Research and Development in Israel: Successes and Challenges

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Abstract

Economic development is characterized by a process of extending knowledge and using such knowledge to increase economic growth and welfare. Research and development (R&D) not only creates new knowledge but also increases the ability to learn and the ability to use existing know-how. In this paper we examine Israel's standing in the world of knowledge creation, by tracking the registration of Israeli patents in the US. We have also identified obstacles and challenges facing Israeli companies in their future development of R&D.

Patent registration is an important source of information on R&D activities with direct economic value. Registering a patent waives the confidentiality of a new invention in return for obtaining exclusive rights to use the invention for a limited period of time. Registering a patent also allows for the pricing and trading of knowledge. Analyzing the number of Israeli patents registered in the US shows that in the past decade the number of Israeli patents registered in the US has doubled. In the period 1977 to 2004 Israelis registered more than 12,000 patents in the US, around 4,500 of them in the period 2001-04. The number of Israeli patents registered since 1977 places Israel as number 11 in the world in terms of patents registered in the US. A sign of the success of R&D in Israel in the past decade is that during this period the rate of growth in the number of Israeli patents registered in the US was higher than the rate of growth in the number of American patents registered. The research also shows that there is a clear and strong link between Israeli companies' R&D expenditure and the number of patents registered in the US.

The paper includes a specially commissioned survey of about 100 companies that conduct R&D and that have received state-funded assistance from the Chief Scientist. A major challenge faced by companies that carry out R&D is the shortage of professional workers; Some 60 percent of the companies carrying out R&D reported difficulties in recruiting professional staffers. The percentage of educated workers that work in R&D is particularly high, and it is possibly surprising that mobility of professional workers between companies is low.

A further major challenge for R&D is the problem of financing. Half of the companies in our survey reported funding problems as their major obstacle in creating new products. Given the size of Israeli companies—most are relatively small—most are not able to raise funds on the stock exchange either in Israel or overseas. Only one third of the companies that received state assistance from the Chief Scientist had access too to venture capital. The problem of funding is one facing older companies as well; Around half of the companies reporting financing difficulties were companies that were over 10 years old, though most were small and employed fewer than 50 staffers. Many successful companies also reported that they too had problems financing their R&D work. In this context, developing the capital market, through broadening it and deepening it, and developing financial instruments that supply the needs of the R&D sector, are all important factors in the future success of this sector.

Introduction

The contribution of research and development (R&D) to innovation and productivity growth has been widely recognized both here in Israel and abroad. Generally speaking, economic development is characterized as a process of discovery of knowledge and the application of knowledge to increase growth and welfare. A main element of economic progress is finding practical ways to apply knowledge. There are various steps in using knowledge as an economic input: the creation of knowledge, the acquisition and dissemination of knowledge, the adaptation of knowledge to specific needs, and the use of knowledge.[1] R&D does not only generate new information, but also the capacity to learn,[2] as it increases a company's ability to identify, assimilate and exploit existing information. This paper will concentrate on the stage of knowledge creation and will examine where Israel stands in terms of its R&D achievements.

R&D intensive sectors lead the growth of Israeli exports. The success of Israeli R&D and its high-tech sector can be also measured by the number of Israeli companies traded on the NASDAQ, a number that is larger than any other country outside the US, except Canada. When analyzing the sources of success, it is commonly understood that R&D activities in Israel have contributed significantly to the success of many Israeli high-tech companies. Relative to the size of its economy, Israel stands out in its allocation of funds for R&D investments.

This paper will look at R&D in Israel from several angles, with the aim of identifying the important elements. I will analyze R&D activities in Israel, using the number of Israeli patents registered in the US as the main indicator for the output of the sector[3]. The analysis of patent registration is used to assess R&D progress over the last decade, both from the perspective of the country's own development and also relative to other players in the global market for innovation. During the last decade, R&D activities have expanded rapidly in many countries, including Israel. In the last decade, the number of Israeli patents registered in the US has almost doubled.

As knowledge has many elements of a public good, and due to the important role of public policy in stimulating the creation of knowledge and learning, a basic role exists for the public sector. In the second part of the paper, I will review the characteristics of the R&D sector in Israel and the main government support program towards R&D and innovations in Israel. This is based on a special survey that was conducted in May-June 2006 among Israeli companies that benefited from government support for their R&D activities. The survey contains interesting information regarding lower than expected labor mobility (one of the main mechanisms of knowledge spillovers is via labor mobility) as well as the high level of human capital involved. The survey also highlights the issue of financing difficulty of R&D activities as a core challenge for many of the companies that are engaging in innovation.

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[1] The conceptual framework of the importance of knowledge for economic development is presented in Carl Dahlman (2006).

[2] For a discussion of this topic see Cohen and Levinthal (1989).

[3] This approach of analyzing research and development activities via patents registered in the US follows Manuel Trajtenberg (1999).

I. Patent Registration

Patent registration is often the natural outcome of successful R&D. The traditional rationale for patent protection is to increase the incentive to invest by conferring the right to exclude others from making, using, or selling the innovation, in exchange for forgoing secrecy by publishing the invention, making the information available for others to build upon.[4] In other words, each request for patent registration is done in order to receive monopoly power for a limited time, in return for full disclosure of the invention. When the validity period of the patent expires, the knowledge is then freely available to the general public.

In recent times, the decision to register patents has been associated with the rapid growth in the market for new knowledge and the value of technology licensing. One of the benefits of the "patent-era" is that patent registration may enable the creation, and affect the organization, of knowledge-based industries by allowing trade in knowledge and facilitating the entry of firms with only intangible assets.

