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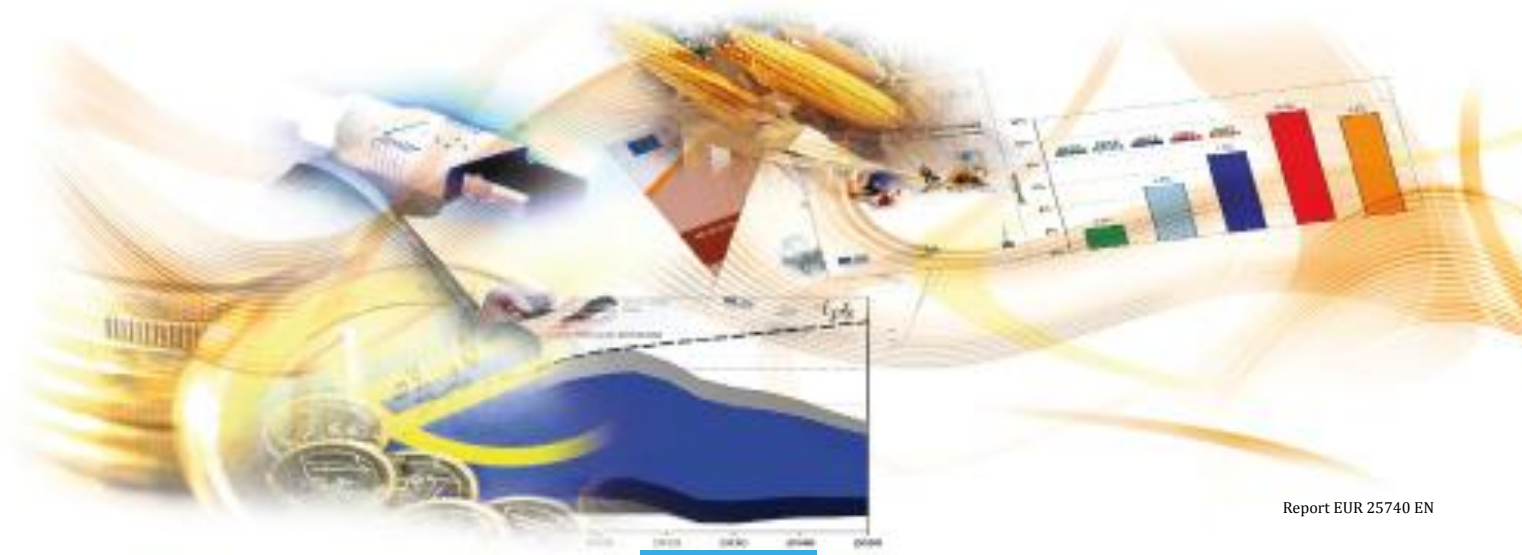

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Executive Summary

So far the global economic crisis has affected the Israeli somewhat less than many other countries, but total RDI expenditure, measured as a percentage of GDP, was markedly affected with GERD's share in GDP dropping from 4.8% in 2008 to 4.4% in 2010, reflecting the vulnerability of a system where the business sector accounts for nearly 80% of RDI spending.

There were no major changes in the governance of the government-funded RDI system, but there were strong indications of increased involvement of the Finance Ministry as a coordinator and driver of links between research and innovation policy. The two main RDI bodies -- the Council of Higher Education (CHE) through its Planning and Budgetary Committee (Vatat), and the Office of the Chief Scientist (OCS) in the Ministry of Industry, Trade and Employment – charged with making and executing research and innovation policy respectively have different missions and traditionally cooperated only on an ad hoc basis. But an increasing number of programmes are being launched in tandem by both agencies or by the OCS and the Finance Ministry.

Israel has never had formalized RDI policies with numerate targets, but the new level of coordination and consultation indicates that the country is moving towards a more comprehensive RDI policy orchestrated by the Finance Ministry, which also decides on funding levels.

The academic year of 2010-11 was the first year in which Vatat's six-year plan to revive Israeli higher education and university based research was implemented. The plan calls for a 30% increase in budgets over the course of the plan, nearly doubling funding for competitive grants, and an increase of about 9% in the number of researchers. In addition, four I-CORE centres of research excellence were launched, the first group in 20 such centres that will be opened in Israeli universities.

Innovation budgets through the OCS declined from €435m to €398m in 2011. The budget for 2010 was 70% higher than the budget for 2007, in reaction to the global crisis, but the OCS now says that in actual fact budgets have declined by 36% since 2000, when adjusted for inflation.

It is fortunate that there is an increased level of policy coordination because the Israeli RDI system faces three major structural challenges that require systematic solutions. These structural challenges are as follows:

1. Reviving research in Israeli universities: Budgets for Israeli universities essentially stagnated during the first decade of the century despite a growth in the student body, causing for a decline in bibliometric scores and an accelerating brain drain.
2. Over-reliance on ICT: Companies dealing with computing and communications technologies are one of the mainstays of the Israeli economy. However the period of explosive growth for ICT is over globally and policymakers have been trying for a number of years through several instruments to finds new engines of growth.
3. Precarious state of Venture Capital: Returns on VC investments in Israel by and large match returns in the US, where results have been disappointing compared to other financial investments during the past decade. The total funds available for investments are at a dangerously low level, and Israeli fund management

companies urgently need to raise new funds to continue their important role in funding Israeli start-ups.

Israeli RDI governance does not have a tradition of formally articulating priorities as part of an open policy making process. Nevertheless, the new Vatat six-year plan does lay out a clear vision, by implication, of a set of priorities chiefly calling both for a higher degree of excellence and a higher degree of specialisation in university research.

The priorities of the OCS, though rarely articulated as such, are evident from the changing nature of measures issued over the years. A major shift during the past few years has been the inclusion of priorities with a societal/economic slant beyond the traditional OCS approach of encouraging technological excellence wherever it happens. These priorities range from measures to improve innovation in traditional industries to measures to encourage technology firms to set up operations in peripheral parts of the country.

In terms of venture capital the priorities are very clear. If the Israeli fund management companies do not manage to raise new funds during the next two years a highly important part of the innovation funding mechanism in Israel will be in jeopardy. The Finance Ministry decision to insure a quarter of the risk of Israeli institutional investors, who join funds as limited partners, is a direct reaction to this priority.

Looking at the match between the challenges, priorities and means used to address the needs of the RDI system, Vatat's six year plan, coupled with the I-CORE project, seems to be a comprehensive approach that looks towards creating foci of research excellence while reviving the entire academic research sector.

The need to diversify beyond ICT is a far more complex challenge because it involves creating an infrastructure not only of research but also of human skills and the financial means to realize commercial potentials. The creation of the government backed biotech VC fund is a step in the right direction as are a number of OCS measures intended to stimulate non-ICT innovation issued during the past few years. But the challenge is deeper because of the breadth of the scientific and technological infrastructure needed to create new areas of high added value for Israel's knowledge intensive industries.

As far as Venture Capital is concerned, the effectiveness of the new measure will be apparent by the end of 2012, but its success depends on many extraneous factors, especially the state of global markets during the coming year.

In terms of ERA pillars and objectives the areas that received the most emphasis during 2011 was the major task of research institutions and the closely related fields of research infrastructures and the labour market for researchers. In the other ERA objectives there was no marked change during the past year.

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Introduction

Israel is a small country with a population of population of 7.8 million as of January 2012. GDP per capita reached €22,355 in 2011, and GDP growth reached 4.8% in 2011 (with a similar rate of growth in 2010), indicating that the country was less exposed than most other developed economies to the global economic crisis, even though growth is expected to be substantially lower in 2012 (2.8% according to the most recent forecast of the Bank of Israel) as the result of conditions in the country's major export markets, particularly Europe.

Research and innovation are central pillars of the economy. GERD reached 4.4% of GDP in 2010 compared to the EU average of 2.2% in 2009, with the business sector playing a major part in funding R&D. BERD accounted for 79.8% of GERD compared to the EU average of 62% in 2009 and for 3.5% of GDP compared to the EU average of 1.25%. The government's role in funding university based research is commensurately smaller with R&D performed by HEIs reaching 13.1% compared to the EU average of 23.7%

Research input in terms of human skills is satisfactory with total the number of total recipients of second degrees in science and engineering growing by 7.3% compared to the EU average of 4% between 2000 and 2008. In the near future the situation might be less promising owing to the lower level of educational attainment among Arabs and ultra-orthodox Jews who make up 20 and 10% of the population respectively. Vatat programmes to make higher education more accessible to these population groups was discussed in the ERAWATCH 2010 report, but it is still too early to judge the effectiveness of these programmes.

