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Analysis of policy mixes to foster R&D investment and to contribute to the ERA

Israel

Yaacov Fisher and Michael Eilan

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ERAWATCH COUNTRY REPORT 2009: Israel

Analysis of policy mixes to foster R&D investment and to contribute to the ERA

ERAWATCH Network – **Israel Business Information Services** (I-Biz)

Yaacov Fisher and Michael Eilan

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Executive Summary

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Hence, a central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of the efforts in increasing R&D investments and improving the performance of national research systems.

The main objective of the report is to characterise and assess the evolution of the national policy mixes in the perspective of the national goals for R&D investments, and for the contribution to the realisation of the European Research Area, as associate country. This report is building on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

In 2007, investment in civilian R&D in Israel constituted 4.7% of GDP[1]. This places Israel at the top of the GERD ranking of the developed economies and far above the GERD target of 3% of GDP, as set down in the Lisbon strategy: the comparable 2007 figure for the EU-27 countries was 1.83%[2]. Israel's lead in the ranking does not of necessity point to the success of Israel's national R&D policy: in fact, as of yet, there is no clearly articulated and target oriented national research policy (NRP) in Israel, and this report explains why this is so. There is a coherent industrial R&D policy, but this too is not spelled out or oriented towards specific targets.

The Lisbon strategy aims not only at increasing and improving the overall volume of investment in R&D (to meet the 3% GDP target) but to do so while increasing the share of the private sector in this investment. In 2005, the share of the Israeli business sector in total civilian R&D expenditure (BERD as a % of GERD) was 75.4% compared to "only" 54.5% in the EU-27 countries. Again, even though the impression here is that Israel is ahead of the Lisbon strategy targets, whereas Europe still has to achieve them, the high share of business sector involvement in R&D in Israel has problems attached to it, problems which call for solutions and a relevant research policy. This report delineates the problems and outlines solutions that have been suggested by various bodies.

The Israeli growth strategy that led to the high GERD ranking was hatched in the early ‘90s of the previous century, and was essentially linked to the ICT boom in all its various cycles. A key event was the establishment of the government’s Yozma fund of funds in 1993 that basically created the Israeli Venture Capital (VC) industry. Two other key elements were the network of relations that enabled Israeli firms to go public on NASDAQ, and mass immigration of Jews from the former Soviet Union who upgraded the country’s human capital.

This strategy relied upon the very high quality of research workers who came out of Israeli universities and from universities in the former Soviet Union. Since then it has evolved through various boom and bust cycles, but has remained essentially

[1] A complete set of data on R&D can be found in National Expenditure on Civilian R&D 1989-2006, Central Bureau of Statistics (CBS), Special Publication No. 1321. The 2007 data published in this report were obtained directly from the CBS, prior to the publication of the updated Special Publication.

[2] The Israeli figure is even biased downwards compared to Europe because it covers only civilian R&D, whereas European data cover total investment in R&D. No data are available for defense sector R&D expenditure in Israel.

unchanged. Its strength was in complete abrogation of thematic responsibility because it was felt that business was closer to the real needs of the market than government could ever be. The strategy also had two weaknesses that are becoming more apparent over the years. The first is closely linked to the time in which it evolved. The ICT market, especially in its earlier years, was characterized by very short product cycles and very high returns, a risk profile that was suitable for business. The second weakness was the lack of linkage between research policy and R&D policy, a factor that led to underinvestment in research and education. This weakness was manifested both in investment in basic research and in investment in government sponsored thematic subjects of long and medium term benefit.

With regard to industry, policy has begun to change, as can be seen in the decision to set up a thematic dedicated fund to support biotech, an industry with very long R&D cycles. As far as basic research and education are concerned, there are some beginnings of responses, but it remains to be seen whether these will be implemented by the incoming government and will subsequently receive the same long term commitment that industrial R&D policy has received over the years. There are some policy suggestions on the table that are meant to resolve the weakness in government sponsored applied research, but it remains to be seen whether these will be translated into action.

Barriers to R&D investment	**Opportunities and Risks generated by the policy mix**
Heavy reliance on capital markets for R&D	The decision to increase funding to support commercial R&D might help firms overcome the crisis. The risk is on that nobody knows how long the crisis will last.
University research funding	Ad hoc response to this year's funding crisis might herald the implementation of the Shohat Committee's recommendations. The risk is in that the recommendations have not been formally approved and might be rescinded by the incoming government.
Low level of government sponsored R&D	No policy response
Biotech market failure	New fund might help pharmaceutical biotech start-ups survive "death valley." It will take years, however, to see if this strategy works.
Lack of innovation and research in traditional industries	A solid policy has been in place for the past two years, which is not long enough for evaluation. The risk is in that many of these firms are now fighting for their lives because of the global crisis and will have neither the time or resources to devote to R&D.

Despite its membership in the Framework Programmes and other European bodies, Israeli policy is influenced by ERA only to the extent that the government is committed to maintain and expand these relationships. Hence this report tries to expose the often unarticulated targets of Israeli policy and assess them by the ERA yardstick whenever that is possible.

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	• Not considered very important: too much reliance on immigrant researchers	• Tax incentives for immigrant researchers, no coherent policy on other researchers
Governance of research infrastructures	• Poor research infrastructure is a major contributor to brain drain	• No policy formally has been approved yet but if the Shohat committee recommendations are adopted this subject will be addressed
Autonomy of research institutions	• Israeli universities are highly autonomous	• No policy
Opening up of national research programmes	• No policy in place	• No policy

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1 Introduction

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Hence, a central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of the efforts in increasing R&D investments and improving the performance of national research systems.

The main objective of the report is to characterise and assess the evolution of the national policy mixes in the perspective of the national goals for R&D investments, and for the contribution to the realisation of the European Research Area, as associate country. This report is building on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

In this report we characterise and assess the performance of the national research system and national research policies in Israel. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain is guided by a set of generic "challenges", common to all research systems, which unravel possible bottlenecks, system failures and market failures a research system has to cope with. The main elements of and results from this analysis are presented in Chapter 2, while in the Annex, the reader can find a more detailed account of this exercise.

The need for an effective research policy, appropriately co-ordinated with education, innovation, and other types of policies, is also widely recognised. Therefore, we focus on the following two analytical issues:

- The assessment of the national policy mixes for the achievement of national R&D investment goals set. Particular attention is paid to policies fostering private R&D and addressing barriers (Chapter 3).
- The assessment of national policies contributing to the realisation of the European Research Area, as an associate country (Chapter 4).

2 Characteristics of the national research system and assessment of recent policy changes

2.1 Structure of the national research system and its governance

Israel is a small country (population of 7.3 million in 2008) with a deep appreciation of the importance of high-tech to economic development, both in good times and bad times. The importance of high-tech to Israel's economic growth over the past two decades is linked closely to the understanding regarding the necessity for R&D: this understanding is, in turn, reflected in the high share of civilian R&D[3] in GDP – 4.7%

[3] This report refers solely to civilian R&D: there are no available data on R&D implemented in the defense sector in Israel.

in 2007, the highest share among developed economies, and to be compared with an R&D intensity (GERD as a % of GDP) of 1.83% for the EU-27 countries.

One of the major features of the national research system in Israel is the high share of R&D financing and operation by the private business sector: in 2007, the business sector operated 78.7% of civilian R&D activity, the higher education system – 12.6%, central government – 5.1% and private non-private institutions – 3.6%[4]. Since one of the aims of ERA is to promote private sector involvement in research in EU countries, the current situation in Israel looks ideal. One of the aims of the current report is to point out the problems resulting from the high share of business sector involvement in R&D: these problems can be summarized as the emphasis placed by the business sector on profit making from its R&D activity, rather than from targeting national long-term R&D goals.

It is worthwhile mentioning that the credit for the high share of business sector involvement in R&D can be given to the government. In 1993, in the early stages of the high-tech boom of the 1990's and of the highly-skilled mass immigration from the former Soviet Union, the government set up the Yozma venture capital (VC) fund, with the express purpose of encouraging the private sector to establish a VC industry. This government policy was extremely successful and helped, along the way, to absorb a significant number of the arriving immigrants into the high-tech and R&D sectors.

Israel's R&D system can best be broken down, from the point of view of governance, into three parts – industrial R&D, academic R&D and R&D directed by the government. If, as mentioned, the business sector has the lion's share of R&D performing and financing in Israel, the outcome is that government has relatively little governance of R&D. There is, however, a major government player in the promotion of industrial R&D, the Office of the Chief Scientist (OCS) in the Ministry of Industry, Trade and Employment (referred to below in short as the Ministry of Industry). In 2007, this Ministry was responsible for some 60% of total government expenditure on civilian R&D: the problem is that since the peak year of 2003, R&D financing by the OCS has dropped by 35% (as part of a 25% decline in total government R&D expenditure), thereby severely limiting the ability of the government to promote research, both in the short-term and long-term.

Higher education in Israel is mostly government-financed: the financing is provided via the Budget and Planning Committee (known in Israel as VATAT) of the quasi-government Higher Education Agency, with the finance emanating from the Government budget. Universities in Israel have almost complete autonomy regarding the uses of finance provided to them, so there is no way of knowing in advance how the finance provided is allocated between teaching and research. But in general, government finance provided to higher education has been receding in recent years: because of a shortfall of teaching expenses covered by student fees, it is quite likely that money that would otherwise be used to promote academic research is transferred to cover this shortfall, which means that academic research is also suffering from budgetary constraints. In October 2006, the government-appointed Shohat Committee for Higher Education in Israel began work on a comprehensive reform of higher education. The Committee submitted its report to the government in July 2007, but as of March 2009, the Committee's recommendations have still to be

[4] The breakdown of financing R&D activity was very similar in 2007: the business sector – 76.4%, higher-education – 14.3%, government – 5.5% and non-profit institutions – 3.8%.

formally approved. One of these recommendations was to add a substantial amount of government money to promote academic research over the next five years

The governance of research directed by the government is, in principle, the responsibility of the Ministry of Science, Culture and Sport (formerly the Ministry of Science and Technology: referred to below, in short, as the Ministry of Science). The problem here is that this Ministry has little political influence and a very limited budget.

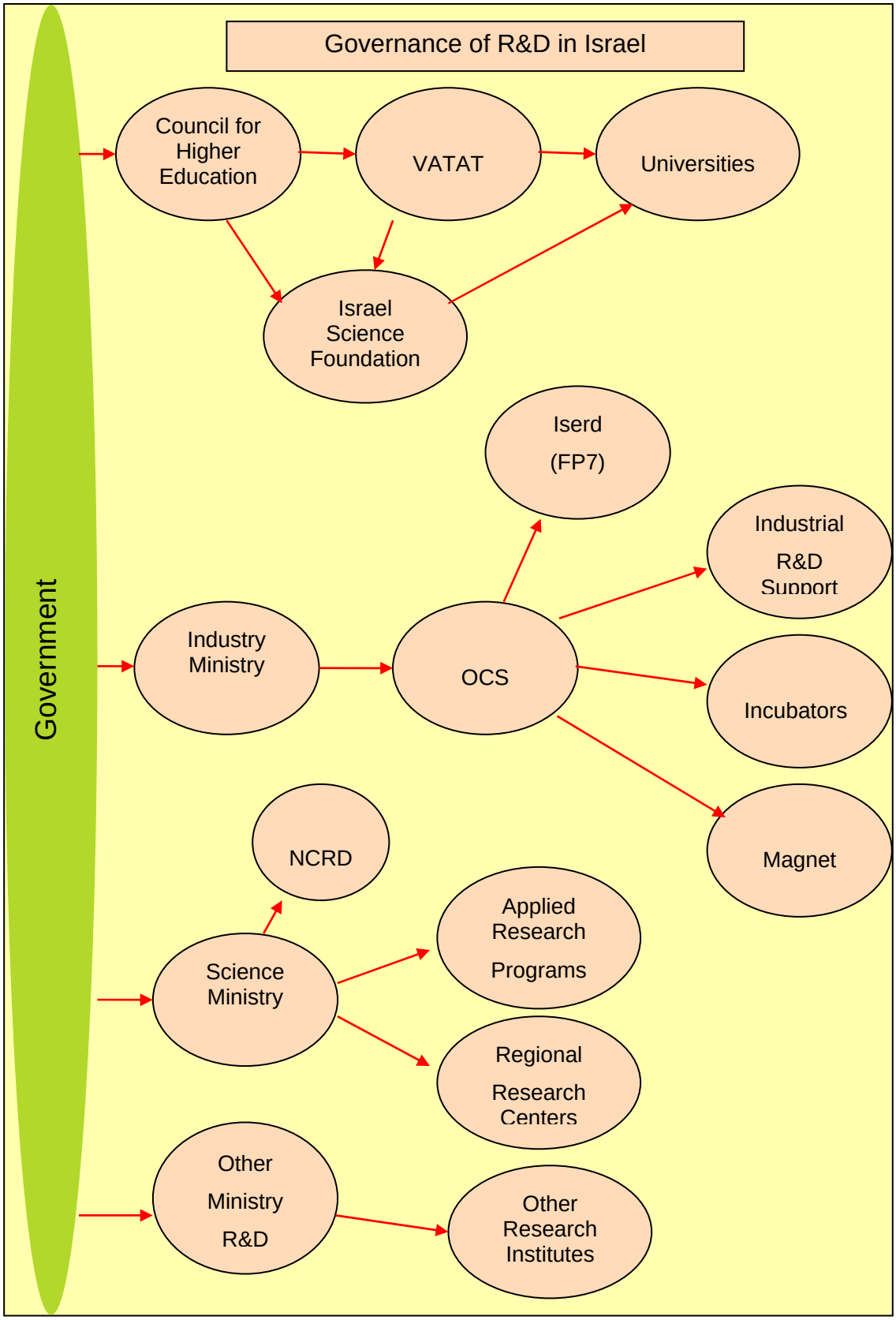
To strengthen the R&D policy making process in general and government-directed research in particular, the National Council for R&D (referred to below as NCRD) was established, by law, in 2004[5]. The principal function of the Council is to act as consultant to the Government in the area of R&D, helping the government to prioritize required areas of R&D: the Forum of Chief Scientists is an authorized advisor to the NCRD.

Main actors and institutions in research governance

Actor	Responsibility
VATAT (an acronym for the Budget and Planning Committee of the Council for Higher Education	Disbursement of all university funding including block financing for research. Governance of these funds, planning.
The Israel Science Foundation	Competitive research funding of university research programs. Funded by VATAT
The Office of the Chief Scientist (OCS) in the Industry Ministry	R&D support for industry, innovation policy.

[5] The law establishing the Council was passed in the Knesset, Israel's parliament, in 2002. Details of the Council and its activities are provided by the website of the Ministry of Finance (www.most.gov.il) but for the moment only in Hebrew.

