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BRAIN DRAINED: A TALE OF TWO COUNTRIES

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ABSTRACT

Brain Drained: A Tale of Two Countries*

This paper provides a comparative examination of how public universities in two countries, the United States and Israel, have evolved over the past few decades - and how differences between the two have culminated in a rate of academic brain drain from the latter to the former that is unparalleled in the western world. The number of Israelis in the top 40 American departments in physics, chemistry, philosophy, computer science and economics, as a percentage of their remaining colleagues in Israel, is over twice the overall academic emigration rates (at all levels) from European countries. Signs of what is currently occurring in Israel have already begun to appear in other developed countries as well, though on a completely different scale - still - making the country an important case study that other countries should study, understand and prepare against a similar eventuality.

JEL Classification: A11, F22, H52, H83, I23, J31, J61 and O15

Keywords: brain drain, higher education and migration

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Submitted 05 February 2008

I. Introduction

The State of Israel became independent in 1948. It was a country with 825,000 people and two universities – the Hebrew University in Jerusalem and the Technion in Haifa. These universities had a combined senior faculty of 118 professors and lecturers who taught 1,635 students. In two years, by 1950, the population had grown by over 50% as refugees flooded in. It was still a poor country, with a GDP per capita of \$4,917 (in ppp-adjusted 2000 dollars¹), compared with \$11,233 for the United States.

Nonetheless, within the next two decades, seven major universities were up and running. By 1973, these universities had a combined senior staff of 4,389 professors and lecturers and 50,000 students. The country's population had grown to three and a quarter million people. Its living standards had also been rapidly accelerating, reaching a GDP per capita of \$14,039. The country that had incomes per capita only 44% of America's in 1950, had now risen to 72% of U.S. incomes.

Since 1973, the number of universities has remained unchanged, while a host of academic colleges have been accredited. Though worldwide comparisons of universities are not an exact science – they can offer a general glimpse of the caliber of Israeli academia.

All seven universities are ranked among the top 500 in the world, while four of the Israeli universities – Hebrew University, Tel-Aviv University, the Technion and Weizmann Institute – are among the top 150 (ARWU, 2007). There are only 19 countries with at least one university among the top 150. The fact that Israel has four such universities puts the country in 9th place, together with Belgium, Sweden and the Netherlands. When the countries' sizes are taken into account, Israel moves into second place – behind Switzerland – in terms of top-150 universities per capita and into first place in terms of GDP.

This latter point is not immaterial because it relates between the overall ability of a country to finance education and the quality of education that it provides. A high rank in this regard gives an idea of the type of national priorities in place that enabled such an outcome.

¹ Heston, Summers and Aten (2006).

The problem is that today's level of education was determined by yesterday's investments while today's priorities will determine tomorrow's level.

In many respects, Israel reached a pinnacle in 1973. In the aftermath of the Yom Kippur War, the country changed direction – in its leadership, in its functioning and in its national priorities. The implications of this change on the country's system of higher education had been less obvious, until recently.

As Israel began to draw back its emphasis on higher education, the United States continued to expand and invest in its public universities. This paper shows how America's public universities evolved over the past few decades and compares them with what transpired in Israel during these years – the stagnation that set in and the policies and bureaucracies that became hardened in stone. It provides evidence on an academic exodus unparalleled in scope – not only in terms of the number of scholars who have left but also in terms of the quality that the country has lost: a double-digit share of Israel's top scholars currently reside on a full-time – non-visiting – basis in America's leading universities.