Griliches (1998) points to the conclusion that patent statistics is a unique source for the analysis of the process of technical change and highlights the strong relationship between patent numbers and R&D expenditures in the cross-sectional dimension, implying that patents are a good indicator of differences in inventive activity across different firms.[5] Although patent registration is not a perfect measure of the output of R&D activities, patent registration has been accepted as a typical measure of R&D outputs, among other commonly used measures, such as articles in technical journals, royalty and licensing payments and receipts, and technology exports as a proportion of total manufactured exports. Following Trajtenberg's analysis in the Israeli context (1999), patent data is used here as a proxy to the output of R&D activities[6].

Patent data, though a positive outcome, is not the final goal, of investment in R&D. Even after patent registration, R&D is a risky process where the outcome is uncertain. The goal of the investment is to yield future returns or rents from new knowledge or innovations. The information content of patents is enhanced by the fact that patent laws are structured in such a way that in order to be registered as a patent the innovation must be new and nontrivial from a technological viewpoint, and it must have commercial potential. Needless to say, a patent on its own is not necessarily a good indicator for economic success, as it is no less important to be able to produce a good product and to distribute it to the market.

Israeli R&D companies tend to request patent registration in the US, as that is the natural market for most inventions. In the information and communications

[4] Stephen Merrill, Richard Levin, Mark Myers (2004).
[5] Griliches, Z. (1998).
[6] Manuel Trajtenberg, (1999).

technology sector (ICT), the cost of issuing a patent is about $20,000 in the US, and could be more than twice as much in Europe. The cost difference is explained by the requirement to translate into European languages at the time of request in each country (although some countries are in the process of simplifying this procedure), in addition to the cost of approaching the local courts in the case of disputes (in the various domestic languages).

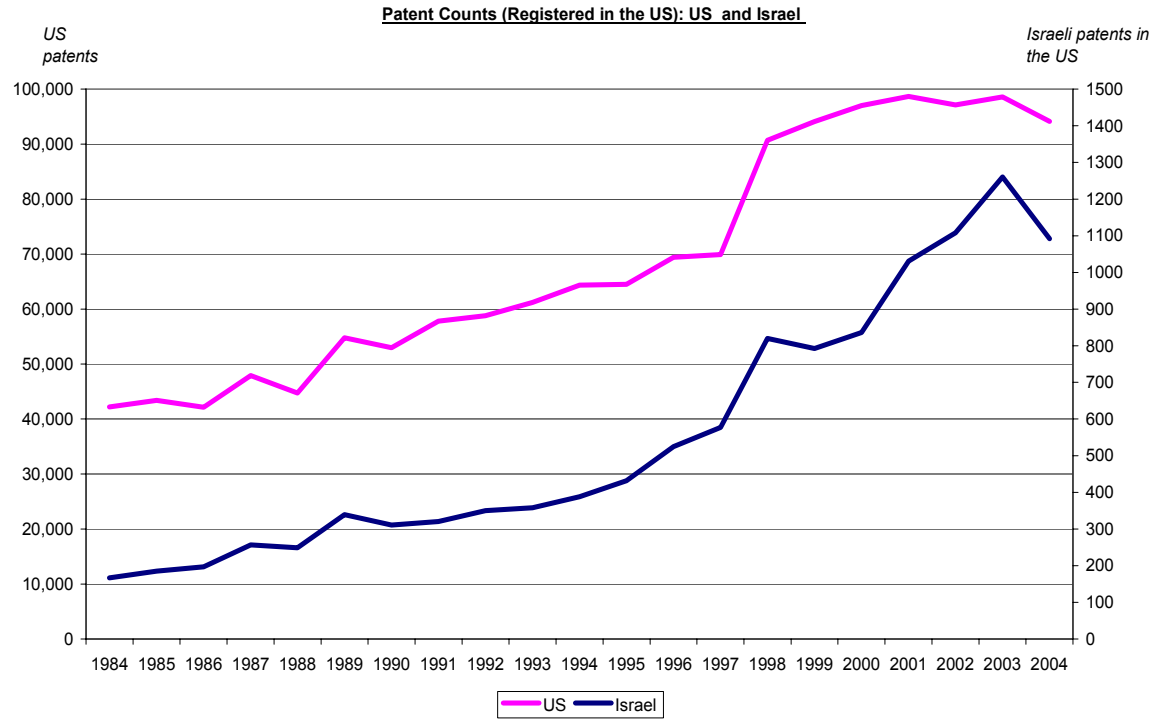
When considering an investment in a high-tech start-up, the level of protection of its knowledge capital is naturally of prime importance, as the value of many start-up companies is derived from the value of their patents. In assessing the value, importance is attached to who owns the patent, whether it is a company, an individual, or an institution such as a university. The strategic approach toward patent registration is a crucial issue for many start-ups from the very outset[7]. Patent registration is also an important element in confronting competition from other players in the market. Many start-up companies try to build a "defensive" portfolio of patents, in order to give them leverage when confronted with patent disputes; Start-ups may be vulnerable to claims by competitors that they are using the competitors' patents without permission, and thus the companies tend to hold a portfolio of patents for the purpose of trading them with their competitors. Such trading behavior is especially prevalent during the initial period of the life of a start-up, when the company does not usually have the financial resources to aggressively enforce the rights derived from its own patents. Larger companies have more resources to defend themselves in hostile disputes and can use their financing ability to protect their innovations.

As mentioned earlier, Israeli innovators tend to register their patents in the US, the major market for Israel's technology exports. From 1977 until 2004, Israeli innovators registered more than 12,000 patents in the US, nearly 4,500 of which in the years 2001-2004. This number of patents, since 1977, places Israel in 11th place on the list of US patent registrations by innovators outside of the US.