Figure 1: Overview of the governance structure of the Israel's research system



Source: Authors

2.2 Summary of strengths and weaknesses of the research system

Table 1: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	In recent years, there has been a growing appreciation on the part of the authorities – including the Ministry of Finance – to increase resources for research activities: the strengthening of the NCRD is a move in the same direction. There is however no guarantee that the additional resources provided will suffice to meet research targets.
	Securing long term investment in research	The Shohat Committee for Higher Education recommended a significant increase in finance for long-term academic research. But again, this is still only a recommendation and has still to be implemented.
	Dealing with barriers to private R&D investment	Private R&D investment is 80% of the total in Israel, so in principle, it has no barriers. However, it is subject to strong cyclical movements, so that the global economic crisis could have – and is indeed already having – a serious effect on this source of R&D financing
	Providing qualified human resources	Not enough attention has been paid in Israel to the provision on qualified human resources for research and too much reliance has been placed on the mass immigration of the 1990's, an immigration that is now aging. This is a definite challenge for the future.
Knowledge demand	Identifying the drivers of knowledge demand	Israel has built its global high-tech status mostly on its achievements in the ICT sector, and has been less successful in identifying and promoting other research areas that can be thought of as drivers of global knowledge demand, even though it has achievements in these areas
	Co-ordination and channelling knowledge demands	In part, the market failure in these other areas (for example, biotech) stems from the lack of a clear national R&D policy and of entities whose function is to implement policy. Coordinating bodies – such as the FCS and the newer NCRD – have not yet proved effective in this endeavour.
	Monitoring of demand fulfilment	If coordination has been ineffective, so has the monitoring of demand fulfilment. It is to be hoped that increasing recognition of the importance of promoting research (see Resource Mobilization above) will be accompanied by improved coordination and monitoring of fulfilment

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge production	Ensuring quality and excellence of knowledge production	The OCS – the main government player in the promotion of research – has always taken excellence as a central criterion of deciding which research to finance. Israeli universities, as well, emphasize the excellence of research projects that they finance either with VATAT money or via competitive financing.
	Ensuring exploitability of knowledge	At the same time, there has been a lack of sufficient exploitability of certain research areas in Israel, mainly because of long times-to-market. This is being gradually recognized by the authorities: a good example of this recognition is the Israel nanotechnology initiative and the recent establishment of the biotech fund by the OCS: biotech as a research area with great potential, but which has witnessed a great deal of market failure in recent years.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	There is no consensus about the success of the connection between academic research and the business sector, with opinions regarding this success ranging from high to poor. There still seems to be definite room for improvement here.
	Profiting from international knowledge	Israel is well-connected with European research via the Framework Programmes and is connected with EURAXESS[6]
	Enhancing absorptive capacity of knowledge users	The importance of high-tech for the Israeli economy over the past two decades has created a built-in absorptive capacity of knowledge users. Israel has indeed established itself as a leader in many areas of research, thereby helping to enhance the absorptive capacity of knowledge users abroad.

The analysis present in Table 1 can be summarised as follows:

1. The main strengths of the Israeli research system – the originality of research, the high degree of potential entrepreneurship among researchers, and the growing recognition in government circles that promotion of research is essential for long-term economic growth – constitute a firm base for developing the research system further.

2. There are important policy challenges in all of the four domains presented in the table. More financial resources are called for – principally from the government (the business sector - both domestic and foreign {for example, foreign venture capital funds are very involved, to the extent of more than 50%, in financing Israeli high-tech companies} - will take care of its own financing). Much more attention needs to be paid towards creating the human resources required to guarantee the long-term enhancement of research. Relevant policy-making entities are called for (or existing entities strengthened) to identify much more clearly and resolutely the drivers of knowledge demand, for Israel's long term economic benefit. The NCRD is a move in this direction, but it is not certain that it will have the necessary clout to achieve this aim. Improving identification of drivers of knowledge demand will, almost by definition, help to improve

[6] For a more complete description of Israel's international relations in the area of research, go to the following link http://www.most.gov.il/English/Units/Science/Programs/International+Relations/default.htm

knowledge production – both its volume and sector makeup. And lastly, policy can help in improving knowledge circulation, both within Israel and between Israel and abroad, even though the current research connections between Israel and abroad are certainly commendable and expanding.

3. The strengths of the research system – particularly entrepreneurship – are certainly bound up with the important role of the business sector in operating and financing research in Israel. One other strength that has not been mentioned up to now is the contribution to civilian research by the defence sector, with research carried out in this sector being subsequently transferred to the civilian sector: from this point of view, the defence sector can also be thought of as a source of qualified human resources, though this is not of necessity an outcome of research policy. The weaknesses listed in Table 1 are certainly the result of policy – or rather lack of it – and also of a dispersion of involvement with research policy among too many different entities (Ministry of Science, Ministry of Finance, OCS, FCS, NCRD, VATAT) with limited coordination between them.

The weaknesses presented in Table 1 do overlap the 4 domains in varying degrees: lack of identification of drivers of knowledge demand can lead to a short fall in resource mobilization and in knowledge production. Problems with prioritizing research areas (knowledge demand identification) obviously affects knowledge production in certain areas (a good example of this in Israel is the backward state of its research in solar energy - for which it has ideal climatic resources - compared to certain European countries). Weaknesses in knowledge circulation can also lead to shortfalls in resource mobilization and problems with knowledge demand identification.

There is no doubt that enhanced clarity of research policy in Israel, together with the strengthening of policy-making entities, will do much to alleviate the current weaknesses in each domain and the cross-transfer of weaknesses between domains.

2.3 Analysis of recent policy changes since 2008

The importance of the high-tech sector for economic growth in Israel has been recognized now for the last two decades: in periods of rapid macro-economic growth, the high-tech sector had been the leading factor behind this growth and in periods of recession, the decline in high-tech activity has usually been greater than the overall decline in growth – in such situations, high-tech also took the lead.

Despite this recognition of the importance of high-tech, there is still no cohesive National Research Development and Innovation (RDI) regarding the role of research in the broader economic growth policy This is surprising given the reliance of the success of high-tech on research: one would think that if the promotion of high-tech is considered essential for future economic growth, then the promotion of research as the basis of long-term high-tech growth would also be considered essential. One factor here is the high share of business sector involvement in the promotion of high-tech growth: an RDI would not normally be the outcome of business sector activity, which is more directed by shorter time profit motives.

The establishment of the National Council for R&D (NCRD) in 2004, whose primary function is to act as a consultant to the government regarding formulation of an RDI, is definitely a step in the right direction, but only recently has the NCRD been

provided with an initial limited budget to finance its activities and there is no certainty as to how long it will take for it to become – if at all – an effective policy-formulating entity.

In the meantime, government research budgets have actually been declining. It is only recently, due in part to the effect of the global economic crisis on the Israeli economy that the government has woken up to the need to provide more resources for research. These additional resources constitute the main policy measures/activities for the promotion of research in Israel in 2008-2009.

2.3.1 Resource mobilisation

Table 2: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision for research activities	The provision of an extra €46m to the budget of the Office of the Chief Scientist (OCS) in the Ministry of Industry, Trade and Employment. The OCS budget shrank from €335 in 2003 to less than €223m in 2007, and continued to shrink in 2008. The additional €46m works to change this trend.
Securing long term investments in research	The Shohat Committee on Higher Education in Israel recommended adding €148m to academic research over the next 5 years. The Committee's recommendations have still not been officially approved by the government, but in the negotiations over the 2009 State Budget, the Prime Minister ruled to transfer a sum of €104m to the universities, €46m of which are designated for research
Dealing with uncertain returns and other barriers	Uncertainty regarding the ability of the business sector to raise research funds as a result of the global economic crisis was a major incentive behind the additional sum of €46m to the OCS budget (see above).
Providing qualified human resources	No policy changes

Policy changes in the resource mobilisation domain in 2008-2009 concentrated on adding financial resources to research, principally from the public sector. Given the downward trend in government research budgets in recent years, this is a welcome policy change, which hopefully will continue. It also shows increased understanding by government that the business sector cannot always be relied upon to provide sufficient research funds.

2.3.2 Knowledge demand

There were no specific policy changes implemented in the knowledge demand domain in 2008-9, but there were organizational/recognition changes which are essential for the process of identifying the drivers of knowledge demand.

Table 3: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	No specific policy changes. However, recognition continues to expand regarding the need to promote research in areas where there has been market failure in the past, or where Israel lags other countries. Examples are: biotech, nano-tech, alternative energy, water technology, innovation of traditional industries.
Co-ordinating and channelling knowledge demands	The increasing influence of the National Council for R&D since 2008 is a definite step towards challenging knowledge demands and coordinating between the entities – both public and private sector – that are connected with research.
Monitoring demand fulfilment	No policy changes

2.3.3 Knowledge production

Table 4: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	All main players in research governance in Israel: the business sector, the OCS and the universities continue to base their operation or financing of knowledge production mostly on the basis of excellence.
Ensuring exploitability of knowledge production	A biotech fund with a budget of €46m has been established by the OCS, to promote research in this area. Biotech has for many years been recognized as a source of great potential for the Israeli high-tech sector in particular and for macro-economic growth in general. However, the sector has suffered from considerable market failure in recent years, in large part stemming from the inability of biotech research to obtain relevant funds, with a major barrier the relatively long time-to-market of this research. The new fund is a major step towards enhancing the exploitability of biotech knowledge.

The establishment of the biotech fund is a policy change that constitutes an important step towards strengthening the role of the government in supporting specific areas of knowledge production, that are considered to have significant potential for long-term economic growth, but have been discarded in the past by the business sector for not producing profits quickly enough.

2.3.4 Knowledge circulation

Table 5: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	Emanating from the OCS, the MAGNET programme provides a competitive position for Israel's industry with regard to state of the art technologies of worldwide interest. The new technologies are developed via cooperative ventures between industry and leading academic scientific research in specific areas, which provide the basis for new high-tech products and processes[7]. Additional knowledge circulation is achieved via the technology transfer companies at all major Israeli universities[8].
Profiting from access to international knowledge	Israel has been involved in all EU Framework Programmes, with involvement in FP7 the greatest of all.
Absorptive capacity of knowledge users	No policy changes.

As in the case of the knowledge demand domain (see above), there were no specific policy changes in the knowledge circulation domain in 2008-2009. However, there is ongoing and increasing recognition that the current state of knowledge circulation between the academic system and the business sector has to be strengthened[9]. Also, for many years now, Israel has endeavoured – successfully - to connect and work with international knowledge systems. Israel's upcoming membership of the OECD, likely to be approved by the end of 2009, can only help to strengthen these connections[10]

2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

The paucity of policy changes in the research area in 2008-2009 makes it difficult to assess the extent to which policy is creating opportunities and/or is dealing with the risks related to knowledge demand and knowledge production. This difficulty exists not only with regard to the analysis of developments in 2008-2009 but in general,

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[7] For a full description of the MAGNET programme go to: http://www.moit.gov.il/NR/exeres/111E3D45-56E4-4752-BD27-F544B171B19A.htm

[8] The main technology transfer companies are: Yissum at the Hebrew University in Jerusalem (www.yissum.co.il), Ramot at Tel Aviv University (www.ramot.org), Yeda at the Weizmann Institute (www.yedarnd.com), T3 at the Technion (http://t3.technion.ac.il), BGN Technologies at Ben-Gurion University (http://cmsprod.bgu.ac.il), Carmel at Haifa University (http://carmel-ltd.haifa.ac.il) and Bar-Ilan R&D at Bar-Ilan University (http://www.biu.ac.il/birnd)

[9] It is worthwhile noting that in the many meetings we held with people connected with research, in preparation for this report, views about the degree of cooperation between the academic world and the business sector with the purpose of commercializing research varied from poor to very good.

[10] As part of the OECD membership application process, Israel is required to establish new data systems in the area of innovation. Among these information tasks is the implementation of a comprehensive innovation survey, on the lines of the Community Innovation Survey (CIS) of the European Union.

because – as already mentioned – Israel still has not formulated a comprehensive National Reform Policy (NRP) in the area of research. Furthermore, since a RDI does not yet exist, it is unlikely that whatever research policy is undertaken will commit itself to taking a comprehensive look at the 4 domains of resource mobilisation, knowledge demand, knowledge production and knowledge circulation, all of which would be considered by an RDI. At best, policy measures introduced in Israel aim at creating opportunities and/or dealing with risks in one of these domains.

It is to be hoped that the growing effectiveness of the National Council for R&D in 2008-9 will eventually lead to the formulation of an RDI, approved by the government, which will change the face of the research system in Israel.

Taking all this into account, there is no doubt that the policy measures/activities implemented in 2008-2009 – increasing the OCS budget, establishing the Biotech Fund, partial implementation of the recommendations of the Shohat Committee for Higher Education in Israel – could contribute significantly to bringing about desired changes in the Israeli research system.

Table 6 lists the main policy related opportunities and risks associated with all 4 domains but with special emphasis on Knowledge Demand and Knowledge Production.

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy related opportunities	Main policy-related risks
Resource mobilisation	The additional finance provided by the OCS and via partial implementation of the Shohat Committee recommendations is expected to give a boost to industrial and academic research respectively, which have been hit by budget cuts and by the global economic crisis.	The main possible risk is that the additional finance will be regarded ex post as a one-off "measure", and not – as it should be – as the beginning of a new upward trend in the provision of finance to research, which is a necessity for long-term economic growth. Lack of continuing government financial resources is particularly likely once the global crisis comes to an end, with the business sector resuming its role of premier operator and financier of research in Israel.
Knowledge demand	The recent enhancement of the influence of the NCRD is crucial for the eventual formulation of Israel's RDI: the NCRD was set up precisely for this purpose. A particular opportunity offered by the NCRD is strengthening government-directed research, an area of research that has lagged behind industrial and academic research for many years.	The risk is that for political or other reasons, the NCRD will not be allowed to function as it should, according to the legislation based on which it was established. The outcome of this will be continued dispersed governance of research without any clear long-term targets.
Knowledge production	The establishment of the biotech fund is an important step towards recognition that market forces are not always efficient in producing the knowledge required for the long term benefit of the economy. The biotech fund could well set a precedent for the establishment of other funds that act to prioritize areas of research.	The risk is that - as with the policy measures of resource mobilisation above – this fund will be a one-off measure and not create a trend, with the establishment of funds in other prioritized areas. It appears that such funds are extremely important in research areas with long times-to-market. A cross-domain risk is that the extra biotech finance provided by the fund will not be combined with sufficient exploitation of knowledge circulation channels, to guarantee the most effective use of the additional finance.

Domain	Main policy related opportunities	Main policy-related risks
Knowledge circulation	There were no specific measures under this domain, but there was a continuing and increasing involvement in the current EU Framework Programme and a desire to link up with other international research frameworks.	There is no particular risk attached to the increasing Israeli involvement in knowledge circulation frameworks. It is however important that the interest in expanding international research connections should not be limited to frameworks with a specific time frame, but should continue in the long-term. This includes attracting foreign researchers to work in Israel and the removal of any barriers to achieving this.