II. The Evolution of Israeli Academia

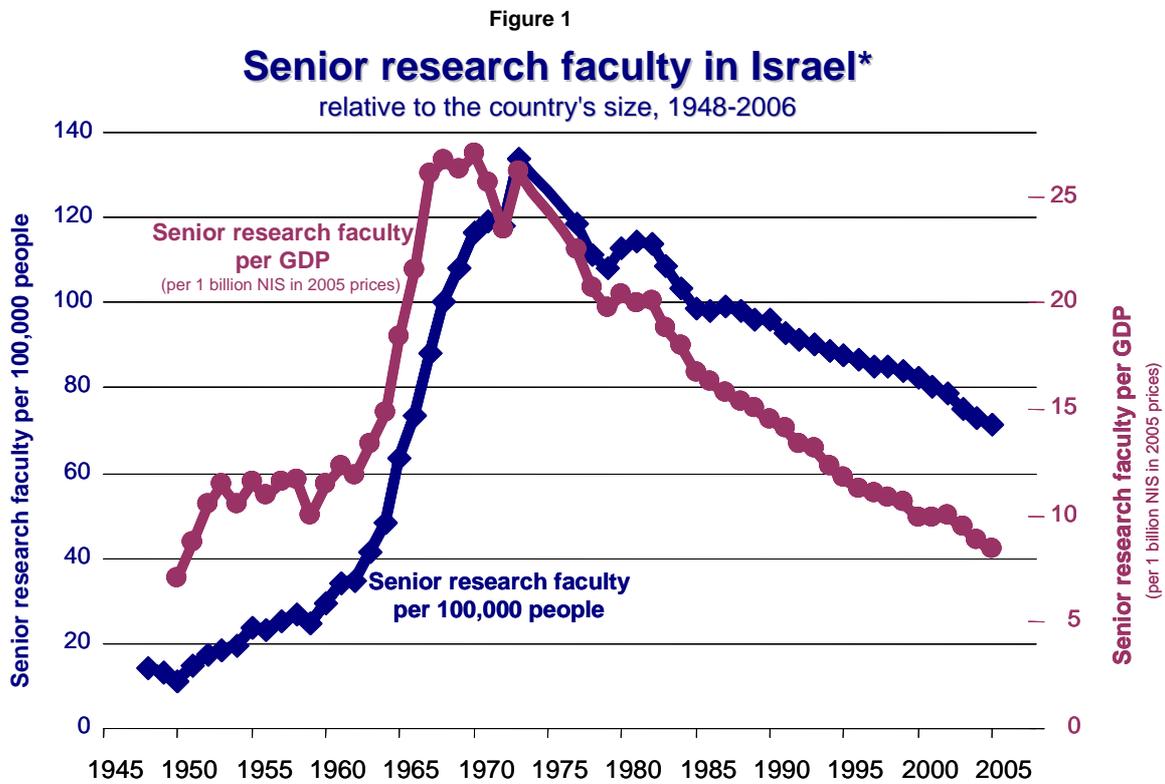
Israel's rate of economic growth declined precipitously in the 1970s and has never recovered. As noted in Ben-David and Papell (1998), the country experienced a statistically significant structural break in its growth path in 1973. The rate of economic growth per capita since 1973 not only fell below what it had been until 1973, it fell below the growth rate of most of the West: 1.8% per annum between 1973 and 2007 versus 2.1% for the OECD.² The country, which had been catching up with the leaders until the mid-seventies, began to fall farther and farther behind in relative terms. Incomes per capita vis-à-vis the United States returned to 59% in 2004 (the most recent year in the Heston, Summers and Aten (2006) data) – where they had been in the early sixties.

The change in national priorities lead not only to a relative decline in per capita incomes, in relation to leading developed countries, it was also reflected in a marked change

² Based on data from Israel's Central Bureau of Statistics and the OECD.

in direction with regard to higher education. By the end of the 1950s, a decade after the country's birth, the number of senior faculty numbered 24.8 for every 100,000 population. Though the country was still relatively poor, absorbing huge numbers of immigrants with only the clothes on their backs, fighting major wars and endless smaller skirmishes, it managed to find the wherewithal to increase the number of senior faculty per capita between 1959 and 1973 by a factor of 5, reaching 133.9 per 100,000 population (figure 1). Israel went from being a relatively poor country with 10 academic scholars per billion shekels GDP (in 2005 prices) in the 1950s, to a wealthier country with 26 scholars per billion shekels GDP by the late 60s. Just like the other major infrastructures being built from scratch at the time, higher education was considered an important infrastructure and it ranked high among the national priorities.

Evidence suggests that this conviction changed in the 1970s. Since then, the country has returned to rates of senior faculty per capita that existed in the mid-sixties. This turnaround is also reflected in the number of research professors per billion shekels GDP,



* Senior research faculty includes full professors, associate professors, senior lecturers and lecturers.

which is now back to where it was in the mid-1950s. Even if all of the senior faculty in the recently-opened non-research academic colleges are included, the country is still back to 1960 in terms of senior faculty relative to GDP.³

In fact, the absolute number of senior faculty positions in Israel's research universities barely changed since 1973. From a total of 4,389 then, it climbed to a peak of 5,178 in 2000 before settling at 4,937 in the 2005-06 academic year. In other words, while the country's population grew by 109%, the number of research faculty positions rose by just 12%. The overall number of such slots in Israeli academia – i.e. including relatively new non-research colleges – reached 5,730 in 2005-2006. This is just 31% more than the overall number in 1973.