A major input problem is in research infrastructures, which were largely neglected between 2000 and 2010 with the exception of the area of nanotechnology, which was addressed by the Israel Nanotechnology Initiative, funded partly by the government and partly by donors. The Vatat six-year plan is supposed to address this issue, partly through the I-CORE centres, by it has not yet published the full plan, which is said to be roughly equivalent to the European RI roadmap.

Output as measured by scientific publications declined from 1.1% of the global total in 2000 to 0.9% in 2009. In terms of EPO patent applications per GDP Israel is the best performing country, as it is in PCT patent applications for health technologies. In high-tech EPO patent applications it is third after Finland and Sweden. In terms of ERC grants, Israel is the sixth best country in terms of the absolute number of grantees after Germany, the UK, France, Italy and the Netherlands. There are three Israeli universities in the ranking of the top 20 winners of ERC grants.

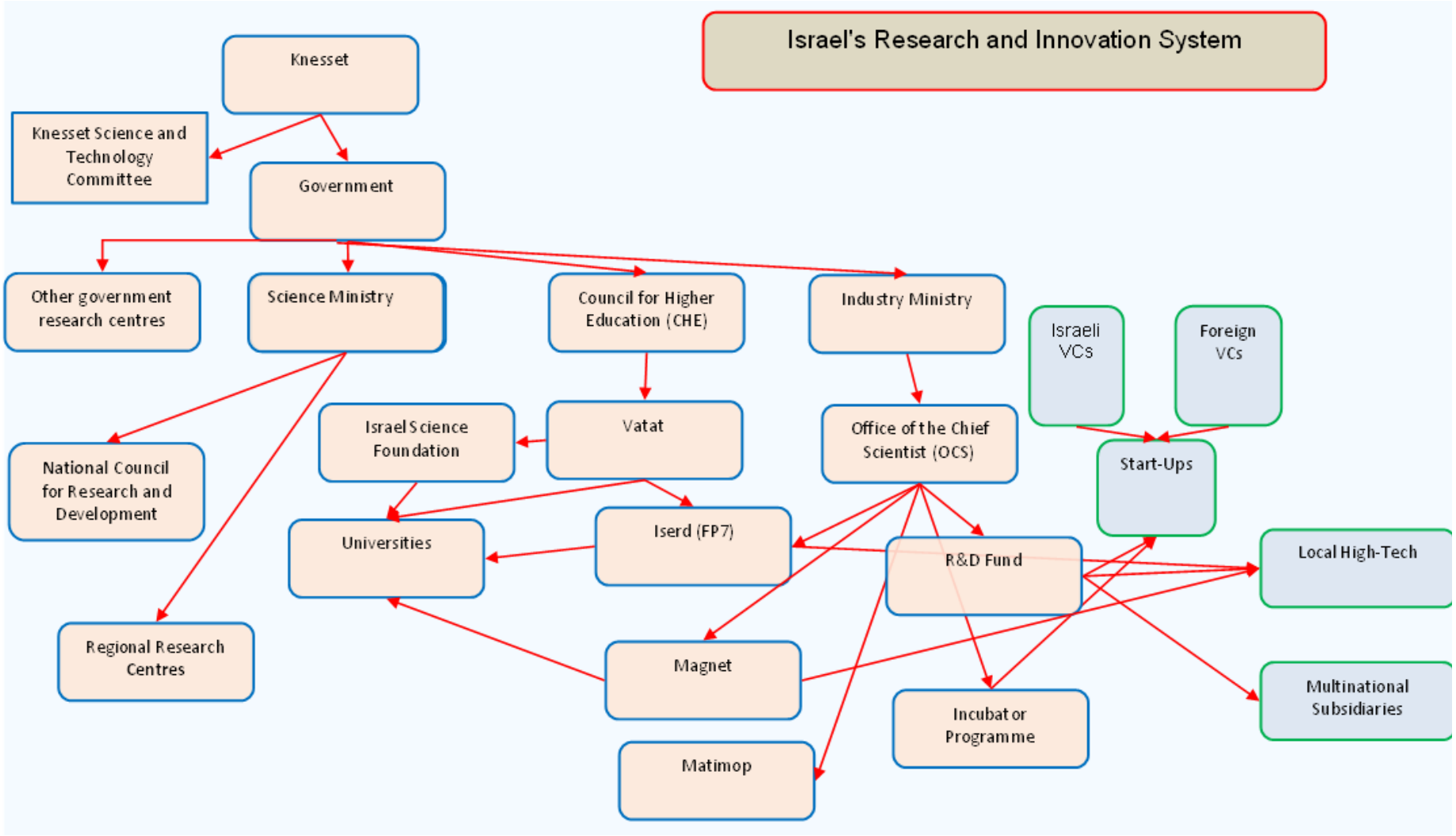
The main players in Israel's national research and innovation system, responsible for policy-making and governance, remain the Office of the Chief Scientist (OCS) in the Ministry of Industry, Trade and Employment, responsible for industrial R&D, and the Planning & Budgeting Committee (known as the Vatat) of the Council for Higher Education, which covers academic R&D. However, since 2011, the Ministry of Finance, the ultimate source of funds for R&D initiated by the government and academe (GBAORD and HERD respectively), has become much more involved in innovation policy making. The heightened involvement of the Finance Ministry has helped increase the cooperation and coordination between all entities involved in innovation policy, including the OCS and Vatat.

A lesser player both in budget and influence is the Ministry of Science and Technology which funds some small thematic research centres, runs 10 small regional research centres and is responsible for some aspects of international scientific cooperation. Under the Ministry's aegis is the National Council for Research and Development a body that has statutory authority to devise policy and advise the government, but has proved largely ineffective in recent years.

Outside of government most academic research is carried out in seven research universities. PROs do not play a central role except in the field of agriculture. R&D in the business sector is divided between indigenous firms, many of which went public on NASDAQ, subsidiaries of multinational, mainly American corporations, and a large number of technological start-up companies. Many of the local subsidiaries of multinationals were set up after the acquisition of local start-ups. One of the problems of Israel's relatively large venture capital industry, referred to in section 2, is that is has become far more difficult to float Israeli companies on NASDAQ, the preferred option in terms of liquidity and visibility, meaning that most of the prevalent strategy for Israeli start-ups is through M&A.

In terms of specialisation, there are two main fields of expertise, one which has been translated into noted commercial success and another which has only partially delivered on expectations. There is a broad range of distinct successful ICT clusters in Israel with expertise ranging from semiconductors though communications to data security and various kinds of software. Academically, life sciences are another strong suit but this has been translated into notable success only in the field of medical devices. Persistent government efforts to stimulate commercial success in pharmaceutical biotechnology have won only partial success. Another major area of expertise in knowledge intensive industries is defence exports, about which most information is classified. Press reports estimated the total volume of defence exports in 2010 at more than €5.7b. About 80% of the output of Israel's defence industries goes to exports, since the Israeli army cannot on its own finance the immense costs involved in developing modern weapons systems.

Figure 1: Israel's Research and Innovation System



Structural challenges faced by the national system

The Israeli research and innovation systems face three deep structural challenges that derive both from internal factors and from shifts in the global marketplace. These are long term challenges that predate the global economic crisis that started in 2008, even though the crisis may have highlighted their urgency, and they require the kind of long term responses that helped the Israeli research and innovation systems excel in the previous two decades.

At least two of the challenges stem partly from this same success. The ability to attract private investment in R&D is what enabled Israel to be the top scorer in the Innovation Union scoreboard of R&D intensity[1], but that same success made for underinvestment in other factors that also contributed significantly to the success.

Like most structural challenges, these challenges are extensively interrelated and touch on many other issues of concern to policymakers, but they are distinct enough to outline separately as follows:

1. Making up for the "lost decade"

Investments in Israeli higher education and research essentially stagnated during the first decade of the century. From 2000 until 2010 budgets effectively declined compared to the growth in population. By mid-decade, investments per student had declined by 9% compared to 1995[2] and the average age of faculty in exact science departments was over 55. Investment in research infrastructures also fell behind, forcing universities to rely mainly on donations.

In output terms the first results could be seen by the end of the decade in the decline in the country's share of world scientific publications which declined from 1.1% in 2000 to 0.9% in 2009,[3] proportionately a radical decrease for a small country highly dependent on research and innovation. As far as citation impact is concerned, the decline was less acute, from 12th to 13th place worldwide according to a study[4] of Israeli scientists' publications. The lower drop in citation index rankings was attributed to the impact of papers of older researchers many of whom have reached retirement age.