3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent reaching the Lisbon goal? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?
3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system for the achievement of R&D investment objectives

As stated above, Israel has long surpassed the Lisbon objectives with GERD reaching 4.7% of GDP in 2007. Furthermore this was done without the government ever stating in public a target for RDI expenditure or specifications of policy needed to reach these targets.

Historically, the target has always been set as the achievement of more: more research in universities, and more business investment in R&D. The barriers towards achieving these targets have been overcome in a manner that was never spelled out as a formal policy target but was nonetheless long term in its thinking and execution.

Since the Lisbon targets have been achieved, even though they were never a target for Israeli policy makers, this section will deal with the barriers perceived by policymakers and stakeholders within the R&D system. Since overall R&D targets in terms of specific numbers are hardly ever articulated in public policy documents, the objectives and the barriers that stand in their way have been gleaned from meetings with policy makers and officials as well as public reports from a wide variety of bodies. As quite often is the case in Israel, there is fairly broad consensus on the nature of the objectives and barriers, even though there are some substantial differences in the means deemed best to overcome the barriers.

The first three barriers described below are systematic and span the entire range of research, from basic research in universities, through government initiated R&D and to business investment in R&D. These barriers are broad and require commensurately sweeping policy responses. The last two barriers are sector specific yet nonetheless acute.

Heavy reliance on capital markets for R&D

Israel's very high BERD intensity, which reached 3.68% in 2007, has been a blessing for the economy. It however makes the country's research system uniquely vulnerable to a meltdown of global capital markets. In recent years, government has tended not to get involved in barriers related to the capital market's role in financing R&D. The nature of the current crisis is so severe, however, that this barrier has been recognized as a highly serious threat which requires recognition and intervention.

The vulnerability to capital markets is evident in several distinct areas:

- Funding for start-up companies;
- Funding of venture capital firms;
- Reduced R&D funding by multinationals;
- Poor market for exits.

For more details on this vulnerability see the section: **Dealing with uncertain returns and other barriers to business R&D Investment** in the Annex.

The global financial crisis is leading economies worldwide into uncharted territory, which makes predictions about possible future trends less useful than ever. However, it is clear that the fuel of Israel's business investment in research is in the financial ecosystem that has developed around the process of launching, funding and exiting from start-up companies, and that this process is tightly intertwined with developments in global capital markets. On the plus side it must be noted that private equity for technology companies has performed less badly than other financial instruments. However capital scarcity and poor returns from M&A exits will leave their mark and the statistics of future years might show a decline in BERD. The Israeli VC industry successfully overcame the slump of 2001-2003 and probably has to means to overcome this crisis as well.

University Research Funding

Israel's ranking in international studies measuring the numbers of scientific papers is still very high, but is declining both in the numbers of papers per capita (fourth in the world between 2001 and 2005 compared to second in the world between 1993 and

1997[11]) and in Citation Impact. Successive budget cuts, ageing research staff, inflexible researcher remuneration, an accelerated brain drain and increases in teaching loads have all taken their toll and point to further declines in the future. For more details on the budgetary aspects of this barrier see **Securing long term investment in research** in the Annex***.***

This is a complex barrier which consists of several separate but interlocked elements:

- Eroded budged in research universities;
- Ageing University research staff;
- Poor and inflexible researcher remuneration;
- Brain Drain

More details on these challenges are available in the annex.

Among the various stakeholders, there is almost wall-to-wall consensus about the description of this barrier. They tend to differ, however, in describing how it came to be such a formidable obstacle. There is no doubt that the level of university funding is a major contributor to the problem, but it is not the sole factor.

Issues like the high salaries available in the technology industries definitely contributed to the weakening of academic research. The average salary for senior academics with usually over 20 years of seniority -- about €46,000 per annum[12] -- is roughly equivalent to salaries in technology industries for professionals with about five years of experience. The academic brain drain was caused not only by the higher salaries available for academics abroad, but also because academics were attracted by research opportunities and better research infrastructure.

There are also structural issues. Israeli universities -- with the backing and encouragement of VATAT -- are fiercely defensive about their academic and administrative autonomy. In the ongoing battles to protect this independence they are backed by the academic unions. Judging by the attitudes the universities came across in annual tussles over budgets, they had valid reasons to doubt the good intentions of various governments and the civil servants in the Treasury who conduct the budget negotiations. (In an almost ritualized fashion the annual tussles over academic budgets tend to be accompanied by leaks to the popular press about the supposedly outrageous sums earned by academics) However, in protecting this autonomy they tend to adopt defensive positions across the board. It is arguable that this defensive attitude might not have worked to the benefit of the universities and the research system, especially in issues regarding pay scales for researchers from abroad or the ratio between competitive and block funding of research.

Government Sponsored R&D

The country's success in attracting business investment for R&D has had its prices. The main victim of this success has been what is called "directed research" – research commissioned by the government in specific areas of strategic interest.

[11] Czapski, G. Israel's Status in International Scientific Productivity, a paper submitted to the National R&D Council.

[12] Data for Central Bureau of Statistics

Israeli government support for R&D in firms through the Office of the Chief Scientist in the Ministry of Industry Trade and Employment (OCS) (www.moit.gov.il/NR/exeres/B3F78073-454A-48D5-A8BA-6D088DDECCD5.htm) is not "directed research." OCS programs have always been technology agnostic in the sense that each request for support is judged on its own merits according to a rigorous scoring system which examines both the level of innovation and its international competitiveness. The same is true to large extent about the long standing and successful MAGNET program that funds pre-competitive research in consortia of academics and industrial firms. This approach is mandated by law, and has largely been justified by the claim that industry is always closer to the real needs of the market than bureaucrats. It proved especially successful during the ICT boom with short product cycles and a large number of hungry start-up companies eager to seize the next technological opportunity. This approach is changing to a certain extent, but both legal and market constraints are bound to keep most OCS funds unattached to any specific research area.

It is significant that the only area in which there is commitment to long-term financing of thematic research and development is through the EU framework programs. The EU provides legitimacy for what cannot be provided locally.

The barrier in this area is largely political. Government funding of research and development outside of academia stood at 5.1% of total research funds in 2007 and most of the money went to the OCS, where, as said above, the government is determined not to set too many priorities.

With the universities enjoying complete research autonomy and the OCS determined not to intervene too much in directions of research, a miniscule thematic budget of €17m gives the government hardly any say at all on thematic research policy. The argument in favour of this hands-off policy is powerful: the economy literally thrived as a result because business was indeed far more responsive to the market than government officials could have been. Academic collaboration with Industry through the MAGNET programme also did well in an environment in which ideas that started either in academia or business could try to win enough support for the government to fund a MAGNET consortium.

The one area is which the government is directly and heavily involved in setting research and development agendas is in defence. However, the levels of funding in this area are classified, and while there is extensive anecdotal evidence of spill over effects into both industry and academic research, there are no data to back it up.

However, there is growing recognition that the somewhat atrophied arm of indigenous non defence directed research is necessary. Business finds it too risky to fund R&D on technologies with long development times and academia is not necessarily interested in the more mundane solutions the country needs. The three areas that require most immediate attention of directed research are water, energy and medicine.

The barrier towards resolving this issue is political – to persuade politicians and top civil servants that the market is not providing what the country needs, and to justify in clear terms that relatively long term investments in research in areas such as the three mentioned above will be of great economic and societal benefit.

Market failure of biotech

"Israel is first worldwide in medical device patents per capita, fourth worldwide in biopharma patents per capita, seventh in absolute number of medical device patents, and first worldwide in the percent of life science patents of total patents."[13] Despite this impressive success recorded in an in-depth study of Israel's bio-medical industry, commercial success has been elusive, with the notable exception of the interdisciplinary field of medical devices. The best efforts of the OCS, university commercialization firms, local and foreign VCs and an eager and highly skilled workforce have produced only meagre results, given both the amount of funds invested and the long standing commitment by many bodies in government, academia and business.

The paper quoted above from the Milken Institute identifies several barriers to success in biotech. The chief barrier is capital: huge sums are needs to take bio-pharma companies through the various rigid stages of drug and therapy development. Another is the structure of VC funds which are usually limited to 10 years, while it often takes up to 15 years to usher a new development through the various stages of clinical trials. Yet another barrier is the lack of major Israeli R&D subsidiaries of international pharma companies. Israel has enjoyed the presence of nearly all the major players in US IT who have set up successful development centres in Israel. The presence of major players in IT has been a critical element in the success of indigenous firms. Yet another barrier is regulatory. There is a need of an Israeli version of the FDA to help companies through the approval process.

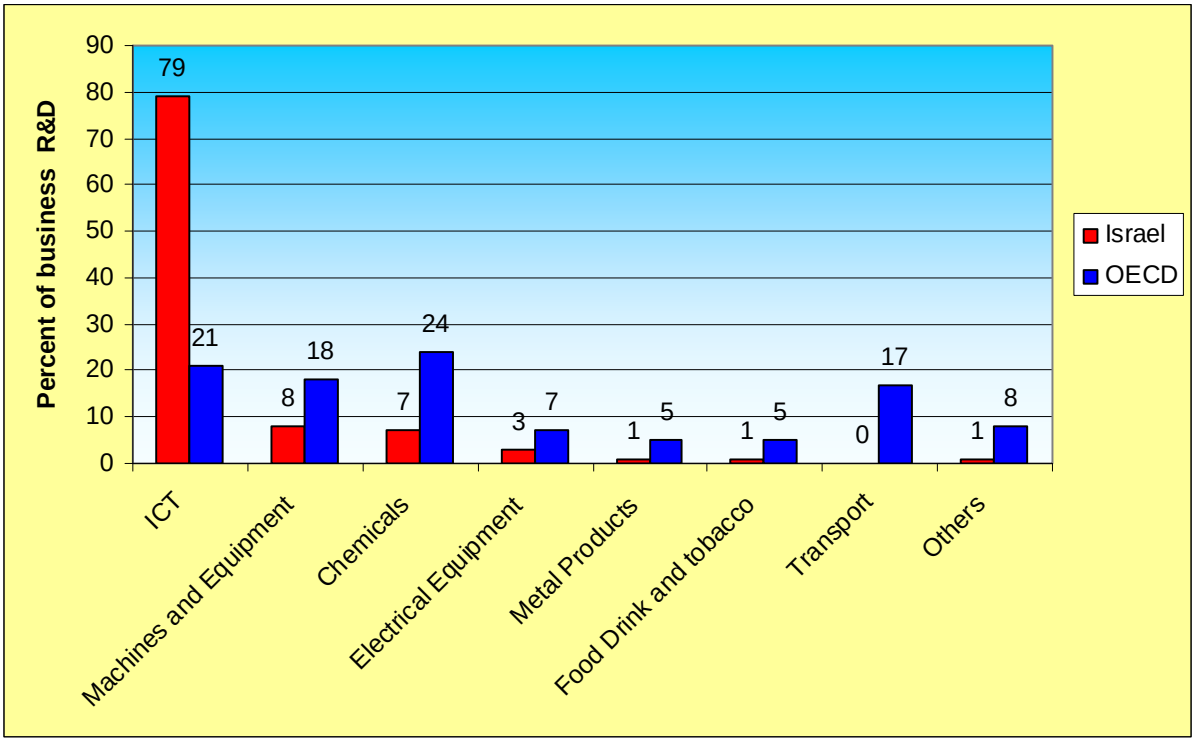
Lack of innovation and research in traditional industries

Israel's basic industrial backbone has lagged during the ICT boom. Productivity is low and only few firms perform R&D or use external R&D resources. It makes sense for a small export-dependent economy to specialize, but the degree of R&D concentration in Israel means that a huge number of firm and employees are not enjoying the fruits of more R&D. The following chart[14] shows the problematic level of specialization:

[13] Financial Innovations Lab Report for Accelerating Medical Solutions in Israel: Building a Global Life Science Industry, Yago, Porian-Lukatch, Vaknin, Milken Insitute

[14] Data from Report of the Committee to Examine Means to Empower the Periphery and Traditional Industry (Makov Report)

Figure 2: Israel/OECD R&D in industries



There are two main barriers towards increasing R&D in traditional industries. The first is lack of awareness among industrialists about ways in which they can use R&D to increase productivity both through process and product innovation. The second, until quite recently, has been lack of government support towards these targets.

The twofold nature of this barrier has been recognized policymakers. Israel has an excellent record of using government incentives to promote R&D. The barrier consists of finding ways to include firms in more traditional industries to join the OCS ecosystem which means that firms will both perform better and find it easier to attract investments.

3.2 Policy objectives addressing R&D investment and barriers

Israeli policy making might be opaque, especially by European standards, but it is nevertheless coherent. As said above, targets are rarely published and government measures are not evaluated in a European or North American manner.

However, Israel is a small and highly networked country. Most of the Chief Scientists who have served in the Industry Ministry were previously senior executives in technology companies. When they leave government they either return to industry or move into the closely allied VC community. Most of the key players in industry government and academia know each other and take part in various governments, private and academic reviews of performances and goals.

Since policy objectives are not stated as clear goals, the best way to assess policy objectives is to see which of these government decisions, reviews, studies, or reports gain traction within the system and win consistent support in terms of budget priorities. The weakness of this approach towards assessment of objectives is that it works only in hindsight. Its strength is that it looks at real commitment. The following list of objectives will try to assess briefly whether they have the kind of institutional and governmental consensus that will guarantee the traction needed for execution.

1. **Academic Research:** The current point of reference for reform of the academic research system is the report by the Shohat Committee, a government appointed commission headed by the highly respected former finance minister Avraham Shohat to examine the entire higher education system. The committee's recommendations include as an objective increasing budgets for basic research. To do this it recommended among other elements a €150m increase in budgets for university research. More details on its specific recommendations can be seen in the Annex below.

   The Shohat committee recommendations were debated in the cabinet but were not formerly endorsed. In last year's budget the government decided to allocate an additional €102m for universities – a decision that was perceived as a first step towards implementation of the Shohat recommendations. VATAT works according to five-year budgeting plans but last year's budget was in a hiatus between two five-year plans. If the new government follows in the same track for the next-five year plan, then the Shohat committee recommendations will gain traction as an objective.

2. **Government Support of Business R&D:** The objective here is clear even though it was never spelled out in any official documents: to preserve and protect Israel's outstanding private sector investments in R&D during the period of turmoil in capital markets outlined above.

   The outgoing government announced that it would increase the total OCS budget by 45%. This decision has not yet been published as a formal government measure. It has, however, won endorsement from the Treasury and the Bank of Israel. Half of the funds are to be allocated for the new biotech fund (see below).

   The government does not expect that it can replace the lower funding levels from private enterprise. It is relying however on the historically tested fact that business trusts OCS decisions. In most programmes except for the incubators the OCS never funds more than 50% of development costs, and in some cases the level can go down to 20% or 30%. Firms whose programmes succeed also have to pay back their funding in the form of royalties. But the reputation of the OCS screening process is so high that it encourages both investors in new companies and corporate management in established corporations to invest their own money.