Graph 1 demonstrates the rapid development of the R&D industry in both the US and Israel. A fast growth trend has been experienced by both countries, including the jump upwards in the number of patents in 1998. In the last decade, Israel's increase in patent registration has been faster than the US increase.

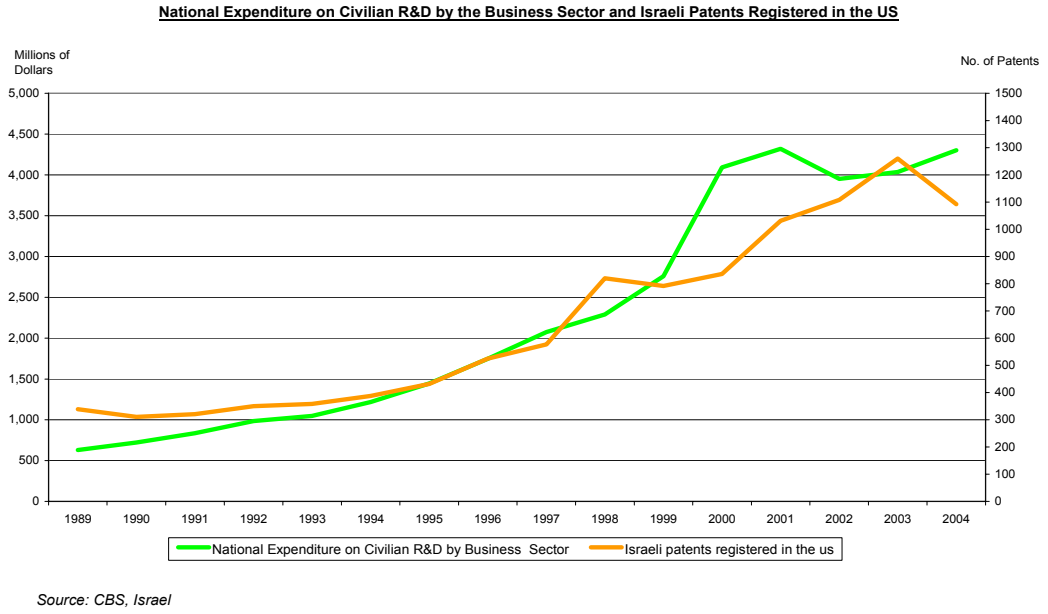
Graph 1

[7] I thank Jonathan Topper from Reinhold Cohn and Partners for his invaluable input on this topic.



Source: US Patent and Trademark Office

Graph 2



Source: CBS, Israel

As can be seen in Graph 2, there is a strong correlation between industrial expenditure on R&D and Israeli patents registered in the US. The doubling of civilian expenditure on R&D by the business sector between 1998 and 2004 brought about the doubling of

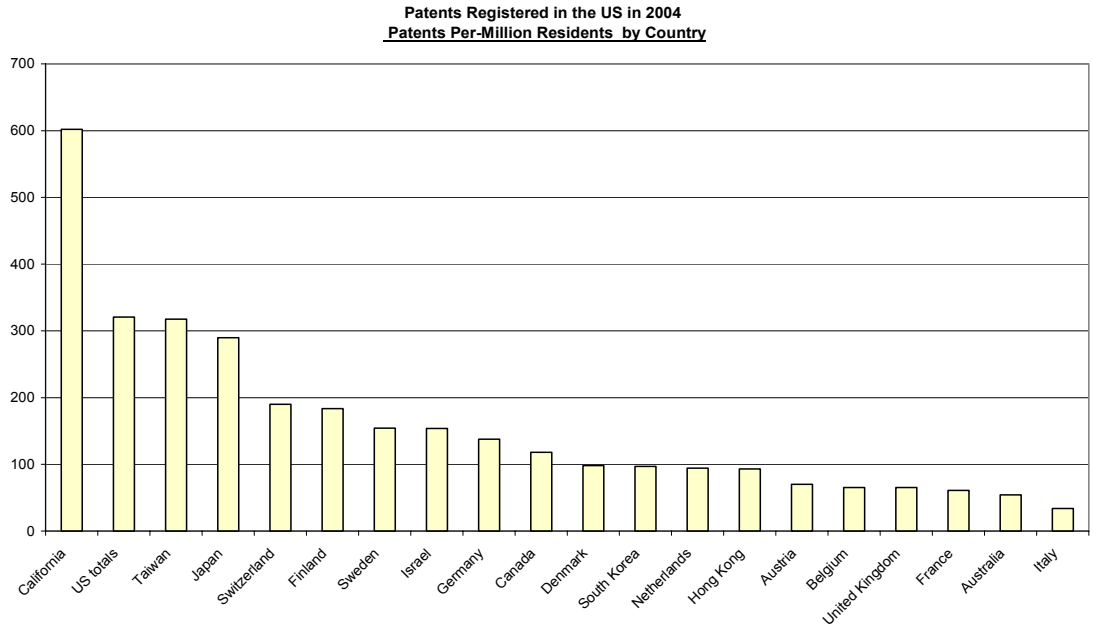
the number of Israeli patents registered in the US in the same period.[8] Such a strong and almost immediate correlation between increased expenditures and patent counts is expected, as the value of knowledge tends to depreciate rather quickly, which leads to a strong flow of increased investment in order to preserve and develop the value of knowledge capital.

The increase in Israeli patents registered in the US in the last one and a half decades, can be attributed to a preceding increase in national expenditure on civilian R&D by the business sector.

II. Patent Registration - a Global Perspective

A perspective on the relative size and importance of the R&D sector in Israel can be reached by comparing the per-capita number of patents registered by Israeli innovators in the US, relative to the number registered by other countries.