As a result of this stagnation brain drain became an acute problem. There are no up to date definitive figures on brain drain but a study published in 2007[5] showed that Israelis with tertiary degrees had proportionately the highest rate of emigration to the US in the world. In the higher tiers of scientific research this has become such a major problem that it has become a defining policy priority.

2. Over Reliance on ICT

[1] Innovation Union Competitiveness Report, 2011 edition, page 49

[2] Erawatch Israel country report 2009

[3] Innovation Union Competitiveness Report, 2011 edition, page 137

[4] Research and Development Outputs in Israel, Samuel Neaman Institute, 2011 (in Hebrew)

[5] Israel's Brain Drain, Eric D. Gould and Omer Moav, Israel Economic Review Vol. 5 No. 1 (2007)

The Israeli economy is heavily reliant on ICT based exports and clusters of industries based on a deep pool of talent that stretches from academe to small ICT based start-ups. The success of this industry is what enabled Israeli R&D based industries to attract substantial investment by business in ICT based industries, and this in turn was one of the reasons for the reduction of total government support of business based R&D by 36.3%[6] compared to inflation adjusted prices of the year 2000. (In the past few years budgets for commercial R&D have increased fairly dramatically from a nadir in 2007 in reaction to the global economic crisis, but Israeli government investment in business R&D, once highest in the world, now lags behind countries like the US, the UK or Korea.)

Policymakers have been aware of this over reliance for years, and have been encouraging Israeli industry to diversify through a variety of measures and initiatives. Yet they face a challenging dilemma: an in depth study has proven that government support of mainly ICT based industries is critical for economic growth in a highly competitive world, even though the majority of funding for innovation comes from the business sector. This means that a decision to divert a major part of the government resources intended to support industrial R&D to other new fields would cause extensive economic damage. Technology based exports, predominantly based on ICT, account for close to half of Israeli exports. There is no data on exactly what percentage of these exports are based on government support programmes, but by definition, government support is extended to the riskiest R&D ventures, those that give Israeli ICT exporters their competitive edge. Hence, diversion of resources from ICT would deprive Israeli industry of an important element of its competitive capacity.

Yet not diversifying is also not a good long range option. The overall returns on the heavily ICT based Israeli venture capital industry have been disappointing during the past decade. Since a major part of the Israeli innovation system is predicated on creating new ICT companies this is a strong indicator showing that the innovation system needs new engines of growth.

During the past decade, the government largely abandoned the field of thematic university based research in all civilian fields except for agriculture and most of the thematic research conducted in Israeli universities is through the country's participation in the EU Framework Programmes. Extensive thematic research is carried out is the country's large and classified defence R&D system, and there is anecdotal evidence[7] of major spill-over effects to the civilian based ICT innovation system. This successful example shows that developing new areas of expertise requires not only extensive human and physical infrastructures, but also a judicious mix between thematic academic research and project-oriented R&D. Hence, the challenge to develop non-ICT based innovative industries must be cast not only in terms of the industrial policy, which is managed by the Office of the Chief Scientist in the Ministry of Industry Trade and Employment (OCS), but also in terms of research policy managed by Vatat (The Planning and Budgeting Committee of the council for Higher Education, and by the Israeli Science Foundation.

3. Precarious VC Environment

[6] Statement by Avi Hasson, Chief Scientist in the Ministry of Industry, Trade and Employment, October 2011

[7] *Eilam's Arc, How Israel became a Military Technology Powerhouse*, Sussex Academic Press, 2011

Venture Capital is an essential part of the Israeli innovation system. To put things in proportion, the total annual investment by VCs in Israeli technology start-ups during the past decade has usually been at least four times higher than the total government budget to support innovation in all firms from start-ups to major corporations.

Current data is still reassuring, with the latest 2011 Q3 data from IVC-Online, a firm that tracks VC investments, showing that investments in start-ups for the first nine months of the year stood at about €1.2b, on track to meet last years figures and showing a faster than expected recovery from the slump of 2009. Additional data from the same firm show that total exits in 2010 reached over €1.7b, somewhat lower than the previous year but still satisfactory.

The underlying data are far more troubling. Investments by Israeli VCs now account for only 25-30% of total VC investment in Israel, with the rest coming from foreign funds. This means that investments at the seed stage, which are typically handled by Israeli VCs and not their foreign counterparts, are in jeopardy. In addition, the funds from foreign VC funds are not committed *a priori* to investments in Israeli firms and could dry up at the next instance of the global financial crisis or be moved to more promising pastures in the Far East.

In terms of raising capital the picture is also disturbing. No capital was raised by Israeli VCs in 2010, and much of the industry's ability to retain in central position in the Israeli innovation system depends on capital raising performance in 2011, for which no data are yet available, and in 2012. The total capital available for investment now stands at a very low €1b, which means that Israeli VCs will be even more cautious unless they raise new funds.

The Israeli VC industry has been through several slumps since it was kick started by government in 1994 and has successfully bounced back. But the data for Israel correspond to a large degree with data from the US, because the industry as a whole has been delivering less than satisfactory returns (1.25% per year during the past decade compared to the 6.5% yield of the S&P index[8].) The Israeli VC industry has become part of the system, and it diminishment could have a severe impact on company formation and the rest of the Israeli innovation system, thus presenting government with a major challenge.

[8] Cambridge Index of US venture capital

Assessment of the national innovation strategy

National research and innovation priorities

Israel has never had formalized research or innovation policies in the sense of policy documents that lay out long term strategies for the entire system with strategic goals and numerate targets. Until fairly recently research and innovation were not even considered by the same department in the Finance Ministry, and coordination between the two policy fields was on an ad hoc basis.

The level of coordination has improved to a certain degree during the past two years but functionally the research and innovation policies should be still be considered separately. Research policy is made and enacted by the Council of Higher Education through its Planning and Budgetary Committee, commonly known by its Hebrew acronym, Vatat, while innovation policy is made and managed by the OCS in the Industry Ministry.

Research Priorities

Up to the year 2010, there was no research policy and no research priorities, Vatat viewed itself principally as a conduit for funds to universities and colleges. University-based research was supported through a block funding mechanism and through monies transferred to the Israel Science Foundation (ISF) which awarded grants purely on their academic merits as judged by peers with no priorities.

This changed with the instruction of a new six-year plan, which besides giving higher education and research a 30% increase in budgets over and above the usual formulas for growth in the student body, added an increase of about 9% in the number of academic researchers, and a near doubling of the allocation to the ISF for research grants. But besides the increased budgets, the six-year plan for the first time laid the ground for a research policy.

The overall aim of the policy is to increase research excellence and increase targeted specialisation. The means to accomplish this are two initiatives. The first is a return to thematic funding through the I-CORE programme, under which up to 20 centres of excellence, funded partly directly by the government, are being set up in Israeli universities. The I-CORE programme is based on the assumption that the Israeli research environment needs specific foci of excellence to compete in today's world. It is a radical departure from the previous set of thinking, based on a tradition of very high university autonomy, under which policy makers made no thematic choices regarding which areas would be funded. The thematic framework is as such that some of the centres will be based on proposals by consortia of academics and some will be decided by the Council for Higher Education. More details on the I-CORE programme are in section 1 of the Annex.

The second arm of policy is the change in the block funding formula, introduced in 2010, giving far higher priority to publications. The aim here was twofold, first to award funds for excellence and the second to encourage universities to specialise in specific areas in which they have a higher chance of excelling. The change here was less radical than the I-CORE programme, and was meant mainly to correct the errors of an old an inefficient block funding formula, but the impact of the new formula has already made several universities change their priorities.

Innovation Priorities

Unlike research, government support of innovation has operated for the past two decades under consistent policies with clearly defined priorities. These priorities have changed over the years. But the key principles and instruments used to stimulate innovation have remained remarkably stable.

The key principle is that the role of the OCS is to reduce the risk of innovation in firms by shouldering part of the costs. In most cases, if the innovation project succeeds, companies repay royalties to the OCS. But it is important to stress that the OCS does not regard itself as an investor, but rather as an agency

that helps firms tread where they would not dare without some help. The instruments are the R&D Fund, which funds innovation projects in all firms, the incubator framework which supports start-ups, and the Magnet Organisation which deals with pre-competitive R&D through collaboration between the academic world and industry.