   It remains to be seen, however, how this extra funding will be allocated. Early stage funding will be scarce for the next two years and this is likely to increase the number of firms that seek entry into incubator programmes. It will be interesting to see if the OCS will increase funding for the incubator programme, even though such a decision will probably not be announced in advance.

3. **Biotechnology:** The objective here is to overcome the "death valley" in which many pharmaceutical biotechnology firms fail between pre-clinical trials and the three tiers of clinical trials. News of the new €46m annual budget for a new OCS biotech fund to address this objective was published in the media at the beginning of 2009 and confirmed by senior officials. The detailed objectives and mode of operation have not, however been formally published yet. (It is clear that one of the major drivers towards this decision was a report published by the Milken Institute in the US on the Israeli life sciences industry – see Note 12 above).

4. **Traditional industries:** The objective in this case is both economic and societal. It aims to improve performance of Israel's traditional industries by encouraging these firms – which have relatively low productivity – to perform more R&D. The target is both to improve their economic performance and to provide better employment in the so called peripheral areas of Israel in the north and south of the country which have a lower socio-economic ranking. This objective has been formally published by the OCS with enough detailed information to justify entry of a measure into the Trendchart database. It did not, however, get the status of a formal directive by the Director General of the Ministry of Industry, Trade and Employment. But it was acted upon vigorously by the OCS during the past two years, and as such now seems part of formal policy. The measure is based largely on two detailed reviews of traditional industries, the last of which was the report of a formal committee chaired by Israel Makov, former CEO of Teva, the largest Israeli industrial company and the world leader in manufacturing of generic drugs. The Makov committee's recommended objective is to raise productivity in traditional industries from its 2003 level of 56%, compared to such industries in the US, to 70% in 2015 and to 89% in 2025. This target was mentioned in one of the OCS annual reports, but never endorsed in a formal decision.

3.3 Characteristics of the policy mix to foster R&D investment

This section is about the characterisation and governance of the national policy and instrument mix chosen to foster public and private R&D investment. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments have been set up and are in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

3.3.1 Overall funding mechanisms

The two major elements of government research funding are VATAT, and the OCS. Other revenue streams such as funding for the Science Ministry and research sponsored by ministries are relatively minor items in the state budget.

VATAT

The main items in VATAT's budget of 2005 (the last year for which there is a detailed breakdown) allocated €733m in block support for universities, €34m as matching funds for university endowments, €86m for competitive research, more than half of which went to the Israel Science Foundation (ISF) and the rest to other foundations and activities including FP7 and other European programs such as ESRF.

The ISF is the main instrument used for competitive research. The proportion between its funding and block funding illustrates some of the structural issues described in section 3.1.

By definition, VATAT research funding is for basic research and is not thematic. There are, however, some thematic elements that are not handled by VATAT. The largest of these is the seventh Framework Programme, which is thematic. VATAT pays 45% of Israel's participation in FP7, with the majority of the remaining coming from the OCS (45%) and 10% from the Science Ministry. Other thematic elements in the VATAT budget are funding the Israel Nanotechnology Initiative (also in

Office of the Chief Scientist (OCS)

The OCS does not usually publicly earmark funds for specific lines of activity, both because it needs to be flexible and because it has had to deal with fluctuating budgets of the years. The budget breaks down as follows:

- The R&D Fund is the largest framework with a budget that ranges[15] around €112m.
- The Magnet program for encouraging pre-competitive R&D in collaboration between industry and academic sector usually gets a budget in the range of €37m.
- The Incubators programme also usually gets about €37m for funding the government's part in establishing new companies in privatized incubators.

For more details on these programmes see the Annex below.

3.3.2 Policy Mix Routes

The "Policy Mix Project" identified the following six 'routes' to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one 'route', the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

This route has always been a high priority for policy makers. The most dynamic part of Israel's ICT industry is hundreds of start-up companies. In some industries like semiconductors the companies tend not to use government funding to start their companies and instead use the VC industry. Companies in biotechnology and other industries with relatively longer times to market make extensive use of the incubator system. For more information on the incubator system see **Dealing with uncertain returns and other barriers to business R&D Investment** in the annex.

[15] The budget tends to change every year

One can deduce in hindsight – since Israeli policymakers do not spell out targets – that this route is a high priority because the incubator programme's budget was cut proportionately less than other programmes in years when the OCS budget was cut across the board.

Route 2: Stimulating greater R&D investment in R&D performing firms

The OCS devotes the bulk of its budget to supporting R&D in R&D performing firms. The OCS perceives its main function in reducing the risk of R&D for firms. There is constant debate about whether the OCS should favour larger or smaller firms that conduct R&D, with obvious economic merits on both sides since large firms often make more economically profitable use of R&D while small R&D performing firms are the basis of the country's start-up industry. The OCS says it tries to be as impartial as possible in this debate.

In terms of priorities, the funding of R&D in R&D performing firms has always received the most generous funding compared to other OCS programmes. It is significant, however, that in leaner budgetary years, this item tends to be cut proportionately more than other items.

Route 3: Stimulating firms that do not perform R&D yet

This is a new priority: as a result of two major studies, the OCS is pushing for innovation in traditional industries. Realizing that these firms need more help, the measure introducing the initiative spells out coaching and consulting for management of these firms to introduce them to the benefits of more R&D.

This measure is of relatively high priority and the OCS has applied it across the board from funds disbursed by the Research Committee, through incubators and the Magnet program.

Route 4: Attracting R&D-performing firms from abroad

This route has always been a high priority, but the thrust of policy during the past two years is more towards attracting multinational firms in traditional and mixed traditional industries to conduct R&D in Israel, rather than high technology corporations. The reason for this policy is that there are many international ICT companies that maintain R&D centres in Israel. Some of these were opened at the companies' initiative because they were attracted by the quality of Israeli scientists and engineers and others emerged as a result of the acquisition of Israeli firms by multinational firms and their subsequent decision to leave the acquired firms' R&D operations in place.

The exception to this rule is when industrial policy, such as the Law for Encouragement of Investments, was used to persuade Intel to set up manufacturing plants in Israel. Intel's operations in Israel have been hugely influential in the creation of the country's strong semiconductor cluster, and there is a strong argument for spill over effects from the industrial to R&D policies. Intel's extensive R&D operations were set up shortly after its first manufacturing plant and this pattern has continued throughout the years.

A measure introduced in 2007 promises incentives to multinational corporations in traditional industries to set up R&D centres in peripheral areas in Israel. The intention here is both to create innovation based relationships with these corporations and to strengthen peripheral areas. It is too early to assess the priority accorded to this measure.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The main policy instrument for this route is Magnet, which sponsors academic-industrial cooperation through consortia that engage in pre-competitive R&D. Other routes of academic industrial cooperation do exist but do not receive appreciable support, except for the unknown level of cooperation between the defence establishment and universities.

Like the Incubator program, Magnet's level of priority can be deduced from the fact that its budget suffers proportionately less in leaner years.

Route 6: Increasing R&D in the public sector

Public sector R&D can be divided into two parts – purely academic and governmental or quasi governmental. Both areas have not been accorded high priority in recent years. University research budgets are a function of the total budget per student, which declined by 9% between 1996 and 2005, while many government ministry budgets for R&D (excluding agriculture) have been cut by over 50% during the past 10 years.

The importance of education and innovation policies

Improving Israel's level of educational achievements has been listed as one of the Israel's main challenges in the three previous Trendchart reports. The challenge is throughout the system, from K-12 education to universities. This challenge has been recognized by policymakers and numerous bodies, including the Shohat Committee have been appointed to propose solutions. So far, more has been said than done. Ofek Hadash (New Horizon), an initiative to revolutionize the quality of primary and intermediate schools launched by the outgoing Education Minister, has been accorded sizable budgets but is too new to assess. It remains to be seen whether the new government will implement all or part of the Shohat Committee recommendations.

Outside the universities it is hard to differentiate between research and innovation policies because they are essentially the same, especially since Israel has always been weak on low-R&D based innovation and strong in those areas of innovation where R&D provides the main competitive edge.

Recent policy changes in infrastructure, specifically energy and water, may also influence R&D investments, but it is too early to assess their impact. In any case Israeli technology firms tend to be highly export oriented so it is somewhat doubtful whether beneficial policies in these areas will provide a substantial boost to investment.

Assessment of the importance of policy mix routes and their balance

If one looks at the policy routes over the years it is clear that Routes 1,2,4 and 5 have always been accorded high priority. Route 3 is a new player but seems to command considerable support. Except for Route 3, the relative priorities have been stable.

The newly energized NCRD has issued a report urging the government to accord more attention and resources to Route 6. The NCRD's role, according to law, is to advise the government. In the past year, however, it has taken upon itself the ambitious programme of first creating a national research and innovation policy and of selling this policy to policymakers.

If indeed it succeeds in this task, there might very well be a change in priorities, especially with regard to Route 6.

Table 7: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	High priority for many years	Establishment of incubators for traditional industries (see Route 3)
2	High priority for many years	Unofficial statements about a budget increase of 45% to be spread in unknown proportions between Routes 1, 2, 3 and 5
3	New priority	Programmes in combination with Routes 1 and 2
4	Reasonably high priority with no specific programme in terms of budget	No change
5	High priority for many years	No change
6	Lower priority. University budgets have declined and governmental R&D has atrophied	Budget increase may signify the beginning of the implementation of the Shohat Committee recommendations and a move towards higher priority.

3.4 Progress towards national R&D investment targets

Table 8: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Heavy reliance on capital markets for R&D	The budget increase for the OCS will definitely help more firms to continue R&D programs. The risk is external: the length and depth of the global financial crisis cannot be assessed.
University Research Funding	The budget increase will allow the universities to maintain current research levels. The risk is that it will not be followed through by the new government
Government Sponsored R&D	No policy response
Biotech market failure	New biotech fund may help more firms through the “death valley.” The risk, as always in biotech, is in the long duration of the commitment until policymakers can evaluate results
Low R&D in Traditional Industries	The opportunity is in allowing these firms to increase productivity. The risk is that they will not be able to use this opportunity because so many of them are fighting for their lives as a result of the global economic crisis.

The Israeli innovation system has overcome previous drastic drops in the level of capital available for industry. It survived the slump of 2001-2003 and emerged stronger with less reliance on inflated valuation of firms. Government is aware of the challenge and is responding quickly and as such the assessment is that this barrier can be overcome in time.

There is growing awareness of the challenge to university research, but there are conceptual differences about how this is to be remedied, principally with regard to university autonomy. These differences have, as of March 2009, prevented a system-wide response to the barrier, but the research oriented sections of the Shohat report

have attracted fairly broad support. Disputes over other parts of the report, especially on tuition fees could, however, derail the process.

The lack of enough funds for government sponsored R&D is apparent to many policymakers, but is a cause that has not attracted enough influential champions to suggest that a remedy is imminent.

The market failure of biotech has, on the other hand, attracted enough champions, but it will take a long time to evaluate the efficacy of the response. The risk here is high but policymakers are convinced that after many years of less successful investments they have identified a weak link that needs strengthening.

It will be hard to assess the efficacy of government response to the challenge of low R&D in traditional industries until one can understand how these industries will survive the current crisis. Those that do emerge with intact R&D programmes are likely to be strengthened because the modality of OCS programmes has been largely successful over the years.

4 Contributions of national policies to the European Research Area

This Chapter provides a thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA[16] which comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers
- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing
- Opening up and co-ordination of national research programmes

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers

Israel is not a member state of the European Union (EU) and hence its linkage with the European Research Area (ERA), though significant, is by definition weaker than for Member States. However, we can refer to elements of R&D policy in Israel which are targeted to contribute to – or are, at least, connected with - the four

[16] Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM(2007) 161final (see http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf).

dimensions/pillars of ERA (of the six set down in the Green Paper on ERA) that are covered by this chapter of the Policy Mix report: the labour market for researchers, building R&D infrastructures, modernizing research organizations - especially universities, and opening up and coordinating national research programmes. We will find below that in some areas, Israel tends to be ahead of leading EU member states (though not always is this lead meaningful) while in others, Israel lags behind Europe.

Two important points need to be listed here as background to the discussion, referring to developments which have significant (potential or actual) implications for the topics covered in this chapter:

1. The Russian immigration: in the first half of the 1990's, some 1 million immigrants arrived in Israel from the former Soviet Union. This was a highly trained immigration, which added to the innovation work force and therefore had a bearing on the labour market for researchers. One question we will be addressing is the extent to which the immigration, and the supply of skilled labour it created, reduced the incentive for an active domestic policy to encourage Israelis to train as researchers.
2. The Shohat Committee for Higher Education in Israel: a public committee, established in October 2006, under the chairmanship of Mr. Avraham Shohat, a former Minister of Finance, to investigate Israel's higher-education system and recommend changes: the committee's mandate included a close look at university research. The committee's recommendations were submitted in July 2007, were debated by the government but have yet to be formally approved. The question to be asked, within the context of this report, is: how will the committee's recommendations, if and when implemented have an impact on university research.

4.1.1 Policies for opening up the national labour market for researchers

Given the basic macro-statistic regarding R&D in Israel – that civilian R&D[17] constitutes (in 2007) 4.7% of GDP, the highest share of R&D among industrialized economies, and given the importance of the high-tech sector for economic growth in Israel (for example, high-tech products constituted close to 43% of total industrial exports excluding diamonds in 2008 and over 46% on average in the previous three years: ICT product constituted 12.3% of total GDP in 2007), it might well be assumed that there is a vibrant labour market for researchers in Israel.

Another relevant point for analyzing this labour market is the importance of the private sector in financing and operating R&D in Israel, compared to the limited and decreasing importance of the public sector (including the universities) as a financier and operator of R&D: in 2007, of total civilian R&D, the business sector implemented 79%, higher education – 13%, the government – 5%, and private non-profit institutions – 4%. The result of this is that the labour market for researchers – certainly on the demand side – is mostly considered a private sector affair, with the market determining the demand. The government in Israel does not seem to feel that it has to directly create significant demand for researchers: since the universities are mostly funded by the government (see Section 4.3 below), budgetary considerations may well have hindered the demand for university researchers over the years.

[17] All data on R&D in Israel refer to civilian R&D, and do not include R&D implemented in the defence sector for which no data are available.

Another element on the demand side of the labour market for researchers in Israel is the system of research institutes, both government and non-government, whose number has contracted over time[18], principally because of lack of finance. Even though the research carried out in the institutes that closed may well have transferred to universities, the closure of the institutes acted to restrict the demand for researchers in the non-business sector.

Data on the market for researchers can be seen in the Annex section "Providing qualified human resources."

4.1.2 Policies enhancing the attractiveness of research careers in Europe

The high degree of autonomy of Israeli universities (see Section 4.3 below on Research Organizations) reflects on their ability and willingness to absorb researchers from abroad: there are no restrictions placed on them in this area by national legislation. From our contacts at several universities, we learned that researchers from abroad are recruited solely on the basis of their qualifications, though in some cases their ability to communicate in the Hebrew language is a necessary criterion of their absorption by the university.