Graph 3



Source: US Patent and Trademark Office and World Bank Data

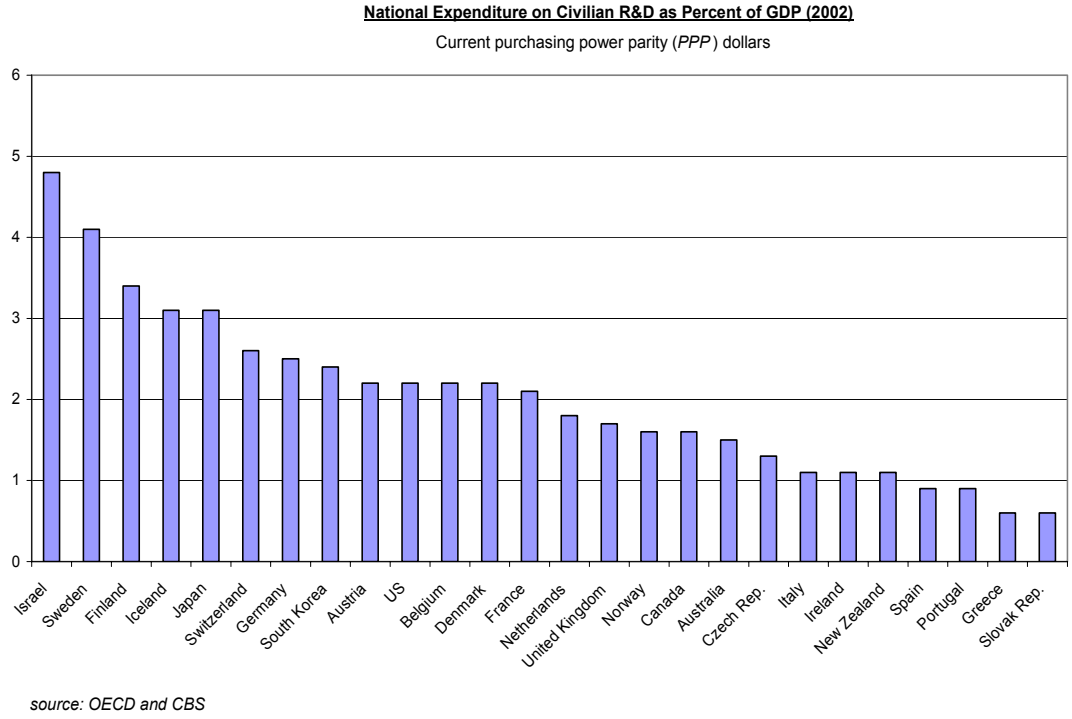
Not surprisingly, California is in a league of its own in terms of registered patents in the US in per-capita terms. The US, Taiwan, and Japan, are ahead of the European continent, where Switzerland, Finland and Sweden are leaders. In per-capita terms, the number of Israeli patents registered in the US is greater than most European countries, despite the fact that in absolute levels Israel has to confront disadvantages created by its absolute scale.

A strong correlation exists between the number of patents (per-capita) registered in the US and national expenditure on R&D (per-capita). Countries that lead the table in

[8] Trajtenberg (1999) presents the correlation between changes in industrial R&D expenditure in Israel and subsequent changes in registered Israeli patents in the US, for the earlier years 1972-1996.

the number of per-capita registered patents (Graph 3) also lead in terms of national civilian R&D expenditure as percent of output (Graph 4). This strong relationship supports the approach of looking at patent registration in the US as a good measure of the output of the innovation process. More importantly, it also emphasizes the strong correlation between R&D expenditure and patent registration. Israel proves no exception to this rule, and as a leader in R&D expenditure, it enjoys a strong position in patent registration. Thus the relationship between expenditure on R&D and innovation output can be seen by international comparison, in addition to the time series data for Israel.

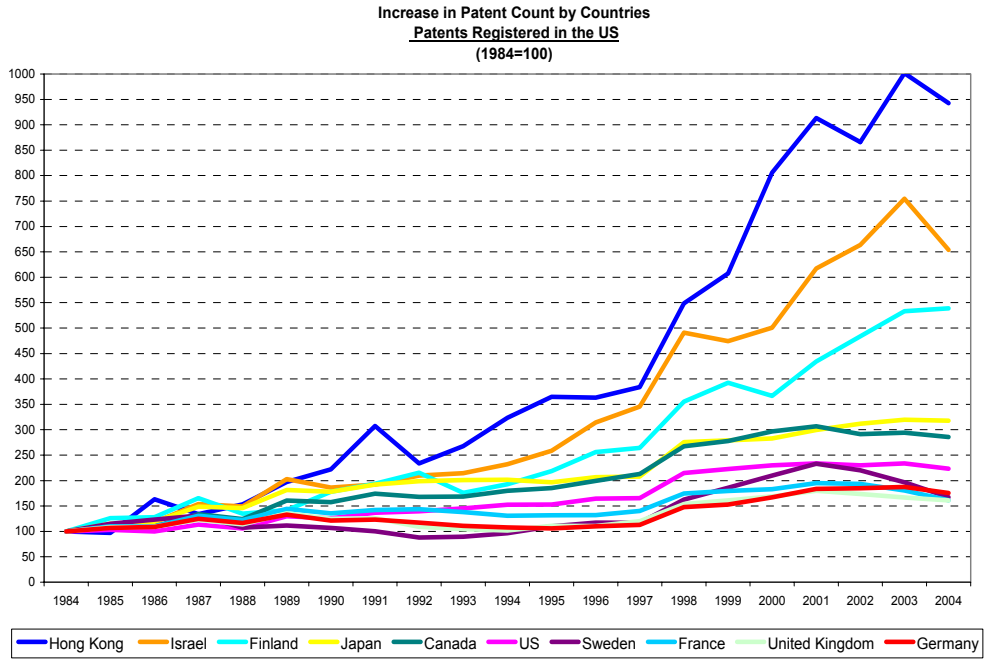
Graph 4



source: OECD and CBS

The dynamic progress in the R&D sector is by no means unique to Israel. As can be seen from Graph 5, the last two decades have been characterized by a surge in patent counts, reflecting the international progress in the market for innovations.