There have been two main shifts in priorities during the past few years. The first, which was taken by the OCS working with the Finance Ministry, was a government decision to invest in a dedicated biotechnology venture capital fund. The creation of the fund was based on the realisation that years of consistent support by the OCS of biotechnology based innovation were not enough, and the government needed to reduce the financial risk of investing in biotech and not only the commercial risk of biotech innovation. A smaller initiative, also intended to increase diversification beyond ICT, supported the creation of a novel alternative energy R&D centre.

The second major shift in priorities was the admission of many more priorities with mixed socio-economic objectives into the policy mix. This shift that started in 2005 with the measure to stimulate innovation in traditional industries became more marked over the past few years as the funds devoted to the measure increased, and more measures were introduced prioritizing support for innovation in peripheral parts of Israel that traditionally have been poorer and enjoyed less of the benefits of high technology industry. It is important to note that special stated prioritisation of socio-economic objectives, was essential because companies that enjoyed support under these measures would not have normally met the OCS criteria for funding, which are based mostly on international competitiveness.

The last in-depth evaluation of the effectiveness of OCS policy was published in 2008, and concluded that the traditional policy of fostering innovation was highly effective. A new study which is due to be published some time in 2012 will examine the effectiveness of OCS support to traditional industries. Until this study is published there are no means of judging whether the new, more societal priorities in the OCS policy mix do indeed act effectively to stimulate industrial investment in innovation. It will take many more years to learn whether the biotechnology fund had indeed succeeded.

Venture Capital Insurance

In January 2012 the government launched a new programme intended to address the challenge faced by the venture capital industry by promising to insure 25% of the risk of Israeli institutional investors who invest in venture capital funds.

The government plans to invest up to €40m in the programme, which is intended to stimulate investments of €160m by the Israeli institutional investors during the course of 2012, a critical year for Israeli VC funds. The fund sets guarantees on the IRR of up to 25% of the investment in the fund, so long as the fund invests in Israeli start-ups. This subsidy, or rather insurance, will be paid out as the fund winds down, at least seven years after its inception if the fund does not reach minimum targets on yield.

Israeli venture capital funds have traditionally raised nearly all of their funds from institutional and other investors abroad, mainly the US. Poor returns on VC investments in the US during the past decade and the impact of the global financial crisis have reduced the proportion of venture capital in global institutional investors' capital allocations schemes. If Israeli institutional investors do rise to the bait, this will give Israeli funds an important kick-start in their fund raising activities abroad.

Trends in R&D funding

Table 1: Basic indicators for R&D investments in Israel

	2008	2009	2010	EU average 2010
GDP growth rate (%)	4.0%	0.8%	4.8%	2,0
GERD as % of GDP	4.8%	4.5%	4.4%	2.0

GERD per capita (€ million)	897,58	834,05	947,33	490.2
GBAORD (€ million)	860,40	871,56	979,14	92,729.05
GBAORD as % of GDP	0.63%	0.62%	0.60%	0.76
BERD (€ million)	5,228,30	4,970,83	5,763,69	151,125.56
BERD as % of GDP	3.80%	3.55%	3.51%	1.23
GERD financed by abroad as % of total GERD	29.6%	N/A	N/A	N/A[9]
R&D performed by HEIs (% of GERD)	13.50%	13.19%	13.18%	24.2
R&D performed by PROs (% of GERD)	3.00%	3.18%	3.08%	13.2
R&D performed by Business Enterprise sector (as % of GERD)	79.70%	79.62%	79.81%	61.5

[1]. GDP at market prices; Percentage change on previous period.

Data sources: EU data from Eurostat; Israeli data from Israel Central Bureau of Statistics

The global economic crisis has had a definite impact on R&D funding in Israel as can be seen in the table above. GERD declined from a height of 4.8% in 2008 to 4.4% in 2010 despite a marked increase in government spending (GBAORD), highlighting the research and innovation systems' very high exposure to global financial conditions, which stems from the very high share of business in funding R&D. The total GERD figures are for civilian R&D, and there are no unclassified data on the total expenditure of the large defence related R&D system. The government has never set out specific targets for R&D expenditure, and is unlikely to do so in the future.

Funding for university based research is increasing, but the proportion between funds allocated for block funding versus competitive funding are unlikely to change very much. Block funding is a total budget divided between universities according to their score that measures accomplishments in research. In the budget for 2010, before the beginning of the new six-year plan, competitive funding through the ISF (Israel Science Foundation) accounted for about 10% of the block funding for research in universities (€50m compared to about €470m). Funding for universities is slated to increase by 30% over the course of the six-year plan while appropriations for the ISF will nearly double. But the proportions between block and competitive funding will not change to a large degree because the part of total university funding earmarked for research as opposed to teaching is increasing from about 40% to 50%.

In reaction to the global crisis that started in 2008 funding for innovation through the OCS increased in 2010 by 70% compared to 2007, but then declined again in 2011, from €435m to €398m. A large part of the OCS budget is predicated on co-financing by the private sector, ranging from 50-70% co-financing by the private sector in R&D Fund grants to 15% co-financing in the incubator programme.

There are no data yet on the actual funds allocated in 2011 to the I-CORE programme, which could be considered a form of thematic funding. Besides I-CORE programme the Agriculture Ministry funds thematic research with a budget of about €75m and there are some relatively small thematic research programmes run by the Ministry of Science and Technology.

Most of the thematic civilian research in Israel is carried out under the funding of the seventh Framework Programme, which is of central importance to the Israeli R&D system. In 2010, before the beginning of the Vatat six-year plan, FP7 funding of university based research was actually higher than funding for competitive funds from the ISF. This proportion is likely to change over the next six years as the ISF budget grows, but the Framework Programmes will remain of central importance to the research system.

[9] 8.4 (2009), 9.04 (2005)

Evolution and analysis of the policy mixes

Until fairly recently, the only body in the research and innovation spheres of which it could be said that it had a policy mix was the OCS, where three main instruments were used in different ways to address a changing list of priorities. This has now changed. The introduction of the new Vatat six-year plan combined with heightened involvement by the Finance Ministry in all spheres of research and innovation policy is producing a new reality in which measures introduced in one sphere can or should interact with other initiatives in different spheres.

Since this is a new situation, there is insufficient data to pinpoint the strengths or weaknesses of each constituent of the integrated policy mix because the level of successful interaction is a key determinant of both of the mixes' capacity to overcome the challenges outlined in section 2, and the opportunities this might create if successful.

This new reality is best illustrated with a few examples. For many years Israel's vibrant ICT sector was the beneficiary of the very large defence R&D system. The sector enjoyed the benefits not only of technologies and a deep reservoir of thematic research, but most critically of human resources, young people intensively trained to develop and use cutting edge technologies under tight discipline. If one of the challenges outlined in section 2 points to the country's need to diversify beyond ICT, then this need must be addressed by creating the necessary infrastructure, both in skills and the backbone of thematic research which Israeli industry is adept at using.

The I-CORE programme can thus be seen in several dimensions. On the one hand it is intended to redress the damage of the "lost decade" in Israeli universities and act against brain drain, but it is also intended to create the research-based infrastructure of a new generation of competitive technologies that will act as a magnet to talented young researchers. This is a policy that goes beyond the immediate needs of the academic research system and touches on the entire innovation system.

In a similar vein, the programme to insure part of the investment by Israeli institutional investors in Israeli VC funds was launched by the Finance Ministry as part of its comparative advantage programme, which is not necessarily related to the OCS. But if successful, this programme will release some of the funding pressure from the OCS programmes.

Smaller programmes like Kamin bear the same hallmark. Intended to encourage academics to pursue research in areas of potential commercial interest, the programme will be managed by the OCS' Magnet Organisation, but was launched in coordination with the Council of Higher Education and the Finance Ministry.

The apparent strength of this new coordination of policy mixes is that for the first time policymakers are looking at the entire range of issues that start with higher education through research to innovation policy. It is too early to look at actual weaknesses, but potential problems could arise from the fact that policy is being coordinated by a very small group of officials in the Finance Ministry and not by a body dedicated to the purpose. The main threat is that the new initiatives will not be sufficient to overcome the challenges outlined in section 2. The opportunity is based on the proven capacity of Israeli entrepreneurs to make use of the new technologies that hopefully will be developed as a result of the renewed vigour of the research sector.

Assessment of the policy mix

Two of the three challenges outlined above, the quality of university research and the precarious status of Israeli venture capital, have been addressed by actions intended to directly mitigate the problems in the country's research and innovation systems. The third challenge, the need to diversify the ICT-centric technology sector, has been addressed by a variety of measures, but this is a long term and complex challenge that defies simple solutions.