Specific actions are being taken to encourage former Israeli researchers to come home, with baskets of incentives that are due to be increased. There are no specific incentives to encourage researchers from other countries to come to Israel, though this was discussed by the Shohat committee.

Uptake of the Charter of Researchers

All the vice presidents for research in Israel's seven research universities have undertaken to uphold the Charter for Researchers.

Remuneration policies

The way salaries of academic staff at universities in Israel are determined is very straightforward. An umbrella organization of university staff, on which there are representatives of all universities, negotiates salaries with the government in a centralized fashion. In principle, salaries differ by university rank and seniority within each university but are common – for the same rank and seniority – among all the universities.

Staff salaries was one of the subjects discussed by the Shohat Committee for Higher Education in Israel: one of the Committee's recommendations was to allow differentiated salaries of academic staff at the level of the specific university, as a means of recruiting talented staff and researchers. This recommendation was introduced by the government during the salary negotiations with the staff umbrella organization that took place in 2008, but was turned down by the staff, who expressed their determination to maintain uniformity of salaries between the different universities.

[18] There are no data at present on the number of research institutes on Israel so it is not possible to present this downward trend in numbers. Israel's National R&D Council has just recently begun a major project to establish a comprehensive database of R&D in Israel. A survey of research institutes is being carried out as part of this project.

There are, however, various ways in which de facto salary differentiation can take place at universities:

1. Private work: university staff is allowed a certain amount of private work beyond their university duties – in the order of up to one day a week – to supplement their university salaries. Staff whose academic discipline does not lend itself to private work is compensated for this by an increase in salary.
2. Work at more than one university: Academic staff is allowed to teach and/or do research at more than one university as a way of adding to their income.
3. Competitive research grants: A staff member that obtains a competitive research grant for financing a project to be implemented at his/her university is given a salary increase during the period of project implementation.

It should be emphasized that these methods of salary differentiation are not necessarily common to all universities in Israel and therefore cannot be thought of as specific schemes designed to lead to salary flexibility compared with general salary rules and levels. As already mentioned, it is considered important by academic staff at Israeli universities to preserve the general rules and levels.

Promotion of women

More than 50% of students at Israeli universities are female for 1st, 2nd and 3rd degrees and an even higher share of recipients of all three degrees are female (based on data for the 2006/7 academic year). And yet, according to She Figures 2006, the percentage of female professors in Israel is lower than in the EU-25 countries – 10.6% compared to 15.3%[19]. This source also presents a low share of female researchers (25%) in the higher education sector. At the same time, the proportion of female Ph.D. graduates in Israel is higher than in EU25 in practically all broad fields of study.

The very latest piece of research on the status of women in the economy in Israel is a study of women in the high-tech sector, published in March 2009 by the Ministry of Industry, Trade and Employment and based on data for 2007. The main findings of the study are:

a. The number of women employed in high-tech more than doubled between 1995 and 2007 and their share in the sector's total employment increased during this period from 32.6% to 34%.

b. The monthly wage of female researchers in high-tech is 38% higher than that of female researchers in other business sectors.

c. The share of women receiving degrees in the natural sciences, mathematics (including computer science) and engineering - who constitute a potential source of labour for the high-tech sector – out of total female degree recipients, dropped from 15.6% to 9.2% over the study period.

Thus, the potential source of female high-tech employees declined while actual female employment increased significantly.

There is no doubt – the study concludes – that women are an important potential resource for a sector characterized by a severe labour shortage, but in order for this potential to be utilized, two developments have to take place:

[19] It is worth noting that the data in She Figures 2006 refer to the year 2003 and are therefore not very updated. However, there is no evidence that the situation in Israel has improved since then.

- The number of female students of the relevant subjects at university must increase.
- The high-tech sector has to find a better balance of requirements from its employees in general and from parents of children in particular – both males and females: this can be achieved by adopting mechanisms to reduce the burdens on employees by allowing flexible work hours, work from home and by evaluating workers by the quality of their work rather than by the hours put in at work. It is worth noting that paid maternity leave – for 3 months – is given primarily to mothers. Should the mother decide to take longer, she is entitled to do so up to a year without losing her place of work, but she is not paid for the extra 9 months of leave. Men can take part but not all of a woman's statutory maternity leave.

4.2 Governing research infrastructures

The state of research infrastructures (RI) in Israel is generally considered to be inadequate, given the importance of R&D for economic growth. We have already referred to this problem as a major factor behind the brain drain of researchers from Israel and there is no doubt that Israel needs to adopt the aim of achieving world-class research infrastructures (RI) as set down in the ERA green paper.

There are no organized data – within Israel's National Accounts – on investment in research infrastructures, so the conclusion that these infrastructures are inadequate in Israel cannot be backed up for the moment with statistical information. One important project that needs to be mentioned in this context is the comprehensive database on the R&D sector that Israel's National Council for R&D has taken upon itself to establish, but it is likely to be a few years before this infrastructure resource is available for use.

Despite this lack of information, there are a number of points that can be made about RI in Israel. Firstly, since overall investment in R&D is mostly implemented by the business sector (almost 80% in 2007), the business sector has to hold itself responsible for investment in research infrastructures, as a means of guaranteeing the long-term success of its R&D investment. The problem here is that R&D investment of the business sector is slanted towards certain areas, with a particular emphasis on investment in ICT. We have already discussed this issue in Chapters 2 and 3 above: all that needs to be added here is that other R&D implementers – universities, government - have to take responsibility for improving infrastructures in areas that are of less interest to the business sector.

A good recent example of this taking of responsibility is the biotech fund set up by the government in the amount of €46m to promote the development of the Israeli biotech sector, a sector regarded to have great future potential but has suffered from significant market failure in recent years. However, there is no idea at present as to what share of the fund will be invested in biotech research infrastructure.

Secondly, there is a certain amount of information about investment in RI by universities in Israel: the bottom line is not particularly favourable. Investment in R&D by universities is mostly financed by the Budgeting and Planning Committee (VATAT): the monies made available to VATAT for allocation among the universities emanates from the State Budget. In the 2006-2007 fiscal year (the last year for which a complete set of statistics is available), the total amount allocated to the universities by VATAT was €1b. Of this total, only €7.6m was designated for infrastructure, and

this sum may not have all been invested in RI. In the main, universities are dependent on outside contributions for financing their RI.

Researchers at Israeli universities overcome the domestic shortage of adequate research infrastructures by trans-national cooperation with Europe, both at the inter-governmental level and the national level. A good recent example of the former is the long-term participation of Israeli scientists, at a high level, in the Large Hadron Collider project implemented by the European Organization for Nuclear Research (CERN): in 2008, the first beam from the collider was produced after 20 years work on the project.

4.3 Research organisations

Universities in Israel are very autonomous: once they have been allocated their annual budget (block financing) by the Budgeting and Planning Committee (VATAT: see previous section), they are at liberty to decide how to use this budget within the university – for teaching or for research. It is true that the block financing is allocated according to a model in which the universities' achievements both in teaching and research are measured (the internal weighting of this model is: 55% based on teaching achievements and 45% based on research achievements[20]), which means that each university is allocated a different overall amount of financing, but once the budget is decided, each university decides on its use autonomously.

To what extent does the VATAT model for allocating funds according to teaching and research achievements guarantee that sufficient funds will be available for research, given the autonomy that universities have regarding the use of these funds? The answer is that there is no certainty regarding this. The VATAT itself recognizes that its allocation model is outdated and that insufficient money go to research. The model is based on an earlier period in the history of the country when there were less students and more researchers at universities. The current budgetary problems of the universities (mostly stemming from low student fees, a situation that the Shohat Committee recommended to correct) leads to a de facto transfer of funds from research to teaching, whose costs should be covered - or more covered – by student fees.

In this context, a point made in a previous section is worth mentioning: the reduction in the number of research institutes in Israel over time. Research institutes do not face the same potential conflict between teaching and research that universities do, but are devoted solely to research. They would not therefore have to face the same dilemma of transferring funds from research in order to cover teaching costs – even though there are universities in Israel that are regarded primarily as research universities (such as the Weizmann Institute in the city of Rehovot), for most Israeli universities, the mainstay activity is teaching.

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[20] Research achievements are measured by a weighting system that scores achievements by the following key:

1. Winning competitive research grants from a list of 14 designated competitive research funds (including the Israel Science Foundation) – 34.6%
2. Winning research grants from other sources – 19.7%
3. The number of doctoral students who engage in research and complete their theses – 29.6%
4. Publications, measured by number and impact – 14.8%
5. Number of MA students with thesis – 1.3%

In principle, however, each university in Israel has autonomy in managing its research budgets, in hiring research personnel and in the design of research agendas the choice of topics of research specialization. The Ministry of Finance in Israel would like to reduce the degree of autonomy that universities have: during the negotiations surrounding university finance within the 2009 State Budget, the Ministry tried to make an increase in university finance contingent on the universities' submitting an advance plan regarding use of the budget, but the Minister of Finance was overruled by the Prime Minister on this occasion and the autonomy of the universities was maintained.

It is worth noting that according to the 2007 Annual Report of the National R&D Council, block financing constitutes some 80% of the total research budget of universities in Israel, a much higher share than in other countries – in the US, 90% of this budget comes from competitive funding, and in the UK – 45%. The estimated 20% of competitive funding of academic research in Israel may even be overstated. According to VATAT budget data for the 2006/7 academic year, the actual share of competitive financing for academic research was only some 12%.

The Shohat Committee for Higher Education in Israel called for an increase in the share of competitive funding of academic research. But none of the report's recommendations have yet been implemented by the government. Since a new government is in the process of being formed, there is no knowing what will be the fate of the Shohat Committee's report. In the meantime, de facto, there is no clear trend towards an increase of competitive financing.

Even if the current high share of block financing will not be reduced, the autonomy of the universities regarding their research expenditure is expected to be maintained for the foreseeable future. At the same time, for reasons presented above, it is likely that the shortage of funds for academic research will also continue for the foreseeable future. This may well push the universities into seeking more competitive financing for research, thereby reducing the share of block financing and the universities' reliance on VATAT money. As already mentioned, this was one of the recommendations of the Shohat Committee report.

The Shohat Committee can be thought of as an attempt to comprehensively reform higher education in Israel. Even if the current high degree of autonomy of Israeli universities – certainly compared to European universities – means that no significant reform is needed in this particular area in Israel, there are many other areas of the academic system where the Committee called for reforms and where reforms are indeed needed.

In the matter of university governance, the current situation in Israel can be described as follows. There are two main governing bodies, the Senate, made up of senior university staff, and the Board of Trustees, above the Senate in hierarchy, which can – and does – include external stakeholders. Over time, the governing power of the Senate has been relatively reduced, so that, in principle, the governing power of the external stakeholders on the Board of Trustees has increased, though since members of the Senate also sit on the Board of Trustees, it is not certain that the external stakeholders have a majority vote. Nevertheless, there seems to be a trend over time of increasing the influence of external stakeholders in university governance.

This seems to be reflected in the fact that the President at universities in Israel is the one senior university official that is recruited through an open tender process: all other senior officials - Rectors, Deans - are recruited from within the university. The

President at an Israeli university could therefore, in principle, be someone from outside the university world, who could bring his non-university professional experience to bear in university governance. Ironically, however, over the past 20 years, most Presidents of universities in Israel has been chosen from within rather than from outside the university. Another of the recommendations of the Shohat Committee is to increase the power of the university President, with the possible aim of increasing the influence of external stakeholders. But to the extent that Presidents of universities in Israel will continue to be "insiders", this is unlikely to happen.

Be that as it may, the matter of university governance – at the personal level – seems far less important for promoting academic research than dealing with the financial issues that are hampering research.

4.4 Opening up national research programmes

As a non-EU member state, Israel does not have the opportunities for joint programming that member states do, though it does participate actively on Eureka, COST as well as in ERANET projects, to name just some frameworks.

The high level of participation is indicative of a major commitment towards coordination, but does not necessarily signify an opening of national research programmes. The Israel Science Foundation (ISF) is targeted towards Israeli researchers and the only specific program it manages in this regard is to persuade expatriate Israeli researchers to come home. Until fairly recently it was constrained from funding non-Israeli research.

So far Israel has participated in more than 15 ERANET projects. However the number of projects "owned" by ministries which actually issued calls is far lower because of the acute lack of funds for research in most government ministries.

Israel has also been an active participant in EU Framework Programmes for Research and Technological Development : the latest – 7th – programme, FP7, which will run from 2007 through 2013, is considered as the basis for the creation of ERA, which in turn will act as the mechanism for the development of the knowledge economy and society in Europe. The Framework Programmes allow for cooperation between Israeli academic institutions and companies and their European counterparts. More details on Israeli participation in FP7 can be seen in the Annex below.

Since Israeli policy making does not often spell out targets in a European manner, long term budgetary commitment, supported by all governments in power, is often the best key to understand policy. With this key it is clear that the framework programs managed by ISERD represent the most substantial long term commitment towards work within the ERA.

The following points are however worth mentioning in the context of opening up national research programmes:

- Israel is certainly interested in providing access for non-national participants to existing research programmes, though this cannot be considered a matter of national R&D priority.
- Besides EU frameworks bi-national R&D agreements are a high priority. The largest of these frameworks is BIRD-F, which funds commercial R&D between Israeli and American firms. A large network of other agreements governs projects with other countries as well as multi-national corporations.

- International grants are available from many organizations and governments allow Israeli researchers to work in tandem with non-national researchers, either in Israel or abroad.
- Regarding barriers to joint programming such as those acknowledged by the ERA Green Paper, there are no obvious barriers in Israel, except possibly for military research, which in any case is not covered by this report (though even in the case of military research, there are cases of cooperation between Israeli producers of defence products and parallel producers in other countries).

4.5 National ERA-related policies - a summary

It is crude but usually correct to measure commitment by budgets. As such, the brunt of Israeli commitment towards ERA is through the framework programs managed by ISERD. However, as stated at the opening of this chapter, though Israel is a non-EU member state, there are elements of R&D policy in Israel that can be considered as attempting to achieve the aims set down in the ERA Green Paper. In the area of the academic sector, this is mostly reflected in the establishment of the Shohat Committee on Higher Education in Israel. There were previous attempts at university reform in Israel, but the Shohat Committee was the most comprehensive attempt to the present. The Committee presented its report in July 2007, but unfortunately its recommendations have not yet begun to be implemented. With a change in government currently under way, and with the significant problems facing the new government once it is formed, there is no way of knowing if and when the Committee's recommendations will be implemented – if at all.

One of the "problems" with the implementation of R&D policy in Israel is the significant weight of the private sector in financing and operating R&D investment – 80%. This was the result of a conscious decision on the part of the government in the early 1990's to promote a private venture capital (VC) industry in Israel, and the outcome was definitely successful.

But the downside of this development is that the government has little control over the VC industry, from the policy angle: the VC industry, from its point of view, is mostly concerned with profit-making and far less concerned with long-run national R&D policy making. Only just recently has the government begun to step in and provide finance for areas of R&D in which the private sector is less interested in becoming involved – examples are biotech, nano-tech, innovation in traditional industries, water technology and alternative energy.