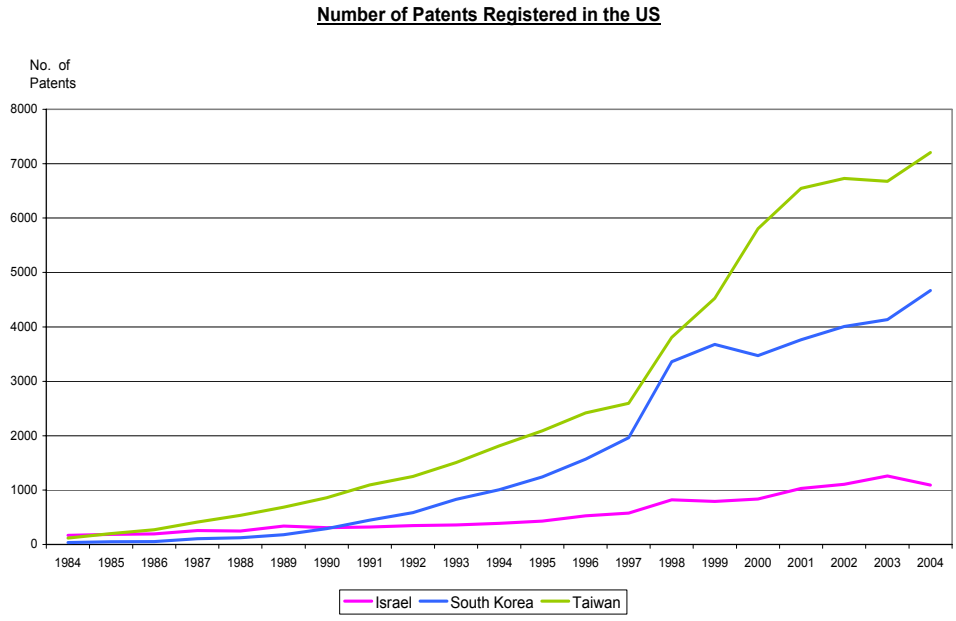
Graph 5



Source: US Patent and Trademark Office

In the international setting, Israel has emerged as a fast growing country in the innovation sector, growing faster than Europe and even North America. The "tigers" in the R&D field have been in Asia (as can be seen by Hong Kong in Graph 5 and even to a greater extent, South Korea and Taiwan in Graph 6).

Graph 6



Source: US Patent and Trademark Office

III. Government Support

There has been a growing interest in identifying the necessary and sufficient conditions for developing the innovations sector. Stern, Porter and Furman[9] (2000) examined the relationship between patenting by foreign inventors in the US and variables associated with national innovative capacity framework. They found that the production function for international patents is well characterized by a small set of observable factors, including R&D manpower and spending, aggregate policy choices such as the extent of IP protection and openness to international trade, and the share of research performed by the academic sector and funded by the private sector. International patenting productivity depends on each individual country's knowledge "stock". Stern, Porter and Furman also found that innovative capacity has an important impact on more downstream commercialization and diffusion activities (such as high market share of high-technology export markets).

Investment in R&D affects rates of productivity growth through innovation and the absorption of technology transfer. By engaging in R&D, one also enhances the capacity to understand and assimilate the discovery of others. A prevailing idea is that of "learning by doing", that is that some knowledge is hard to acquire without direct experience. Receptivity to new technologies, and the capacity to assimilate them, whatever their origin, is strongly complementary to the inventiveness itself.

The standard economic argument in favor of government support to the R&D sector rests on the social returns from R&D investments that exceed the private returns. Economy-wide productivity growth is enhanced by R&D investment by individual firms, with some benefits partly external to the investing firm. In this situation, government intervention is made to correct a systematic underinvestment by the private sector. While it is true that with the development of markets, resources and knowledge move more easily than ever before also across national borders, it is also true that in order to effectively compete internationally, firms are required to invest in their knowledge base. Yet, when profitability declines, firms often cut their R&D expenditure. Since the goal of the government is to correct some of the underinvestment by the private sector, a successful program must minimize the element of "crowding out" private funds by the public sector, although the public sector also wishes to engage in projects with a high probability of success.[10] Given that the Office of the Chief Scientist (OCS) tends to invest in projects that award substantial royalties as a share of expenditures, as seen in Graph 7, it is important that the government program would indeed be focused to avoid "crowding out" private investments.