It is far too early to assess the effectiveness of the six-year Vatat plan and the I-CORE programme. The first indicators of success will be the number of new researchers retained by universities and the number of researchers who return to Israel to join I-CORE programmes. But the real tests of the programme will

be in general academic quality as measured by bibliometric studies, and in the commercial technologies that derive from this basic research. Both of these will take a long time to materialize. There has been some criticism in academic circles of the I-CORE programmes with academics saying that preferred status of I-CORE centres will be at the expense of other academic researchers. But there is so far little evidence to support this claim. In general, the response to the challenge of the "lost decade" seems comprehensive and integrative, especially since it does not seek to turn the wheel back but to create a research environment suited to the conditions of the 21st century.

The assessment of the response to save the Israeli VC industry from its current precarious state will be far quicker and results should be apparent towards the end of 2012. However, the effectiveness of the response depends on so many extraneous factors that it will be hard to judge on its own merits. Israeli institutional investors, like their colleagues in other countries, are judged by harsh criteria such as performance per quarter. The decision whether to lock up capital for seven to 10 years because of the government's commitment to underwrite part of the risk depends to a large extent as much on current market conditions as on strategic considerations about the composition of each investor's portfolio. And if Israeli investors do chose to enter the programme, this is only one part of each fund management company's struggle. They then have to persuade investors abroad, who should make up the majority of each limited partnership to invest in their fund despite the current tumultuous state of capital markets.

The challenge of diversification beyond ICT is both more complex and more intriguing. Proof that it is achievable can be seen in the development during the past decade of a substantial cluster of Israeli companies in the field of medical devices, which is based on the skills and entrepreneurial drive of researchers and technologists from a broad range of fields ranging from medicine to ICT. However, even if the various measures promulgated and enacted by the OCS from biotechnology through nanotechnology to cleantech are successful, and if the I-CORE programme does indeed lead to the development of skills needed for the next generation of technologies, this might not be enough. The various clusters of Israeli companies in ICT are predicated on two additional conditions. The first is markets in a state of rapid growth in which relatively small Israeli companies can make their mark. The second is the existence of a financial ecosystem that can develop these companies. Even if these issues have not been resolved now, it is clear that various government initiatives, if seen in concert, are trying to address the complexities of this problem.

Table 2: Policy measures and assessments

Challenges	Policy measures/actions[10]	Assessment in terms of appropriateness, efficiency and effectiveness
Redressing the "lost decade" in academic research	1. Six-year Vatat plan increasing research budgets and retaining more researchers 2. I-CORE programmes for centres of research excellence	The programme to repair and renew academic research appears to be both appropriate and comprehensive, but it is too early to appraise its effectiveness
Over reliance on ICT-based innovation	1. OCS programmes encouraging R&D in new fields including traditional industry. 2. Government participation in dedicated biotech VC fund.	OCS programmes are generally effective in addressing their immediate target. However the OCS cannot devote more of its limited budget devoted to non-ICT commercial R&D because the funds are needed by proven generators of jobs and wealth in ICT. The drive to diversify must go far beyond the immediate target of reducing the risk of commercial R&D. If the I-CORE programme does indeed produce both the knowledge and human skills needed to develop new fields, this is only part of the infrastructure needed for diversification.

[10] Changes in the legislation and other initiatives not necessarily related with funding are also included.

Challenges	Policy measures/actions[10]	Assessment in terms of appropriateness, efficiency and effectiveness
Precarious state of Venture Capital	Government measure to insure 25% of the risk of Israeli institutional investors who join funds as limited partners	The effectiveness of this measure will be clear by the end of 2012, but success in re-funding the industry depends on many extraneous factors in world financial markets.

National policy and the European perspective

The Annex to this report presents a series of challenges in several different areas at the national level that are summarized in the table below. However, only a few of these challenges are reflected in policy changes that have been either approved or implemented.

First and foremost, the brain drain of researchers particularly from the academic sector and the resulting short supply of such researchers have led to concrete measures to attract Israeli researchers working abroad back home. This is to be achieved by significantly increased budgets to HE and specifically to academic research, with improved research infrastructure as one of the targets. These policy changes are taking place within the new six-year plan for HE, whose implementation began in 2011 (topics 1 and 3 in the Annex).

Israel already has a wide network of international cooperation R&D agreements, with countries both in Europe and elsewhere. Expansion of this network is definitely considered a target – with supervision of the network in large part by the Ministries of Industry, Trade and Employment and of Science and Technology. At the same time, expansion of the network is not being carried out as a national programme, though Israel's approval as a member of the OECD in 2010 is a definite step in the right direction (Topic 3).

Strengthening the universities in Israel (Topic 4) is a national priority and the new six-year plan is the policy channel through which this target is to be achieved. It is recognized that strengthening academic research requires not only larger budgets – which the six-year plan will provide – but also more well-established ties between academe and the business sector (Topic 5). Technology transfer has been for some time a feature of all 7 Israeli universities, but there are various government programmes in place, some fairly recent, which are designed to strengthen the ties between the two sectors.

Table 3: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	**Labour Market for Researchers**	1. To increase the number of researchers in Israel, particularly in HE. 2. To attract Israeli researchers working abroad to return home. 3. To recruit researchers from abroad to work in Israel. 4. To provide incentives to increase the number of science and technology university students and to stem the decline in technology track secondary schools.	Continuing establishment of 20 Excellence Centres, as part of the new six-year plan – whose implementation began in 2011 - to support university R&D. The first four centres have already begun functioning. Proposals for another 18 centres are being considered, with 10 of these expected to be functioning within a year. The Centres aim at meeting all three main challenges: to increase the number of researchers, to attract Israeli researchers back home and to offer suitable research facilities to attract foreign researchers to work in Israel.
2	**Cross-border cooperation**	1. To expand the current list of bilateral R&D agreements between Israel and various EU and other countries. 2. To encourage R&D entities to apply to Framework Programme 7	There are no national programmes for cross-border cooperation and no recent policy changes connected with such cooperation. Rather there is an ongoing target of enhancing existing connections between Israel and countries in the EU and elsewhere, via bilateral R&D agreements on the clear understanding that such connections are crucial for bolstering Israel's innovation sector. A most recent bilateral agreement, signed in 2011, is the Shanghai-Israel Programme for Industrial R&D which aims at the development of products or processes leading to commercialisation in global markets.
3	**World class research infrastructures**	1. To radically improve the overall research infrastructure of Israel's HE sector.	Once the connection was made between the sorely lacking research infrastructure of Israel's universities and the growing brain drain of researchers, it was understood, within the new six-year plan for the HE sector, that the aim of attracting back to Israel researchers working abroad had as a necessary criterion for success a dramatic improvement in infrastructure. The new plan, whose implementation began in 2011, includes significant budgets for infrastructure improvement. Work is currently being done on the creation of an Israeli RI roadmap, not as part of the official ESFRI, but as a necessary tool for tracking the development of R&D infrastructure in Israel.

	ERA dimension	Main challenges at national level	Recent policy changes
4	**Research institutions**	1. To increase the share of HERD in GERD.	The share of HERD in 2010 was 12.8%, down from 32% in 1990. The new six-year plan has set an increased share of HERD as one of its aims. It is true that the share of BERD has increased to compensate for the declining share of HERD over the past 20 years, but the effect of global crises on BERD in recent years has clarified the need to strengthen HERD, by providing both more finance and more human resources.
5	**Public-private partnerships**	1. To widen the connection between university R&D and industry.	The understanding here is clear: expanding academic R&D has to be accompanied by providing channels of connection with industry in order to guarantee commercialisation of research. More emphasis on non-ICT research and more thematic research (see Chapter 2 of this report) is being paralleled by strengthening of the ties between the academic sector and industry, with government programmes such as Magnet and Kamin aimed at achieving stronger ties.
6	**Knowledge circulation across Europe**	Not applicable to Israel	
7	**International Cooperation**	No specific challenges	Israel has a far-reaching network of international cooperation with many countries both in Europe and elsewhere, and works continually to expand the network.

Annex: Alignment of national policies with ERA pillars / objectives

1. Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers

1.1 Supply of human resources for research

In 2009 (the last year for which data are available), there were some 54,400 researchers in Israel[11], 83% in the business sector and the remainder in the academic sector. This breakdown matches the breakdown of R&D financing in Israel, with some 80% coming from the business sector.

After increasing by 18.5% between 2005 and 2007 (the increase was entirely in the private sector), the number of researchers did not increase at all between 2007 and 2009. This was apparently the result of the global recession, which also acted to reduce the volume of business sector innovation financing. The fact that the number of researchers in the academic sector remained unchanged throughout 2005-2009 – together with the relatively low share of researchers in this sector – more than hints at a supply problem with researchers at Israel's universities.