In Table 9. we summarize the extent to which the 4 ERA pillars covered by this chapter are taken into account in the R&D policy mix in Israel.

Table 9: Importance of the ERA pillars in the ERA policy mix and key characteristics

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	Not considered very important: too much reliance on immigrant researchers, especially those who were part of the immigration wave from the former Soviet Union in the 1990's. Challenge for the future.	• Tax incentives for returning expatriate Israeli researchers. • General encouragement of researcher immigration to Israel. • Lack of understanding of the need to improve technology education at the high-school level.
Governance of research infrastructures	Brain drain of researchers considered to be connected with lack of adequate research infrastructure in Israel, a fact of life in the academic R&D world.	• Shohat Committee for Higher Education in Israel calls for significant increase in funds for universities, part of which may be assigned to infrastructure. • Government setting up special funds to promote particular R&D areas: part of these funds may be used for infrastructure purposes.
Autonomy of research institutions	Universities are very autonomous in Israel: all attempts to reduce this autonomy have been thwarted up to the present	• Shohat Committee recommends continued university autonomy.
Opening up of national research programmes	No national policy for opening up research programmes.	No specific barriers to the opening-up process.

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

The policy mix between Routes 1 to 5 is all the responsibility of one body – the OCS. Unsurprisingly, it is well integrated. The best example of this integration is the way in which the new Route 3 initiative to foster R&D and innovation in traditional industries was integrated in less than two years into Routes 1 and 5.

This policy mix is fluid. With very few exceptions (like the new biotech fund) the OCS budget is not earmarked, and all important decisions are taken by its all important research committee. This fluidity has been an important tool that has allowed the OCS to maintain coherent policy even through severe fluctuations in its budget.

The odd man out is Route 6, which is the heart of the issue. The country needs more basic research and more research on long term goals of thematic interest and these targets have to be integrated successfully with Routes 1 through 5. There is as yet no body that can create better integration between these routes. The Science Ministry, which should have performed this task, has limited powers and has become a political sop to settle coalition problems. The newly energized NCRD is attempting the task, and one can only hope that it will be successful in urging the government to adopt a more comprehensive view of the country's research system.

Institutionally, however, it will be a daunting task. VATAT and the universities have been more successful in defending their autonomy than defending their budget. The

best way to overcome this impasse would be to greatly increase public sector research, most of which would in any case be farmed out to universities in the form of grants for research on specific subjects. To do this, however, government would have to reach a decision in principle that the subject was of high importance and then to enforce this decision in each relevant ministry, at a time when budgets are going to be under great pressure because of the economic crisis.

Not acting on this, however, might erode precisely the same competitive edge that has enabled Israel to exceed the Lisbon targets.

5.2 ERA-related policies

Since Israel has surpassed the Lisbon objectives, it might be a useful periscope into the future, looking both at the success of policies maintained consistently over two decades, and the vulnerabilities such success creates.

Israel never had a cluster policy, but strong clusters have evolved in fields such as communications, semiconductors, electro-optics and certain kinds of software. Unlike traditional clusters, these groups of R&D intensive companies evolved without a customer close at hand.

They could not have evolved, however, without two of the ERA pillars: mobility of people and autonomy of academic research. Most of the mobility of researchers and R&D personnel was with the US – both with leading universities and leading American ICT firms. It would be more than fair to say that Israeli R&D firms could not have possibly attracted such interest from investors without the presence of people who had spent some time in the US, learning, researching and understanding how the US system works. The autonomy enjoyed by researchers in Israeli universities also played a highly significant role in the process.

The vulnerabilities are also clear. Israelis tend to finish their PhDs three to four years after their European counterparts because of military service. By this time many of them are starting families. The level of salaries available in business, either in Israel or abroad can be two to three times what they would get in a starting position in academic life. A booming start-up culture with available capital sounds very good, but it also robs universities of some of their best future potential.

Likewise, the huge increase in business investment in R&D persuaded policy makers over the years that they did not really have to invest too much either in basic research or in research sponsored by government agencies into areas of future economic or societal interest. The argument was why should the taxpayer be funding what business does better?

But there are things that government does much better. For example, Israel has a large number of highly talented researchers and engineers who have specialized in the entire range of semiconductors, from making tools through design and integration. Since the beginning of this century, it has been clear that development of better photovoltaic cells could lead to huge markets. Several European countries followed on this lead and are now world leaders in the cutting edge of next generation systems. This was done with substantial governmental encouragement and assistance. In many senses Israel missed this boat.

One of the most powerful aspects of ERA policies is long term commitment to thematic goals. The Israeli R&D system -- both in academic research and in government sponsored R&D for commercial purposes -- flourished as a result of sets

of policies that studiously ignored thematic elements. There are, however, numerous indications – some of which are apparent in recent Israeli government decisions – that the non-thematic approach might have reached its limits of effectiveness, at least in some areas, and that Israel would do well to seek greater integration with ERA.

Furthermore, the budgetary difficulties of university research have made FP7 funding a factor of growing significance for researchers making integration with the ERA a process which might not be entirely deliberate but is nevertheless consistent.

References

The Council For Higher Education (2008): VATAT annual report (Hebrew)

National Council For Research and Development (2007): NCRD annual report 2007 (Hebrew)

Office of the Chief Scientist, Ministry of Industry, Trade and Employment, OCS Annual report 2007 (Hebrew)

Israel Government, Report of the Committee to Examine Higher Education in Israel, (Shohat Report) (Hebrew), July 2007

Ministry of Industry, Trade and Employment (2007): Report of the Committee to Examine Means to Strengthen The Periphery and Traditional Industries (Makov Report) (Hebrew), October 2007

G.Yago, R. Porian-Lukatch, C. Vaknin (2008): Financial Innovations Lab Report for Accelerating Medical Solutions in Israel: Building a Global Life Science Industry Milken Institute, May 2008.

Pro-Inno, Trendchart database and annual reports http://www.proinno-europe.eu/index.cfm?fuseaction=country.showCountry&topicID=108&parentID=52&ID=10

List of Abbreviations

OCS	Office of the Chief Scientist in the Ministry of Industry, Trade and Employment
VATAT	The Budget and Planning Committee of the Council for Higher Education
ISF	Israel Science Foundation
NCRD	National Council for Research and Development
VC	Venture Capital
FCS	Forum of Chief Scientists
MALAG	Council for Higher Education
RDI	National Research Development and Innovation Strategy
R&D	Research and development
SF	Structural Funds
S&T	Science and technology
RI	Research Infrastructure

RESEARCH SYSTEM ANALYSIS REPORT

Elements on Research System Analysis relevant for the policy Mix Reports 2009 for non EU Member States

Country: Israel

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1 - Introduction and overview of analytical framework

1.1 Scope and methodology of the report in the context of the renewed Lisbon Strategy and the European Research Area

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the economy are at the heart of the strategy for economic growth of many countries. The aim is to increase and improve investment in research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and risks.

To ensure comparability across countries, a dual level analytical framework has been developed. On the *first level*, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions of the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain but as an integral part of each domain analysis.

Figure 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources	• Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment	• Quality and excellence of knowledge production • Exploitability of knowledge production	• Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

On the *second* level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). The way in which a specific research system responds to these generic challenges is an important guide for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective, helps to deal with the considerable institutional diversity observed, and eases the transition from analysis to assessment. Actors, institutions and the interplay between them enter the analysis in terms of how they contribute to system performance in the four domains.

Based on this framework, analysis in each domain proceeds in the following two steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[1] and other important publicly available information sources. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis.

After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these chapters contains two main subsections in correspondence with the two steps of the analysis.

1.2 Overview of the structure of the national research system and its governance

Israel is a small country (population of 7.3 million in 2008) with a deep appreciation of the importance of high-tech to economic development, both in good times and bad times. The importance of high-tech to Israel's economic growth over the past two decades is linked closely to the understanding regarding the necessity for R&D: this

[1] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.

understanding is, in turn, reflected in the high share of civilian R&D[2] in GDP – 4.7% in 2007, the highest share among developed economies, and to be compared with an R&D intensity (GERD as a % of GDP) of 1.83% for the EU-27 countries.

One of the major features of the national research system in Israel is the high share of R&D financing and operation by the private business sector: in 2007, the business sector operated 78.7% of civilian R&D activity, the higher education system – 12.6%, central government – 5.1% and private non-private institutions – 3.6%[3]. Since one of the aims of ERA is to promote private sector involvement in research in EU countries, the current situation in Israel looks ideal. One of the aims of the current report is to point out the problems resulting from the high share of business sector involvement in R&D: these problems can be summarized as the emphasis placed by the business sector on profit making from its R&D activity, rather than from targeting national long-term R&D goals.

It is worthwhile mentioning that the credit for the high share of business sector involvement in R&D can be given to the government. In 1993, in the early stages of the high-tech boom of the 1990's and of the highly-skilled mass immigration from the former Soviet Union, the government set up the Yozma venture capital (VC) fund, with the express purpose of encouraging the private sector to establish a VC industry. This government policy was extremely successful and helped, along the way, to absorb a significant number of the arriving immigrants into the high-tech and R&D sectors.

Israel's R&D system can best be broken down, from the point of view of governance, into three parts – industrial R&D, academic R&D and R&D directed by the government. If, as mentioned, the business sector has the lion's share of R&D performing and financing in Israel, the outcome is that government has relatively little governance of R&D. There is, however, a major government player in the promotion of industrial R&D, the Office of the Chief Scientist (OCS) in the Ministry of Industry, Trade and Employment (referred to below in short as the Ministry of Industry). In 2007, this Ministry was responsible for some 60% of total government expenditure on civilian R&D: the problem is that since the peak year of 2003, R&D financing by the OCS has dropped by 35% (as part of a 25% decline in total government R&D expenditure), thereby severely limiting the ability of the government to promote research, both in the short-term and long-term.

Higher education in Israel is mostly government-financed: the financing is provided via the Budget and Planning Committee (known in Israel as VATAT) of the quasi-government Higher Education Agency, with the finance emanating from the Government budget. Universities in Israel have almost complete autonomy regarding the uses of finance provided to them, so there is no way of knowing in advance how the finance provided is allocated between teaching and research. But in general, government finance provided to higher education has been receding in recent years: because of a shortfall of teaching expenses covered by student fees, it is quite likely that money that would otherwise be used to promote academic research is transferred to cover this shortfall, which means that academic research is also suffering from budgetary constraints. In October 2006, the government-appointed

[2] This report refers solely to civilian R&D: there are no available data on R&D implemented in the defense sector in Israel.

[3] The breakdown of financing R&D activity was very similar in 2007: the business sector – 76.4%, higher-education – 14.3%, government – 5.5% and non-profit institutions – 3.8%.

Shohat Committee for Higher Education in Israel began work on a comprehensive reform of higher education. The Committee submitted its report to the government in July 2007, but as of March 2009, the Committee's recommendations have still to be formally approved. One of these recommendations was to add a substantial amount of government money to promote academic research over the next five years

The governance of research directed by the government is, in principle, the responsibility of the Ministry of Science, Culture and Sport (formerly the Ministry of Science and Technology: referred to below, in short, as the Ministry of Science). The problem here is that this Ministry has little political influence and a very limited budget.

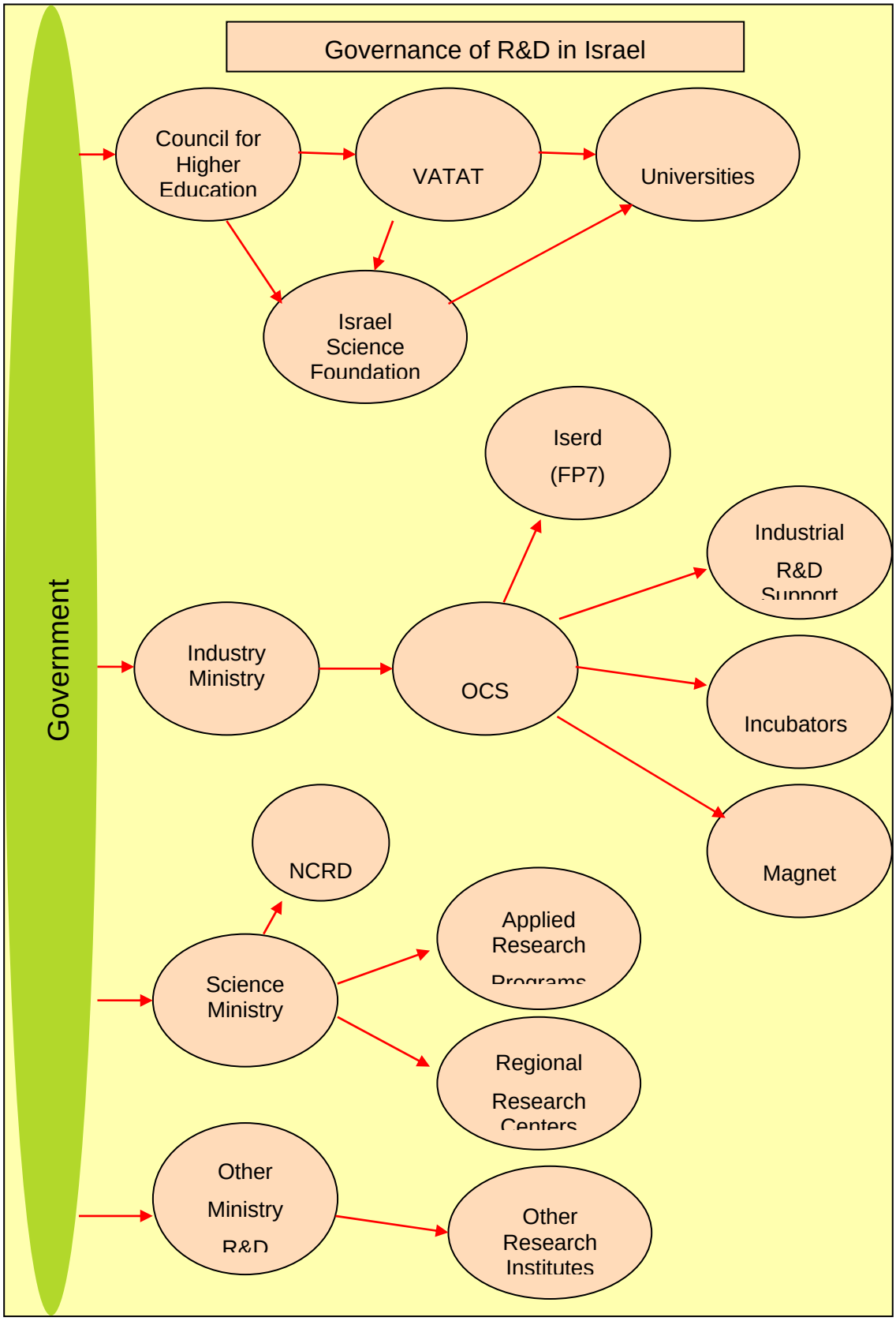
To strengthen the R&D policy making process in general and government-directed research in particular, the National Council for R&D (referred to below as NCRD) was established, by law, in 2004[4]. The principal function of the Council is to act as consultant to the Government in the area of R&D, helping the government to prioritize required areas of R&D: the Forum of Chief Scientists is an authorized advisor to the NCRD.