In Israel, the Office of the Chief Scientist (OCS) is part of the Ministry of Industry and is the body responsible for governmental support of industrial R&D[11]. Under the main program, the OCS provides funding for industrial R&D in such a way that the government shares R&D risks with the industry. Firms apply for R&D financing on a project-by-project basis. Grants are awarded on a sliding scale from 20% to 50% of

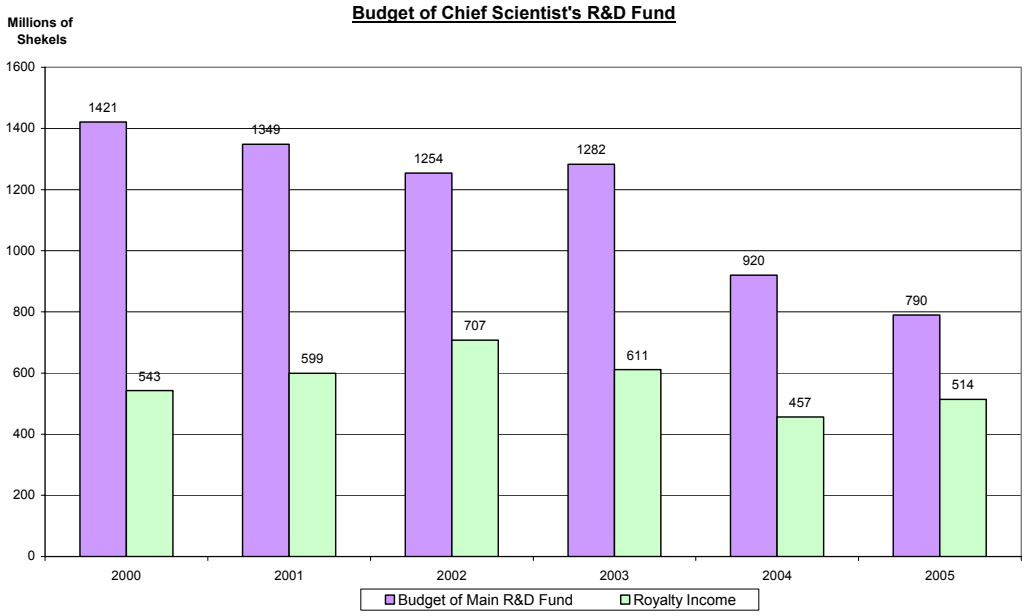
[9] Scott Stern, Michael Porter, and Jeffrey Furman (2000), "The Determinants of National Innovative Capacity".

[10] For a measurement of this problem see Saul Lach (2000).

[11] An overview of R&D policy in Israel and of the work of the Office of the Chief Scientist (OCS) is found in Manuel Trajtenberg (2000).

the project's R&D budget. In return, the company is obliged to pay royalty payments to the OCS from future product sales, of 3 to 6 percent.

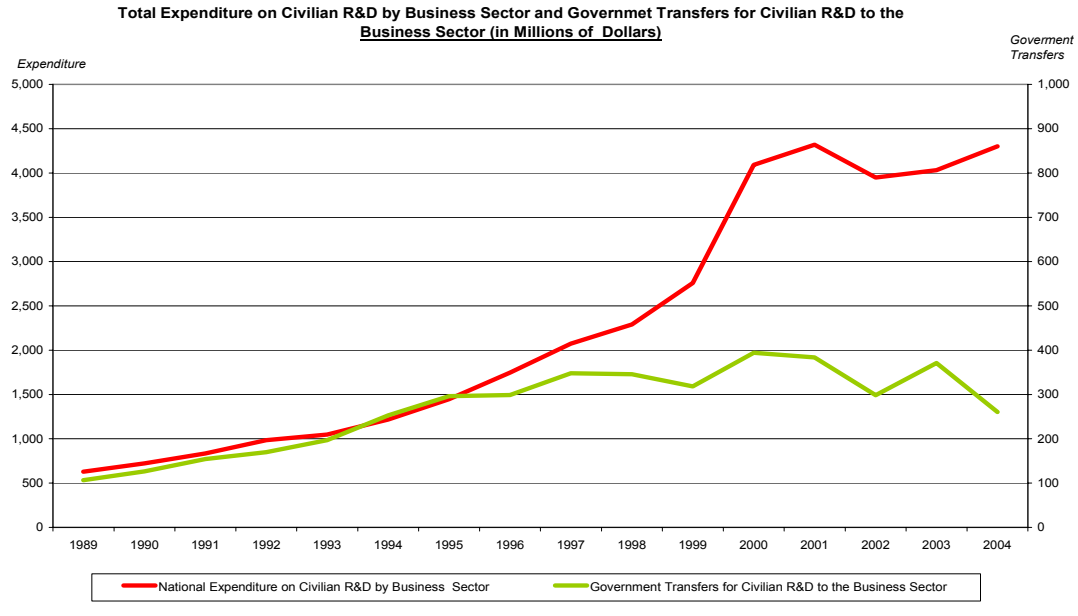
Graph 7



Source: Office of the Chief Scientist

In Graph 7, the left bar for each of the years shows the OCS' budget for grants in its main program of R&D support, while the right bar shows royalties collected. The difference in height between the bars signifies the net expenditures of the program It is clear that in recent years, less new money has been allocated to the program. In addition, one observes that the OCS chooses projects with a high potential to succeed and pay royalties. Royalty income received in each of the years is the outcome of the budget (investment) size and allocation of previous years.

Graph 8



Source: CBS, Israel

As Graph 8 shows, total government transfers for civilian R&D reached a peak in 2000. Government support has tightened while overall business sector R&D expenditures continue to rise.

IV. R&D Support – Company Survey

In May-June 2006, we conducted a survey among companies that enjoyed financial support from the Office of the Chief Scientist. Accepting the reasonable assumption that responses to the survey are credible, one can learn about the conditions in R&D companies in Israel that share a similar profile to the one of responding companies. The survey included a variety of questions concerning areas such as labor market conditions faced by companies receiving government support, the bottle necks for their further development, and the main benefit derived from government support. The survey sheds light on the selection of companies for the OCS' main financing channel—though limited only to those companies still surviving—and the degree of success among the responding companies. Information is also gathered regarding the type of problems that these R&D companies face and the main benefits gained from government funding.