In 2011, Israel continued to lay emphasis on its main challenge in the area of flows of researchers, particularly in the academic sector: to attract researchers – both Israelis working abroad and foreign researchers – to do their research in Israel. The policy vehicle implemented to meet this challenge was the establishment of Excellence Centres (known by the generic name I-CORE – Israeli Centres of Research Excellence) as part of a new six-year plan which will offer significantly increased budgets for higher education, both for teaching and for research: the plan including the I-CORE initiative was presented to the Government of Israel in March 2010 and its implementation began in 2011. The total six-year budget for the establishment of the 20 Centres is some €320 million out of a total budget for the plan of €1,280 million[12].

The main goals of I-CORE are to reinforce excellence in Israeli universities, improve their competitive position globally and reverse the brain drain by attracting back to Israel senior researchers who have worked abroad for an extended period.

Four centres, of the 20 planned within I-CORE, have already been established, attracting back to Israel 40 leading researchers, and began functioning in October 2011. In the next stage of the programme, topics for 18 more Centres have been chosen by a Programme Steering Committee, with the aim of establishing 10 more Centres in the academic year 2012-2013.

The first four centres established were all in scientific and technological areas – the Molecular Basis of Human Diseases, Cognitive Science, Computers Sciences and Alternative Energy Sources. The 18 new topics from which 10 new Centres will be established cover a much wider range of disciplines: Life and Health Sciences, Exact Sciences and Engineering, Humanities and Arts, Social Sciences, Education, Law and Business Administration. The selection of subjects in the second stage was made in cooperation with the entire academic society in Israel via a process involving more than 1200 Israeli researchers in Israel and abroad and the heads of Israel's higher education research institutes.

The 10 new I-COREs will be established as associations of about ten scientists in each of the specific fields of research, regardless of their institutional affiliation. The relatively low number of researchers in

[11] Data from the Central Bureau of Statistics; Parallel data published in the 2010 ERAWATCH report were inaccurate because they included workers in the R&D sector who were not researchers.

[12] Data from Vatat

each Centre is designed to facilitate focused research, real synergy between the researchers and appropriate adjustment to the type of research (experimental or theoretical).

It is clear from the I-CORE programme that Israel is now intent on enhancing inward mobility of researchers and on minimizing their outward mobility. The brain drain from Israel has been a feature of Israel's research community for many years. According to interesting new data published in May 2011 by the Central Bureau of Statistics, as of 2010, 11.9% of Israeli holders of a PhD. lived abroad for an extended period: this percentage rose to 15.9% for holders of a PhD. in the natural sciences and engineering compared to just 4.8% in the humanities and social sciences.

1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed

Researchers continue to be among the best-paid professional groups in Israel. Compared to the overall monthly average wage in 2010 of €1,700, the comparable average salary of R&D personnel was almost €4,300[13] (in Euro terms, salaries in Israel jumped in 2010, since the Euro weakened on average against the Israeli shekel by almost 10% compared to 2009).

The universities are the major negotiators with the government regarding the salaries of their staff, including researchers, with the level of salaries common among all 7 universities. Despite recommendations in the past that differentiated salaries of academic staff at the level of the specific university should be allowed, university staff members continue to express their determination to maintain uniformity of salaries between the different universities.

All of Israel's 7 research universities (the Hebrew University of Jerusalem, Tel-Aviv University, Haifa University, the Technion, Ben-Gurion University, Bar-Ilan University, and the Weizmann Institute) agreed in principle to the European Charter for Researchers as far back as in 2006 and signed a declaration to this effect.

In June 2011, EURAXESS published a revised set of work conditions for researchers called "Human Resources Strategy for Researchers" and each member country will be required to agree to conform to the new strategy. A meeting is scheduled at Israel's Ministry of Science & Technology (which is responsible for EURAXESS Israel: www.euraxess.gov.il) with representatives of all Israeli universities to discuss this matter and make decisions.

In principle, Israeli universities offer open recruitment both to Israeli and non-Israeli researchers. With regard to the latter, the high degree of autonomy of Israeli universities (see Section 4 in the Annex below) makes them able and willing to absorb researchers from abroad: there are no restrictions placed on them in this area by national legislation or on their eligibility to compete for permanent research and academic positions. Open recruitment is evident from the fact that permanent positions at Israeli universities are published on the EURAXESS database: at present, some 100 research positions available in Israel appear on the portal, which ranks Israel quite high among countries using EURAXESS.

The portability of grants is a more complicated issue than open recruitment, because grants are most often extended to a researcher at a particular university. The matter of grant portability is often not a relevant issue in Israel, because there is only limited mobility between universities within Israel. But in cases where mobility takes place, the universities connected with the mobility (the university that the researcher leaves and the one that he/she goes to) need to agree to the transfer of grant money.

Based on information received from the Israel Science Foundation (www.isf.org.il), grants are in fact portable between Israeli universities. However, ISF grants are only extended to researchers doing their research at an Israeli academic institution and are not portable to an academic institution abroad.

Regarding the social security needs of mobile researchers, Israel's National Insurance Institute has signed international social security conventions in order to ensure the protection of social security rights

[13] Data from the Annual Statistical Abstract, Central Bureau of Statistics

of a person who moves from one country to another and to avoid dual insurance payments. Payment of Social Security fees in Israel depends on the status of the researcher.

In the case of health insurance, researchers visiting Israel must arrange (in their country of origin) an overseas full health insurance policy, that will cover emergency services and hospitalisation, prior to their arrival in Israel, or join a local insurance plan, upon arrival. It is possible to purchase such insurance from any of the recognized Israeli National Health Funds.

Supplementary pension needs call for researchers from abroad, who do not intend to apply for Israeli citizenship, to maintain their pension rights in their home country by transferring regular payments, rather than to try and join a pension scheme in Israel.

1.3 Improve young people's scientific education and increase interest in research careers

Despite concern about the ongoing short supply of science & technology and engineering graduates in Israel, there are no particular policies or incentives in place to guarantee this supply in the medium- to long-run.

The data do not seem to back up the concern. Based on the number of degree recipients in natural science and mathematics and in engineering and architecture (there are no separate data on these two disciplines), these areas have become more attractive over time. Over the past decade (between the 1999/2000 and 2010/2009 academic years), the total number of degree recipients increased by 25% while degree recipients in natural sciences and mathematics jumped by 38% and in engineering – by 53%. Similar developments characterised recipients of BA and MA degrees in these two areas. It is worth noting however – a point relevant for the supply of researchers – that the total number of PhD. degree recipients increased more than those in natural sciences and mathematics and in engineering (92%, compared to 62% and 83% respectively)[14].

However, this overall positive picture about the potential supply of researchers appears to have worsened quite significantly in the past five years (between the 2004/2005 and 2009/2010 academic years). During this period, the total number of degree recipients increased by 8.6% while in natural sciences and mathematics, there was a decline of 2.9%. The number of BA degree recipients over this five-year period increased by 7% but in natural sciences and mathematics, there was a sharp drop of 14%.

Of possibly even greater concern for the future supply of researchers in Israel is the decline in the number of technology track high-school pupils, headed for university studies in science and technology. The number of technology track classes and pupils in secondary schools reached a peak in the 1999/2000 academic year. Since then, through the 2010/11 academic year, the number of classes in technological/vocational secondary schools has dropped by 21.6% (while the number of classes in general track secondary schools has jumped by 35.5%) - the number of technology track pupils has declined by 20.7% (compared to an increase of 23.4% in the number of general track secondary school students).

1.4 Promote equal treatment for women and men in research

In general, the preparation of women, via higher education, for careers in Israel is similar to that in other developed countries, where more than half of the student population is female: in Israel, this is true also for PhD. students. According to data from the 2009/10 academic year, women constituted 54.7% of BA students at Israeli universities, 57.4% of MA students and 52.7% of PhD students. The share of women among degree recipients was also above 50% at all degree levels (BA – 57%, MA – 55.4%, PhD – 50.7%).

[14] All data in this section – and from the next section - are taken from the 2011 Annual Statistical Abstract, Central Bureau of Statistics.

Since recipients of a PhD degree are more like to be the supply source of researchers, it is worth noting that in 2009, the labour force participation rate of holders of a PhD degree was a very high 88.6% (compared to a national average of 56.9% in that year) with the rate among women only marginally lower than among men (86.8% compared to 89.7%), while the national participation rate for women was much lower than for men in 2009 – 52.3% compared to 61.7%.