Main actors and institutions in research governance

Actor	Responsibility
VATAT (an acronym for the Budget and Planning Committee of the Council for Higher Education	Disbursement of all university funding including block financing for research. Governance of these funds, planning.
The Israel Science Foundation	Competitive research funding of university research programs. Funded by VATAT
The Office of the Chief Scientist (OCS) in the Industry Ministry	R&D support for industry, innovation policy.

[4] The law establishing the Council was passed in the Knesset, Israel's parliament, in 2002. Details of the Council and its activities are provided by the website of the Ministry of Finance (www.most.gov.il) but for the moment only in Hebrew.

Figure 1: Overview of the governance structure of the Israel's research system



Source: Authors

2 - Resource mobilisation

2.1 Justifying resource provision for research activities

Resources for R&D in Israel are dominated by the private sector which contributes some 75% of total investment. Business, whether in the form of VC funds, major Israeli corporations or multinationals who operate R&D centres have found these investments to be well worth their while over the years, and have made eager use of the government programmes intended to stimulate this tendency, even as the relative importance of government funding declined.

On the other hand, it has been harder for players inside the research system to justify resources for basic research and for government sponsored thematic research. University research is still strong but is under threat as will be seen in the next section, but successive government have slashed the kind of thematic applied programs that go on to feed both industrial and societal needs. This section will deal with the weakest element in the mix, government sponsored R&D, while the following sections will deal with the strengths and weaknesses of the other two elements.

Government Sponsored R&D

Total spending by ministries on science and engineering R&D declined from €29m in 2003 to €17m in 2007. The budget of the Science Ministry was cut nearly by half and the only budget that remained unscathed was the Agriculture Ministry which managed, with the help of the farming lobby, to even increase its budget.

The body that legally should be responsible for identifying the needs and justifying resource provision is the Ministry of Science. But this ministry has a less than 10% share of total financing of R&D compared to the 60% of total government R&D commanded by the Ministry of Industry in 2007. Claims are made by the Science Ministry regarding its responsibility for developing RI in Israel[5], but given the relative political and budgetary unimportance of this ministry, these claims are rather difficult to back up. However, in 1995, the ministry did establish a steering committee to initiate a support programme for RI via a group of Infrastructure Knowledge Centres[6].

Under the auspices of the Ministry of Science is the Forum of Chief Scientists (FCS), established in 2000, whose members are the Chief Scientists of all Government Ministries[7]: the main function of the FCS is to coordinate between the various ministries to avoid inefficiency in government R&D activity. However, given the very tiny research budgets of each ministry, there is very little to coordinate. The Forum

[5] The following quote appears in the Ministry's website (www.most.gov.il): "The ministry is in charge of all the budgets aimed at developing scientific and technological infrastructure and is able to mobilize funds within government R&D."

[6] For information on these centres, see: http://www.most.gov.il/English/Units/Science/Infrastructure+Programs/Infrastructural+Knowledge+Centers/default.htm

[7] 13 government ministries have Chief Scientists and all these are members of the Forum, with the exception of the Chief Scientist in the Ministry of Industry, who only has an observer status on the Forum. The reason for this is that the relatively large share of this Chief Scientist's budget in total government R&D expenditure would provide him with too much influence on the Forum. For a brief General Overview of the Forum, see http://www.most.gov.il/English/Units/Science/Programs/Chief+Scientists+Forum.htm in the website of the Ministry of Science.

has assembled several plans for increased focused R&D directed by the government, but there is little chance that these will be implemented, given the weak position of each chief scientist in his or her ministry. The exception to this rule is the Agriculture Ministry in which the products of R&D can be directly linked to agricultural exports.

Hopes for improvement in this sector are now pinned on the NRCD. In the first few years after its establishment, the Council made little impact on the R&D scene in Israel, mostly because of limited government backing, limited financing[8], and weak leadership.

In 2008, a new Chairman was appointed[9], and initial – if limited - finance was provided. The Council is now engaged in a major and essential infrastructure project, the creation of a comprehensive database of the Israeli R&D sector. The Council realizes that as long as it remains - like the FCS – under the auspices of the politically weak Ministry of Science, its ability to help the government meet the challenges of R&D in Israel will be limited. The new Chairman has adopted as an immediate target the transfer of the Council from the Ministry of Science to the Prime Minister's Office. Given the change of government currently under way, there is no way of knowing if and when this transfer will take place. The new chairman has also engaged a large number of influential members from both industry and government to join its committees and has charged them with drawing up master plans for the entire research and innovation system. It is to be hoped that the personal influence of each of these members will be helpful in advancing the NRCD agenda.

There is consensus that research directed by the government is the least advanced and least well-financed of the three main parts of Israel's R&D system and therefore constitutes one of the major challenges facing the system: this is research that the business sector is not interested in, because the profits are far away on the horizon, and that the academic sector is not willing to engage in precisely because it does not contribute significantly to academic excellence.

2.1.1 Securing long term investment in research

The quality and productivity of Israel university researchers has been the underpinning of the country's success in attracting such a high percentage of business investment in research, both as researchers with both basic and applied research agendas and as teachers of the people involved in business R&D. There are, however some worrisome trends in this field as follows:

- Research University budgets have been cut in a gradual process over the years. While the total budget for higher education in 2008 reflected stability at €1.126b, a growing part of the budget goes to support non-research colleges[10]. Enrolment in universities is proportionately declining, even as the number of students rises. In 1996 there were 101,300 students enrolled in first degree studies, and 63.4% of them studied in research universities. In 2005 (the last year for which there are comprehensive figures) there were 158,709 first degree students but only 43.3%

[8] Despite the fact that the Council is a statutory entity, the Ministry of Finance was unwilling to provide it with finance in the early years, claiming that it was an unnecessary entity.

[9] Professor Oded Abramsky, of the Hadassah Medical School in Jerusalem

[10] Israel has seven research universities, including the Weizmann Institute, which does not teach undergraduates. In addition there are 19 academic colleges that enjoy support from the state and hence follow state limits on tuition fees. There are also another 40 private colleges.

of them studied in research universities. Total government funding per student in both colleges and universities has also declined from €7,451 per student in 1996 to €6,725 in 2005, while staff salaries have risen. If one adds the growing needs of the colleges to the budget, the universities situation is indeed dire, especially since their tuition fees are lower than the colleges. The research universities still take the lion's share of the budget, but their higher cost structure and need to maintain and improve research infrastructure had driven them into crisis mode in which they have threatened not to open academic years unless the Treasury releases more funds. Because of the block financing system explained in Chapter 4 of this report, this has affected research budgets as well.

- University staff is ageing. In physical sciences 74% of university researchers are over 51 years old. In other fields the situation is less acute but also severe, and shows that far too many researchers are past their most productive prime. This means that the studies that measure productivity in terms of papers per capita and citation impact are measuring past success and are not necessarily reliable indicators for future performance.
- As stated below, researcher remuneration is essentially conducted between the academic unions, the Universities, VATAT and the Treasury. The unions have not allowed universities flexibility to attract leading researchers, most of whom are former Israelis, to come home.
- Israel has the highest percentage in the world of its academics teaching and researching in the US, standing at 25% compared the 12% of Canadians, 4.3% of researchers from the Netherlands and 2.9% of researchers from France and Germany.[11] In some fields like computer science, Israelis constitute over 30 percent of the faculty in leading research universities.

The decline in funding the VATAT and the ISF has been offset to a certain and limited extent by participation (funded by the government) in European frameworks.

Israeli universities and industrial companies have participated in all three of the recent FPs' (FP5 to the current FP7), from 1998 to the present, with the degree of participation increasing over time. In FP5 (1998-2002), the total amount of grant money received by Israel for participation in trans-national projects was €167m, an amount that increased to €204m in FP6 (2002-2006). The framework programmes are more used by universities than companies in Israel as a way not only of obtaining financing but also of coping with research infrastructure problems. Within FP5, 47% of the approved projects were submitted by universities, and 36% by companies: within FP6, the parallel shares were 56% and 32%.

It is also interesting to note that the main share of projects submitted to the FP's by universities were in the life science sector (in FP5, universities submitted 63.5% of all life science project applications while industrial companies submitted 74% of all ICT project applications). These shares strengthen the conclusion presented above – that the business sector is not that interested in non-ICT R&D.

Within FP7, which only began in 2007 and is to continue through 2013, Israeli entities have already (up to 31 January 2009) received grants in the amount of €160m – €103m have been received by universities and €45m by industry, and we foresee a

[11] Figures collated by Prof Ehud Gazit, Vice President for Research at Tel Aviv University

far greater volume of grants flowing to Israel in the first four years of the programme (which is to run for 7 years), than the volume of grants during FP6.

However important the European Framework Programmes have been in helping to promote Israeli R&D and its commercialization including supplementing research infrastructures in Israel via trans-national cooperation, the programmes do not absolve Israel – especially the university sector – from taking distinct measures to improve the long term funding of research in universities.

Since we have noted in the discussion above that in the current VATAT financing regime, insufficient finance is available for academic research, it is worth adding that the Shohat Committee – whose mandate included investigating the system of academic research - recommended that an additional sum of €150m be allocated by the government for academic research over the next 5 years. The extra finance may or may not be provided, but the Committee only looked at the additional finance needed and did not ask itself if the current situation regarding academic research requires change: the consensus is that it does.

The specific changes recommended by the committee include:

- An annual increase of €150 in budgets for academic research.
- A strong shift towards more competitive financing of research as opposed to block financing
- Allocating an additional annual budget of €41m for university research infrastructure
- Creating a fund for annual disbursement of €19m for bio-medical research.
- Allowing universities more flexibility in remuneration to attract talent from abroad – especially former Israelis
- Creating research funds humanities and social studies.
- Increasing grants for doctoral and post doctoral students

Members of the committee who are usually on opposite sides of the fence – the Treasury and senior academics – complained that the Shohat committee identified the problems of the research system but did not analyse the problems in sufficient depth to propose adequate solutions. The two sides differ deeply on whether the main issue is simple financing or structural problems. The committee's recommendations tried to address both issues but the deep differences might hinder implementation of the committee's recommendations, if it does indeed win support from the new government.

2.1.2 Dealing with uncertain returns and other barriers to business R&D Investment

The government's role in dealing with the uncertain returns of business R&D is confined to OCS programmes that are dedicated towards that end. It recognized long ago that the people best qualified to quantify this risk are in business, and to that end set up the seminal Yozma programme in 1993 which kick started the Israeli VC industry. This in turn led to creation of both mature, publicly traded technology companies that make it their business to quantify R&D risks and to the creation of many firms that were acquired by multinational technology corporations who are just as adept at this task in the R&D subsidiaries they set up in Israel after the acquisition.

Nevertheless, the global economic crisis poses a unique set of challenges in the following fields:

- Funding for start-up companies: Israeli start-ups raised a total of €1.6b for Israel and foreign venture capital funds in 2008, an 18% increase compared to 2007 and a figure surpassed only by investments at the height of the Internet boom of 2000[12]. This figure is expected to drop considerably in 2009 and 2010. An early indicator of this trend is a study showing the ratio of up-rounds and down rounds in valuation of start-ups (an up-round is a financing event in which the company is valued at a higher price than the previous round of financing: down-rounds are indicative of a tighter market and lower expectations by investors). The study[13] showed up-rounds at 54% of the financing events in the second half of 2008 compared to 82% in the first half of the year. The figures for the latter half of the year include the "good" months of July and August, before the acceleration of the global crisis from September. Another indicator of the trend is the average size of the funding round in the last quarter of 2008 which declined to €2.8m compared to €3.4m in the same quarter of the previous year. Start-ups are a crucial element of the Israeli research and innovation chain, and the expected decline in financing will affect the entire system. High-tech companies have already started to lay off staff, and the trend is likely to increase.
- Funding of venture capital firms: Israeli VCs raised a total of €611m in 2008, and the figure is expected to drop to about €230m in 2009 according to estimates by IVC-Online. The local VCs now have €771m available for investment, a relatively low figure which will compel to the VCs to invest less in new companies and more in their existing portfolio. Last year's figure was lower not only because of market conditions but because several funds with weaker track records did not manage to attract investors. It is true that Israeli VCs financed only 38% of VC investment in 2008 with the remainder coming mainly from American funds, but the institutional investors who fund Israeli VCs also fund their American counterparts and the pressure of both local and foreign funds is likely to reduce both funding levels and their appetite for risk.
- Reduced R&D funding by multinationals: Israel is fortunate in having many multinational companies that conduct R&D in Israel. Many of these R&D operations were set us as a result of acquisition of Israeli firms. Global technology companies are shedding jobs at a rapid rate. While previous downturns tended to affect Israeli R&D operations less than other countries because of the perception that the R&D conducted in the local subsidiaries was crucial to the global companies' future, the current downturn is so severe that the multinationals are firing research workers. There are as yet no aggregate figures on the numbers of personnel affected by the downturn, but every week brings news of yet another multinational firing R&D employees.
- Poor market for exits: The Israeli technology market depends on exits for liquidity. In 2007, for example M&A activities yielded €2.5b while IPOs brought in €540m. Figures to be released later this month[14] will show M&A activity in 2008 at €2.64b with no IPOs at all. The market for IPOs has been drying up in recent years as market conditions and regulatory constraints allowed only more mature

[12] IVC-Online.
[13] By the Shiboleth law office, with Fenwick & West quoted by The Marker financial newspaper
[14] From IVC-Online

companies to go public. Stock markets are likely to be unreceptive for technology based IPOS for quite a while in any case. Of more concern is M&A activity which has become the mainstay of the local technology investment industry. The figures for 2008 were still good, but valuations are dropping, a factor that could affect both profitability of funds and employment of research workers in these funds' portfolio companies.

The government response to this challenge is by definition limited because it cannot possibly compensate for the expected decline in business sector resources. However OCS funding has a justified reputation for efficacy, and the increase in the OCS budget could ameliorate the impact of the expected decline to a limited extent.