Ninety eight companies that received support under the main OCS program responded to the survey[12]. It should be kept in mind that companies responding to the survey are ones that still exist in the same company structure that received the OCS funding. It should be expected that among the companies that received OCS support, the sample is biased towards the more successful companies, as those that failed were no longer in a position to respond. Companies that previously received funding and have ceased to exist could have "disappeared" either because of failure or in some cases because of a successful transformation into another ownership structure. It should also be kept in mind that some R&D companies with great potential may choose not to approach the OCS for funding because of the royalties to be repaid to the OCS in the event of success and the limitations on exit arrangements that are imposed on recipient companies. Perhaps most importantly, The Law for the Encouragement of Industrial R&D, under which the OCS operates, places a strong bias towards companies that produce domestically. Those companies that face a significant cost disadvantage from domestic production would prefer to produce abroad and therefore would not approach the OCS for support.

Company characteristics:

The 98 companies that received support under the main OCS' program and that responded to the survey, cover the spectrum of R&D sectors.

[12] The sample of the companies approached in the survey comprised 430 companies with a valid address and that are listed by the Office of the Chief Scientist (OCS) as having received budget support under the main program (un to November 2005). On the OCS's list there are an additional 600 companies without a valid address.

R&D sector	Number of companies
Communication	26
Medical equipment	14
Chemistry	11
Software	10
Biotechnology	9
Electronics	5
Pharmacology	4
Electro-optics	3
Plastics	3
Other	13

The survey response broadly resembles the allocation of OCS funding under the main program, across sectors, as reported by the OCS. As has been the case over a number of years, the communication sector led the list of funding received by the OCS, and life-science companies (which include medical equipment) come second.

In terms of company age, about one half of the companies in our survey receiving funds under the main OCS program have been established for more than ten years, about one quarter are 5-10 years old, and the remaining one quarter of the companies have been around for only 1-5 years. In other words, the survey mostly covers well established companies that have shown an ability to survive as market players. Such data is consistent with the information supplied by the OCS that more than 80% of the companies that approached the OCS in 2005 to receive some type of assistance have also approached the OCS in the past (i.e. are not first timers).[13]

Company longevity	Number of companies
Over 10 years	48
5 to 10 years	23
3 to 5 years	15
1 to 3 years	11
Up to a year	1

The survey also gathered information on labor market conditions for highly skilled workers in the R&D sector, among firms receiving government support. Since R&D activities are mostly human capital intensive, the majority of R&D spending is on salaries for R&D workers. Therefore, naturally a prime interest in understanding R&D activities is focused on labor market conditions in the sector. Typically, increased R&D spending goes to increased employment opportunities and possibly to higher wages to qualified workers. The more inelastic the supply of labor—as is the case especially in the short run—the greater the pressure for wage increases in response to increased demand.

[13] Industry, Trade, and Employment Ministry, Office of the Chief Scientist, "Report on Summary of Activities in 2005", January 2006.

In terms of the number of employees among firms receiving governmental R&D support under the main program, the survey respondents were split evenly between companies employing more than 50 workers, and those employing fewer than 50. This is in line with the finding that companies dealing in R&D in Israel are often small in size.

Number of employees	Number of companies
Over 100 employees	30
50+ to 100 employees	19
10+ to 50 employees	30
Up to 10 employees	19

R&D activities are intensive in human capital. As expected, nearly one half of the companies reported that more than three quarters of their employees have acquired academic-technological education, and in nearly two thirds of the companies more than 50% of the workers have academic-technological education.

Employees with academic-technological education as a percentage of all employees in company	Number of companies
75% or more	45
51-75%	16
26-50%	15
11-25%	10
Less than 10%	10
Did not respond	2

The value of immigrants (mainly from the former Soviet Union) to the R&D sector is also clear from the reporting by 39 out of the 98 companies, that at least 10% of their professional employees received academic degrees from abroad and immigrated to Israel after 1989 (the first year of the big wave of immigration from the FSU).

Proportion of academic employees in the company that received academic degrees abroad and immigrated to Israel after 1989	Number of companies
More than 75%	6
25% to 50%	12
10% to 25%	21
Less than 10%	51
Did not respond	8

When the mobility of highly skilled labor between firms is high, the benefits derived from the process of learning that the firm undergoes can leak away from the firm. This issue of knowledge spillovers is particularly important in the R&D field, where knowledge is often gained in a process characterized by many failed attempts. In order to look at labor mobility among firms receiving funding from the OCS, firms were asked for information regarding average seniority of their skilled labor as well as

for information regarding skilled labor turnover. The information gathered shows that professional workers tend to spend more than three years in the same company. In addition, in a recent period of 2 years, most companies experienced turnover of relatively few workers. During that period, about 75% of companies that have received funding under the main program of the OCS reported that no more than 10 professional employees had left the company.

Average seniority of employees with academic-technological education	Number of companies
More than 10 years	17
5 to 10 years	25
3 to 5 years	32
1 to 3 years	19
Less than a year	5

Number of working professionals who left company between January 2004 and December 2005	Number of companies
Up to 5	65
6 to 10	10
11 to 50	17
Over 50	6

About 75% of the companies reported turnover of up to 10 professional workers, whether leaving or joining. The figures suggest that there has been an expansion in the recruitment of professional employees in the R&D companies participating in the survey. More companies recruited 6-10 professional employees than those reporting the loss of 6-10 professional workers.

Number of working professionals who joined company between January 2004 and December 2005	Number of companies
Up to 5	45
6 to 10	29
11 to 50	17
Over 50	7

A difficulty in recruitment is also apparent from the survey, as more than 60% of firms responding claimed they suffered from such a problem. This finding is consistent with other sources that point to a tight market for highly skilled labor during the recent period of May-June 2006[14].

[14] A survey conducted by the Manufacturers Association of Israel (June 2006) reports growing difficulties by industrial firms in finding professional workers (reported on the web site of the association).