Also, the total unemployment rate among holders of a PhD. degree in 2009 was a low 2.3% (compared to a national unemployment rate of 7.5% in 2009) with the rate among women holders a slightly higher 3.6%. As only to be expected, the share of female part-time employed persons with Ph.D. degrees was higher than for males – 22.6% compared to 11.7% among males, but this female share is significantly lower than the share of part-time employed in total female employment in 2009 – 39.6%.

Even though the overall picture here seems to point to equal opportunities for males and females to become researchers in Israel, the data presented are indirect so that no clear conclusions can be drawn about women's research opportunities. There are certainly no policy regulations in place to correct any possibilities of discrimination against women in achieving research positions or to promote equal gender representation in academic and research committees, boards and governing bodies.

There are also no regulations to guarantee the progression of female researchers with equal chances to their male counterparts, after career breaks. Paid maternity leave – for 3 months – is given primarily to mothers. Should the mother decide to take longer leave, 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 women's statutory maternity leave.

Direct data on the share of females among researchers show that 21.7% of researchers in the business sector were female in 2009, a very marginal decline from the share in 2005 – 23.5% (there is no breakdown data by sex for university researchers). This may appear low compared to the share of males (78.3%) and also compared to the share of females among total employed persons (47.1% in 2009-2010).

A comparison between Israel and the EU with regard to the role of women in higher education and research is provided by She Figures 2009 (Statistics and Indicators of Gender Equality in Science: the data are for 2007). The comparison is mixed. The overall share of female academic staff in Israel was 26%, compared to 38% in EU-27. The share of female Grade A staff in the Natural Sciences in Israel was 6.6% compared to 13.4% in the EU, and in Engineering and Technology – 4.8% in Israel, compared to 7.2% in the EU. Also, the proportion of women on boards in Israel was 11% compared to 22% in the EU. In these categories, women are in an inferior position than in the EU. In contrast, the share of female heads of universities based on their capacity to deliver PhD's was 29% in Israel as against just 9% in the EU in 2007.

2. Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding[15]

Israel has a long history of joint R&D activity with countries abroad – both in the EU and other countries – in various forms and frameworks, but this activity, which is significant and expanding, is not the result of policy actions at the national level, even though some of the activity is under the supervision of government agencies such as the Ministry of Science and Technology (www.most.gov.il).

Most of the joint R&D activity is in the form of bilateral agreements between Israel and a single country. In the area of industrial R&D, such agreements are most often arrived at through MATIMOP – Israeli

[15] Promote more critical mass and more strategic, focussed, efficient and effective European research via improved cooperation and coordination between public research funding authorities across Europe, including joint programming, jointly funded activities and common foresight.

- Ensure the development of research systems and programmes across the Union in a more simple and coherent manner.
- Promote increased European-wide competition and access of cross-border projects to national projects funding

Industry Centre for R&D (www.matimop.org.il), a branch of the Office of the Chief Scientist in the Ministry for Industry, Trade and Employment (www.moital.gov.il). An excellent recent example of such a bilateral agreement is the Shanghai (China) – Israel programme for Industrial R&D, signed during 2011. The primary aim of the agreement is to support joint industrial R&D projects targeted to develop products or processes leading to commercialisation in the global market.

Each bilateral agreement includes the creation of a funding mechanism. In the case of the Shanghai-Israel agreement, industry may seek support for joint R&D projects, involving at least one Shanghai and one Israeli company.

Israel has joint research funds with a number of individual European countries – Germany, France, Italy, Spain, UK, Hungary, Poland, Czech Republic, Finland – and also with other countries – USA, Japan, Canada, India, Russia, South Korea and Singapore (for a full list of – and information on – these joint research frameworks, go to http://www.science.co.il/international-funds.asp).

Israel is connected with Europe as a whole via, EUREKA (Israel chaired EUREKA in 2010-2011) and of course, FP7 (the connection with FP7 is organized/supervised by ISERD – Israel-Europe R&D Directorate for the EU Framework Programme: www.iserd.org.il). Israel is also active in COST with representatives in some 70 of the approximately 200 COST activities. In addition, Israel participates in the MINERVA programme (which promotes European cooperation in the area of ICT), in the MATERA project (which aims at strengthening cooperation among European countries in the area of researching and developing advanced materials) and is linked to CORDIS (European Community R&D Information Service).

3. Develop world-class research infrastructures (including e-infrastructures) and ensure access to them

As a non-EU member state, Israel is not required to produce a National Research Infrastructure (RI) roadmap. However, it is clear that identification of future national RI needs, with budgets and priorities to meet these needs, is currently under way, particularly in the academic sector. Indeed, at a meeting in early 2012 with the Planning & Budget Committee of the Council for Higher Education, we learned that work is currently being done on the creation of an Israeli RI roadmap.

This enhanced activity is based on the recognition that the research infrastructure of the academic sector is sorely lacking and that the success of the policy to attract Israeli researchers working abroad back to Israel, under the new six-year plan (see Section 1 a in the Annex above), calls for dealing seriously with the lack of infrastructure.

The budget underlying the six-year plan includes the financing of improved research infrastructures in the academic sector. At the same time, as reported in the 2010 ERAWATCH report, the exact overall amounts to be devoted to infrastructure improvement have still not been finally determined. By definition, a part of the investment in infrastructure will be made via establishment of the new Excellence Centres within the I-CORE programme (described above in Section 1 a), but the infrastructure investment will also be channelled in other ways.

The overall six-year plan is designed to be financed by an increase in student fees, but the implementation here requires agreement by the National Students' Council. The Council elected a new leadership during 2010, but negotiations regarding student fees do not appear to be top priority at the present time, possibly as a result of the mass demonstrations for social justice that took place in the summer of 2011, with the National Students' Council one of the main leaders of the demonstrations.

With regard to the financing of infrastructure improvement, the RI roadmap currently being worked on will be designed for individual universities, for the I-CORE programme, and for major standalone research projects. Based on the apparent assumption that the budget of the new six-year plan will not provide sufficient funding for all the sought after improvement in research infrastructure, it is expected to be supplemented with donations.

4. Strengthen research institutions, including notably universities

Universities in Israel remain very autonomous: once they have been allocated their annual budget (block financing) by the Planning & Budgeting Committee (Vatat), they are at liberty to decide how to use this budget within the university – for teaching or for research. In general, the block financing is allocated by Vatat according to a model in which the universities' achievements both in teaching and research are measured. The research allocation model has been reworked under the new 6-year plan, with a weighting of 34% to winning competitive grants, 34% to publications adjusted to the importance of the journal, and the remaining 32% to factors such as non-competitive grants and the numbers of doctoral students. The main change compared to the old model is in the importance accorded to publications, which only accounted for 15% in the old model. The new model, according to which all block funding for research is allocated, will not interfere with university autonomy: once the budget is allocated, each university will continue to be able to decide on its use autonomously.

In principle, therefore, 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 specialisation.

The new six-year plan to bolster Israel's higher education system in 2011-2015, with significant budget increases, shows a recognition on the part of the present government that expanded budgets are a necessary criterion not only for improving the quality of the higher education system within Israel but also to guarantee that Israel's higher education system will keep up with improvements taking place in parallel systems of other countries.

There are 7 research universities in Israel – the Hebrew University of Jerusalem, Tel Aviv University, Haifa University, Ben Gurion University of the Negev, Bar-Ilan University, the Technion and the Weizmann Institute: both Haifa University and the Technion are situated in the northern city of Haifa. All 7 universities are budgeted via the Planning & Budgeting Committee (Vatat) of the Council for Higher Education.

One of the ongoing noteworthy developments of recent years is the accelerated increase in the number of academic colleges (called michlalot in Hebrew), alongside the 7 universities, and in the number of students at these colleges: only some of the colleges are budgeted through Vatat - the non-budgeted colleges are considered private. In the 2008-2009 academic year (the last data available), there were some 14,600 staff members at Israeli universities and some 6,800 at budgeted academic colleges. But compared to the 2004-2005 academic year, the number of staff at academic colleges jumped by 21.2% compared to a minimal 1.7% increase in university staff.

This is one indication of the growth of the academic colleges. Another is the increase in the number of students: in the decade up to the 2010-2011 academic year, the number of students at academic colleges (budgeted and non-budgeted together) increased by an annual average of 9.8%, compared to the 0.3% average increase at universities. In the academic year 2010-2011, there were more BA students at academic colleges than at universities (87,400 compared to 74,900), though still far less MA students (9,300 compared to 38,300)[16]. It is clear that from the point of view of the quality of higher education, at least at the BA degree level, several academic colleges are considered on a par with universities (one good example is the Interdisciplinary Centre in the city of Herzlia), while the relatively higher fees at the private colleges have clearly not been a disincentive to the rapid growth of their student body.