The bulk of the OCS budget (excluding its 40% funding of Israeli participation in FP7) is dedicated to three areas as follows:

The R&D Fund is the largest framework for providing finance for innovation and also one of the main tools used to implement new policy. With a few exceptions, the recipients of funds under this framework are obliged to pay royalties to the Tmura fund if their project succeeds. The form of support is a grant that can reach anywhere between 20-50% of the total cost of the R&D project. Under the terms of the law that governs the OCS's operations, this fund is supposed to be "technology agnostic" in the sense that the Research Committee is obliged to approve a request for support from any industry, so long as it answers two criteria: a) that the proposed technology or product is significantly innovative in world markets and b) that it has demonstrable market potential. However, the R&D Fund has also promoted innovation in particular industries such as biotechnology and nanotechnology as well as being used for the initiative to promote innovation in traditional industries. In the latter initiative, many of the OCS' traditional precepts have been overturned: the primary criterion for approval is no longer development of in-house cutting-edge technology. The technology developed can even be bought or be suitable, in certain circumstances, only for the small local market. Likewise, preferential treatment for nanotechnology or biotechnology in terms of the support level provided and other factors is definitely part of the updated OCS policy but formally is implemented by the same structures and within the same formal policy mix. In a like manner, existing funding frameworks are to be used in a new interdisciplinary framework for Converging Technologies that aims to promote innovation in fields that combine physical sciences, life sciences, engineering, medicine and cognition. This €100m 5-year program will be jointly funded by the Treasury, VATAT, the OCS and universities, but there will be no formal change in the policy mix to accommodate this new field.

Magnet: The second major element in the OCS policy mix is the Magnet Fund, a veteran program active since 1984, which is intended to promote development of generic pre-competitive technologies. Magnet works through consortia of commercial firms and academic researchers. In 2007, there were 12 such consortia in operation; five were due to wind down their five-year programs and three new programs were approved. Like the R&D fund, the Magnet Fund is a vehicle that can be used for many means – one of the consortia now in operation is a light metals research consortia intended to promote innovation in traditional industries. The Magnet budget is in the region of €74m a year, a figure that fluctuates slightly with the total OCS budget.

The question about whether Magnet is thematic is debatable. To a certain extent it could be said that Magnet determines themes. Magnet staff are deeply familiar with industry and academic research. Consortia are initiated either by industry, individual

academics or by Magnet staff. After an idea is launched in this informal process it goes through a formal process in which possible interested parties are invited to take part in presentations. This leads to the creation of groups of interested parties who then create proposals for Magnet approval. Many of the support programs approved by the OCS Research Committee started life as Magnet programs.

Incubators: The third major plank in the OCS policy mix is the incubator programme, another veteran programme that has gone through major changes since its inception in the early 1990s. The programme was originally designed to accomplish two tasks – to provide a framework for Russian technological entrepreneurs who had immigrated to Israel, giving them money to develop technologies and a helping hand in learning business skills. In its earlier years, there were relatively few commercial successes from incubator companies even though there were many people who claimed that the spillover effects of the programme were worth its cost for the taxpayer.

This has changed over the past three years as all but two of the 24 incubators spread around the country have been privatized. After companies are accepted into incubators they apply to the OCS for funding. Companies get €112,000 to launch their companies during two years with 85% of the funds coming from the OCS and the remainder from the company that owns and runs the incubator. Biotechnology companies get €168,000 for three years, with the same division between the OCS and the incubator company. It is worth noting that the incubators, like the R&D fund and the Magnet programme, are receptacles via which various changing polices have been implemented over the years. The incubators are now the bearers of the OCS determination to stimulate innovation in life sciences, and two new industrial incubators are intended to help innovation in traditional industries.

2.1.3 Providing qualified human resources

Israel's reliance on technology oriented exports makes human resources a vital and immediate economic need. Giving people the skills they need to fulfil this need is a long term target that spans several different areas of government activity.

Overall the view ahead is mixed. Following are some basic data on the volume of employment in R&D. The number of employed persons in this sector in 2007 was 27,500 compared to 14,900 in the peak high-tech boom year of 2000, an increase of some 85%. During the same period, total employment increased by a lower 20.7%. Overall, therefore, the private sector has created the required demand for researchers, with growth in the number of employed researchers in recent years much faster than total employment growth.

On the supply side of the labour market for researchers, it is worth while mentioning first of all the significant decline in the number of technology high schools in Israel – from 313 in the academic year 1989/90 to just 110 in 2007/08. Technological education at the secondary school level can be an important stepping-off point for creating a supply of researchers at later stages of the overall educational process, and over the past two decades, Israel has obviously not been applying its attention to this.

At the university level, the situation looks somewhat better, though here also, there are some negative trends. From 1999/2000 to 2006/07, the total number of Ph.D. recipients at Israeli universities increased by 61% while the increase in Science and Mathematics (the latter including Computer Sciences) was only 36.1% and in

Science alone (physical and biological sciences) – 32.6%. The share of Ph.D's in the sciences declined over this period from 41.4% to 34.1%. The parallel data for recipients of an MA degree in science look better with an increase of 129% over the period, compared to an overall increase of 56% in the number of MA recipients. But the number of MA recipients going on to a Ph.D. is fairly limited, so there is no guarantee that interest in the sciences at the MA level will be translated into interest in the sciences at the Ph.D level, a necessary criterion for increasing the supply of researchers. In general, increasing the supply of researchers needs to be a more concrete policy target in Israel.

In section 4.1, we mentioned an important background point from the supply side – the mass highly-skilled immigration from the former Soviet Union (now known as the Commonwealth of Nations) during 1990-95, with a share of scientific and academic workers of over 20%[15]. This was an immense amount of human capital that Israel was granted over a relatively short space of time, and literally changed the situation overnight regarding the supply of potential researchers: many of the immigrants with these skills were indeed absorbed into the academic and research worlds. The question is whether this gift of human capital was a blessing in disguise, in so far as it created a disincentive to guarantee an ongoing supply of researchers in the long run, via the higher education system. Certainly, researchers emanating from that immigration now constitute an aging research population, a situation that if not dealt with, could constitute a barrier to the future of R&D in Israel.

How has the current economic crisis been affecting the supply of researchers in Israel, or to what extent has the research/highly-skilled population been afflicted by increasing unemployment as a result of the crisis. There are no direct data on unemployment in the R&D sector (data are only available for 1-digit economic sectors and occupations), but there are two sources of information that point to the situation as being difficult. First, the high-tech sector – not only in Israel but globally – has proved to be very sensitive to the crisis: the business media continually report on high-tech companies laying off staff. Official data on the total number of job seekers at employment exchanges point to an increase of some 26% from the low point of April 2008 through January 2009: the parallel increase among academic job seekers during the same period was 67%.

Are salary levels for researchers in Israel an incentive or disincentive for increasing their supply? The available data seem clearly to point to their being an incentive. In 2007, the average wage in the R&D sector was some €3800, the highest monthly wage of any 2-digit economic sector in Israel (in comparison, the average wage in banking and finance was some €3200, in public sector administration – €2250, and in manufacturing – €2000: the average wage for the whole economy was €1450).

Given this relative wage structure, R&D should be an attractive sector to work in, and yet there is growing concern about the brain drain of researchers from Israel in recent years, particularly from the universities, with the main explanation provided the relatively low level of university/research salaries in Israel compared to abroad. It is quite likely that parallel salaries abroad – particularly in the US – are higher than in Israel. But it is also likely that there is another more important factor behind the burgeoning brain drain – the lack of adequate research infrastructure in Israel

[15] This immigration continues, in smaller numbers, to the present day. In 2007, 5.600 immigrants over the age of 15 arrived from the former USSR, 24% of whom were scientific and academic workers before they arrived.

compared to abroad. The closure of research institutes, mentioned above, may well have contributed to this problem, as can be seen in Section 4.2 above (Governing Research Infrastructures).

2.2 Assessment of strengths and weaknesses

Main Strengths	Main Weaknesses
Strong university system provided for a dramatic increase in second and third degrees	Proportionally less third degree in science
Strong market for R&D skills with heavy competition from business	This competition, along with other factors, is weakening universities

In simple terms the proof of the quality of the Israeli system for providing qualified human resources is its huge brain drain problem. If its graduates were not that good they would not find employment abroad. Likewise the blessing of a strong market for R&D skills has its own perils in weakening the system that provides these skills.

3 - Knowledge demand

3.1 Analysis of system characteristics

3.1.1 Identifying the drivers of knowledge demand

The very high 75.4% share of the Israeli business sector in total civilian R&D expenditure (BERD as a % of GERD) creates a powerful distortion in demand drivers.

Research and technology intensive business thrives on risk, but only on risk that can be quantified. In Israel as well as some other countries, it is most successful in industries with relatively short product cycles and quick time to market because the level of risk is also a function of time. Locking up resources for research over long periods requires a commensurately higher possible reward. This is the conundrum that has stymied Israeli business success in industries like biotechnology. Part of the problem is structural. VC funds typically have a life of seven to 10 years while the horizon for profitable exits in businesses like biotech is about 15 years. This is one of the main reasons that for the Israeli focus on ICT in creating new start-ups.

This structural problem in business drivers might be more soluble than the distortion it creates in national priorities. After all, most countries seek high BERD and why should the taxpayer pay for research that business funds anyway and creates jobs and high tax revenues in the process?

In the process, however, demand drivers from the basic research system and from societal needs tend to get lost. The challenge faced by the country's research system is now to re-identify these demand drivers and give them their due priority.

3.1.2 Co-ordinating and channelling knowledge demands

As said above, there are two main government sources of funding for research, VATAT and the OCS. VATAT is limited in the amount of coordination of demand drivers it can manage because of the universities' very high level of autonomy, even

though it does act as the funding vehicle for part of the FP-7 funds. The OCS, on the other hand, has proved to be a nimble coordinator of demands among the various programmes it runs.

With one notable exception, the Israel nanotechnology initiative, coordination between the two major funding mechanisms is nearly non-existent. It is to be hoped that the NRDC will – if it is suitably empowered – be able to handle at least part of this task by power of suggestion, even though it is doubtful that an agency without funding authority can impose coordination on bodies with very different priorities.

3.1.3 Monitoring demand fulfilment

VATAT has set up a new evaluation unit, but it has not yet produced results that can point towards demand fulfilment targets, and this issue is not a high priority. The OCS does not monitor demand fulfilment but does commission external studies of its general efficacy. In these studies, however, the highest priority is on measuring the economic impact of OCS activity and not on demand fulfilment.

3.2 Assessment of strengths and weaknesses

Main Strengths	Main Weaknesses
A very strong technology oriented business environment has proven astute in identifying and exploiting new areas of interest	These areas of interest are usually fairly short term and are mostly in ICT
Non-academic government programmes (OCS) are aimed at enhancing and not modifying the business sector's ability to identify future demand	The strong industrial focus is weaker in identifying societal and environmental demand.

The Israeli system of identifying future knowledge demand works very well as in one of the mainstays of the economy. The strength of the "technology agnostic" approach has been proven year after year. The weakness in addressing longer term and societal targets has been identified by government officials and is being acted upon.

4 - Knowledge production

4.1 Analysis of system characteristics

4.1.1 Improving quality and excellence of knowledge production

Nearly all of Israeli research is conducted in the country's seven research universities. Assessment, peer revues and evaluation are not common in Israeli governance. Yet in rather the same way that Israeli government involvement in industrial R&D works very well without these tools, Israeli universities score very high in international rankings for a country of its size with three of its seven universities making the world list of the top 200 universities.[16]

[16] The Times Higher Education - QS World University Rankings

The issue of assessment and evaluation is fraught with politics. The Treasury would dearly like to see more accountability for the money spent on research and higher education, while the universities and VATAT are resentful of any attempt to impinge on their very high level of autonomy.

Nevertheless, VATAT has acted on its own initiative to set up a new evaluation unit, in part at least because it recognizes that its system of allocating funds based on research achievements needs updating. This new unit has not, however, published any results yet.

4.1.2 Improving exploitability of knowledge production

The European Innovation Scoreboard shows that Israel is relatively efficient in generating applications from knowledge but is less efficient in generating intellectual property. The very heavy weighting of the business sector in Israeli R&D may play a part in this. It is possible, though not proven by research, that the relative high numbers of R&D personnel involved in software might account for some of this gap because in many software fields patents are less common than in say, semiconductors.

There is not enough data to analyse Israeli patents by sector except in fields like medical instruments and biopharma where extensive research has been conducted (see above). The fallibility of patent statistics is demonstrated here again because Israel's high scoring in biopharma is not reflected in economic performance, while the far greater strength of other knowledge intensive industries is similarly not reflected in the statistical scoreboards.

4.2 Assessment of strengths and weaknesses

Main Strengths	Main Weaknesses
Israeli universities reach high scores in international assessments	These is insufficient evaluation-based data to further improve the system

5 - Knowledge circulation

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

There are two main tools used to facilitate knowledge circulate between academe and business.

The first is the universities' highly active commercialization companies. These companies have become an extremely important source of revenue for some universities and are hence accorded very high priority. The strategies – mostly adapted from the US – vary. Some prefer only to patent university sourced innovation and licence the patents in return for royalties. Other occasionally take equity stakes in start-up companies based on their patents and yet others are heavily involved in internal or external incubators.

The second tool used for knowledge circulation is Magnet, an OCS programme that works by creating academic-business consortia for generic research. This is a veteran programme which has proven its success and is as such accorded high priority.

5.1.2 Profiting from access to international knowledge

As mentioned above the Seventh Framework Programme is extremely important both for academic and business related R&D, and is growing in importance over the years.

FDI is also vitally important both through relatively huge foreign investments in start-up companies and high investment in Israeli R&D arms of multinational corporations, investment made either by setting up dedicated units (like IBM) or through the acquisition of Israeli R&D firms.

5.1.3 Absorptive capacity of knowledge users

Israeli SMEs in technology sectors are extremely receptive to innovation. In many cases the argument is that there are too many SMEs and not enough large firms. For further information see the ProINNO TrendChart country report on Israel.

5.2 Assessment of strengths and weaknesses

Main Strengths	Main Weaknesses
Both universities and government have well proven systems to encourage knowledge circulation	These is insufficient data to quantify this strength and suggest ways in which it can be improved

References

The Council For Higher Education (2008): VATAT annual report (Hebrew)

National Council For Research and Development (2007): NCRD annual report 2007 (Hebrew)

Office of the Chief Scientist, Ministry of Industry, Trade and Employment, OCS Annual report 2007 (Hebrew)

Israel Government, Report of the Committee to Examine Higher Education in Israel, (Shohat Report) (Hebrew), July 2007

Ministry of Industry, Trade and Employment (2007): Report of the Committee to Examine Means to Strengthen The Periphery and Traditional Industries (Makov Report) (Hebrew), October 2007

G.Yago, R. Porian-Lukatch, C. Vaknin (2008): Financial Innovations Lab Report for Accelerating Medical Solutions in Israel: Building a Global Life Science Industry Milken Institute, May 2008.

Pro-Inno, Trendchart database and annual reports http://www.proinno-europe.eu/index.cfm?fuseaction=country.showCountry&topicID=108&parentID=52&ID=10

List of Abbreviations

OCS	Office of the Chief Scientist in the Ministry of Industry, Trade and Employment
VATAT	The Budget and Planning Committee of the Council for Higher Education
ISF	Israel Science Foundation
NCRD	National Council for Research and Development
VC	Venture Capital
FCS	Forum of Chief Scientists
MALAG	Council for Higher Education
RDI	National Research Development and Innovation Strategy
R&D	Research and development
SF	Structural Funds
S&T	Science and technology
RI	Research Infrastructure

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Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in Israel.

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