research should take into account the views of three additional players – academia experts, policy makers from the government and local firms.

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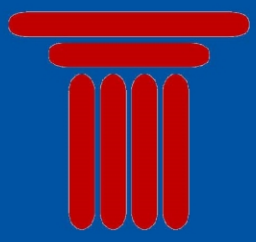

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