Despite the growing importance of academic colleges, data on academic R&D cover only the 7 universities: the Central Bureau of Statistics, the source of Israel's civilian R&D data, is aware that the data on HERD published in Israel are somewhat biased downwards for this reason, though the bias may be minimal. However, because of the emphasis here on R&D, and also because only the universities offer PhD degrees, the analysis will continue based on the universities alone.

[16] These data were specially provided by the Central Bureau of Statistics for the purpose of this report.

If the total number of students at universities has increased by a meagre 0.9% annual average over the past decade (of academic years), the number of PhD. students has jumped by 4.8% annually. If in the decade up to the academic year 2009-2010, the total number of degree recipients at universities increased by an annual average of 2.3%, the average increase in the recipients of Ph.D. degrees was 6.7%.

Total HERD in 2010 amounted to some €787 million compared to some €1 billion in 2000-2001. HERD constituted some 12-13% of total expenditure on civilian R&D in Israel in 2007-2010 (12.8% in 2010): this share of HERD is down from 32% in 1990 (at the same time, the share of BERD was 80% of the total in 2010, compared to 50-60% in the early 1990's).

The business sector financed 7.3% of HERD in 2008 (the last year with available data): the government is the largest financier, with 47.1% of the total while 13.6% was financed from outside Israel[17].

Israeli universities are fully aware of the importance of establishing a strong international position. Nowhere is this more apparent that in the participation of the universities in FP7: the framework programmes in general (Israel has participated so far in FP4 to FP7) have become a central source of R&D funding, especially for universities which do not enjoy the access to capital of Israel's private business sector. FP7 covers the period 2007-2013: up to November 2011, 1350 grants have been extended to Israeli entities – 833 to universities (61.7% of the total), 283 to industry (21%) and 234 to other entities. During this same period, Israeli entities received a total of €502 million in FP7 funding: universities received some 68% of total Israeli FP7 funding.

In the Shanghai University Rankings for 2010, only the Hebrew University of Jerusalem is ranked in the world's top 100 universities (at place 72, down from places 64-65 in the previous three years). Tel Aviv University, the Haifa Technion and the Weizmann Institute are ranked in places 100-150, while the other three Israeli universities are ranked much lower.

Israeli universities do benefit from a quality assurance mechanism. This was established as a unit for academic quality assurance within the Vatat (the Planning & Budgeting Committee of the Council for Higher Education): given that the Vatat is the channel via which the universities receive block funding from the Ministry of Finance, this evaluation mechanism can be considered as being at the national level. The quality assurance is conducted in four stages: a) self evaluation; b) visits to the university by a committee of experts in a particular field; c) discussion of the results of the evaluation in the Council for Higher Education and d) publication of the results. The committees of external evaluators are comprised of senior members of Israeli academe and senior academics from leading universities abroad.

5. Facilitate partnerships and productive interactions between research institutions and the private sector

Even though the importance of knowledge transfer between the academic sector, public research organisations (PRO's) and industry is recognized – and even talked about – in Israel, there are no national guidelines to promote knowledge transfer, no Industrial Liaison Offices in universities and no support measures in place at the national level to facilitate the creation of university spin-offs and to attract venture capital and business angels. Each university has its own rules concerned with Intellectual Property created by researchers, and that fact that the government funds research does not give it any stake in researchers' IP.

Nevertheless, there is considerable de facto knowledge transfer taking place. All seven research universities have highly active technology transfer (TT) companies that specialize in commercialising IP developed in the universities[18], based on different promotion strategies. Some of the universities have turned their TT companies into significant revenue-providers.

[17] Data are from the Annual Statistical Abstract 2011, Central Bureau of Statistics.

[18] Yissum at the Hebrew University of Jerusalem (www.yissum.co.il), Ramot at Tel Aviv University (www.ramot.org), Yeda R&D at the Weizmann Institute (www.yedarnd.com), Carmel Ltd. at Haifa University (www.carmel-ltd.ac.il), T3 Technology

It appears that knowledge transfer works in Israel without national guidance or policy, with the partners to the transfer – the developers of technology and the absorbers/appliers/ commercialisers – cognisant of the mutual benefits of TT: this approach seems to parallel the major share of the business sector in R&D development in general in Israel.

Nevertheless, mention should be made of government-initiated programmes aimed at strengthening the connection between academic R&D and industry. One such programme is Magnet (www.magnet.org.il), under the auspices of the Office of the Chief Scientist (OCS) at the Ministry of Industry, Trade and Labour (MOITAL), in which consortia of industrial companies and academics work together to support generic pre-competitive R&D. A more recent example is the Kamin programme, also out of the MOITAL and set up in mid-2010, which aims at promoting academic research by individual researchers that is considered to have potential for Israeli industry by creating jobs in general and enabling the absorption of scientific and technology staff in particular.

The Boards of Trustees at Israeli universities include external stakeholders – mostly wealthy individuals who have contributed considerable funds to the university and are probably from the business sector - in addition to members of the Senate, the other university governing body, made up of senior university staff and placed below the Board of Trustees in hierarchy. The governing power of the Senate has been relatively reduced over time, so that, in principle, the governing power of the external stakeholders on the Board of Trustees has increased, though they may not have a majority vote. Nevertheless, there seems to be a trend over time of increasing the influence of external stakeholders in university governance.

However, in practise, this capacity of external stakeholders to govern may not be felt that much. The Board of Trustees meets just once a year. The Board does elect the President of the university – this election used to be in the hands of the Senate – but in general, the Trustees, including the external stakeholders, are not particularly involved in the current governance of universities in Israel.

6. Enhance knowledge circulation across Europe and beyond

Not particularly relevant to Israel. Israel is definitely interested in providing access for non-national participants to existing research programmes, though this cannot be considered a matter of national R&D priority.

7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world

Internationalisation of S&T cooperation is perceived, at the national level, as an issue of primary importance for the Israeli research system. But Israel does not have a national strategy for international cooperation. The EU is seen as the main strategic partner in this area, but there is significant cooperation with many countries outside Europe (see Section 2 of the Annex above).

The acceptance of Israel as a member of the OECD during 2010 is the ultimate proof that Israel has decided to look beyond Europe to exploit S&T cooperation: even before Israel's OECD membership was approved, there were research cooperation agreements in place with non-European members of the OECD (again see Section 2 of the Annex above). Like the EU, so the OECD places great emphasis on R&D development: Israeli membership of this organisation has already lead to the creation of new statistical systems, required by the OECD and created by Israel's Central Bureau of Statistics, that will enable better tracking of R&D progress in Israel.

Section 2 of the Annex describes of the far-ranging and ever-expanding network of Israel's bilateral R&D agreements with countries around the world. At the same time, there are neither specific research fields nor countries that are prioritized for cross-border collaboration nor are there particular aspects of this collaboration that are linked to the grand challenges presented in Chapter 2 of this report.

Transfer at the Haifa Technion (t3.technion.ac.il), BGN Technologies at Ben-Gurion University (web.bgu.ac.il/Eng/BGN1) and the Bar-Ilan R&D Company at Bar-Ilan University.

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List of Abbreviations

BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Research
ERA	European Research Area
CHE	Council of Higher Education
COST	European Cooperation in Science and Technology
EPO	European Patent Office
ERA	European Research Area
ERA-NET	European Research Area Network
ESA	European Recovery Programme Fund
ERC	European Research Council
ESFRI	European Space Agency
FP	European Framework Programme for Research and Technology Development
EU-27	European Union including 27 Member States
FDI	Foreign Direct Investments
FP7	7th Framework Programme
GBAORD	Government budget appropriations on R&D
GDP	Gross Domestic Product
GERD	Gross Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
IP	Intellectual Property
ISF	Israel Science Foundation
M&A	Mergers and Acquisitions

OECD	Organisation for Economic Co-operation and Development
MOITAL	Ministry of Industry, Trade and Labour
OCS	Public Research Organization
PRO	Office of the Chief Scientist, Ministry of Industry, Trade and Employment
R&D	Research and development
RI	Research Infrastructures
RDI	Research Development and Innovation
RTDI	Research Technological Development and Innovation
S&P	Standard and Poor
SF	Structural Funds
SME	Small and Medium Sized Enterprise
S&T	Science and technology
Vatat	The Hebrew Acronym for the Planning and Budgeting Committee of the Council of Higher Education
VC	Venture Capital

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Abstract
The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.

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