Did the company face difficulty in recruiting professional employees	Number of companies
Yes	59
No	34
Did not respond	5

Yet despite the tight labor market for highly skilled labor, the main difficulty reported by the R&D firms participating in the survey is a funding difficulty. This reported funding difficulty is all the more striking given that the sample of companies that benefited from government support is already biased toward companies that, according to the assessment of the OCS, have a low risk profile. (This is also apparent from the survey when looking at size, age and achievements of the companies that benefited from government support). Sixty-seven companies reported that funding alone or funding together with another problem are the main difficulties in the production of new products.

The main difficulty in the production of new products	Number of companies
Funding	45
Funding and professional employees	9
Funding and marketability	7
Marketability	7
Marketability and costs	5
New concepts	4
Professional employees	3
New concepts and marketability	3
Professional employees and marketability	3
Funding and costs	2
Funding, professional employees and costs	1
Funding, professional employees, costs and new concepts	1
Professional employees and new concepts	1
Costs	1
Funding and new concepts	1
Funding, new concepts and marketability	1
Did not respond	4

Not surprisingly—given the relatively small company size—the vast majority of companies do not have access to funding from stock exchanges in Israel nor abroad.

Is the company traded on a stock exchange?	Number of companies
Yes, in Israel	7
Yes, abroad	8
Yes, in Israel and abroad	4
No	77
Did not respond	2

About two thirds of the companies have not benefited from venture capital funding.

Has the company received financing from venture capital funds?	Number of companies
Yes	32
No	64
Did not respond	2

The depth of the reported funding problem is revealed by the composition of the 45 companies that identified funding as the main difficulty in the production of new products. The funding difficulty cuts across well established companies in the various sectors, and is especially prevalent among the smaller companies. Many of the companies that reported being constrained by funding limits did not have an access to funding from stock exchanges and venture funds.

Characteristics of the 45 companies that reported funding as the main difficulty:

Company longevity	Number of companies
Over 10 years	22
5 to 10 years	10
3 to 5 years	8
Up to 3 years	5

Number of employees	Number of companies
Over 100 employees	9
50+ to 100 employees	8
10+ to 50 employees	15
Up to 10 employees	13

Is the company traded on a stock exchange?	Number of companies
Yes, in Israel	3
Yes, abroad	3
Yes, in Israel and abroad	1
No	37
Did not respond	1

Has the company received financing from venture capital funds?	Number of companies
Yes	13
No	31
Did not respond	1

Patent registration is common for R&D activities and indeed some three quarters of the companies in the survey registered patents. Most of the companies that registered patents did so both in Israel and in the US, many registered only in the US and a negligible amount of companies registered patents only in Israel. Sixty-eight out of the 72 companies that registered patents did so in the US (whether registering only in US or both in Israel and US). Such a finding reinforces the approach of analyzing patent registration by Israeli innovators in the US as means of understanding R&D activities in Israel.

Patent registration	Number of companies
Companies that registered patents:	72
Only in the US	26
Only in Israel	4
Both in Israel and the US	42
Did not register patents	26

Nearly three quarters of the companies that registered patents in the US, registered relatively few patents, while the remaining companies that registered patents had done so for over 10 patents. The differences in patent registration reflect both differences in R&D between companies and also variation in the strategic approach to the definition of each patent and to what should be registered.

Number of patents registered in the US	Number of companies
1 to 10	50
11 to 50	15
Over 50	3

Patent registration does not seem to be a determining factor in the OCS' decision to allocate government funding. About half of the responding companies registered patents before (or during the year of) receiving funding under the main program of the OCS, and the remaining half did not register patents at all or did so only after receiving governmental support.

Company selection	Number of companies
Company received government support after first (or during the year of) patent registration	48
Company received government support before or without patent registration	50

Out of the 50 companies that received government support before any patent registration, 24 registered patents subsequently.

The success of many of the companies is apparent when looking at the high percentage of companies that report paying royalties (current or historically) to the OCS. Royalty payment to the OCS is required only when the company receives income from sales related to the R&D project that was OCS-financed.

Do you (or did you) pay royalties to the Office of the Chief Scientist	Number of companies
Yes	68
No	25
Did not respond	5

As presented below, the overwhelmingly majority of companies are exporters with revenues of up to $10 million in 2005.

Company exports as share of total sales	Number of companies
More than 50%	65
25-50%	7
10-25%	4
Less than 10%	11
Did not respond	11

Annual revenues in 2005 ($)	Number of companies
More than 50 million	13
10-50 million	18
1-10 million	32
Less than 1 million	24
Did not respond	11

Despite the relative success of many of the companies, the reported main benefit of government support was in the subsidy derived from the state's participation in undertaking some of the project costs. In other words, most companies see the main benefit of the program as receiving direct government funding, and less so in risk participation with another partner (i.e. the state).

Main benefit from financial support of the Office of the Chief Scientist	Number of companies
Reducing costs of conducting R&D	59
Sharing project risk with the State	31
Both of the above	7
Did not respond	1

V. Conclusion

Over the past decade, Israel has continued to achieve significant progress in R&D activities. This paper demonstrates that the impressive results are apparent when evaluating international patent data. Yet, challenges remain. Many successful companies report that they face funding difficulties that constrain the development of new products. In recent years, government support of R&D activities have become more scarce. The survey contains information regarding lower than expected labor mobility (one of the main mechanisms of knowledge spillovers is via labor mobility) as well as the need for reliance on high level of human capital. The survey highlights the issue of financing difficulty of R&D activities as a core challenge for many of the companies that are engaging in innovation, and focuses on the reported limited access to capital.

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