Young researchers completing their PhDs during the past few decades were faced with a double whammy. First, the country failed to create sufficient positions in its public universities (there are no private research universities in Israel) to keep up with population growth. Second, the fact that it was a young country meant that a very large part of the positions were filled enbloc three decades ago by then-young faculty members, many of who have still not reached retirement and continue to fill the scarce positions.

The change in the composition of the faculty positions within Israel also played a role. Since 1973, the country's two premier universities were forced to *reduce* by 14% (the Hebrew University) and by 21% (Tel-Aviv University) the number of their senior faculty positions while the Technion – the Israeli institution closest in concept to MIT – was able to increase its staff by just 1 slot (from 682 to 683 positions). The government's goal may have been to divert – as opposed to simply adding – positions to smaller/younger and less renowned universities in an attempt to reduce the quality differences within Israeli academia. But in the process, it forced an entire generation of leading PhD graduates, many with offers from top American institutions, to agree to return to universities not even at the top of the

³ Israeli academia is officially divided into two groups: seven research universities and a number of much newer colleges that are officially categorized as non-research academic institutions, with teaching loads and limited access to research funds that reflect this designation. That said, the very limited number of slots in the research universities has lead young PhDs with research ability and potential to accept positions in the colleges rather than move abroad. Some of these individuals continue to do research despite the non-conducive employment conditions.

Israeli academic pyramid. Some accepted this extra cost and contributed toward an improvement in the newer universities. Others voted with their feet.

As shown in Figure 2, a comparison of faculty ages is telling. Though Israel's population is one of the youngest in the developed world,⁴ its senior faculty is one of the oldest. While 17% of the senior faculty in England, 25% in Australia and

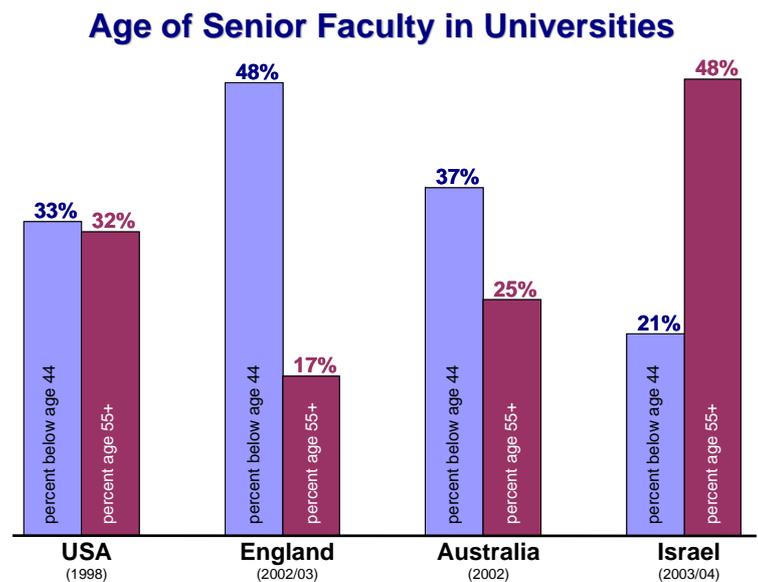
32% in the United States are aged 55 and up, nearly half of the Israeli senior faculty – 48% – are seniors not only in position, but in age as well. Alternatively, just 21% of the senior faculty in Israel is below age 44, compared with 48%, 37% and 33% in England, Australia and the USA, respectively.

While the lack of available positions has made it extremely difficult for young new researchers to return to Israel, a large and growing number of Israel's top researchers and scientists have emigrated from the country, primarily to the United States. As Gould and Moav (2007) show, the group with the highest rates of emigration from Israel are senior faculty members – more than doctors, engineers, or any other profession.

According to the OECD (2006), there were 82,905 foreign scholars in American universities in 2003. They represented 7.1% of the combined senior academic staff (lecturer and above) in American institutions of higher learning.

The largest group of foreign academics came from the U.K. As can be seen in Figure 3, these 3,117 scholars represented 2.1% of the senior academic faculty in the U.K. The 2,842 French scholars in America comprised 2.9% of the domestic French academia while the 2,317 Italians reflected 4.2% of Italy's academic staff.

Figure 2



⁴ The share of Israel's 65+ population in 2005 was 10.1% versus an average of 15.3% in the 24 high-income OECD countries (World Bank, 2007).

In general, the number of First World scholars in the U.S. ranged from 1.3% in Spain to 4.3% in the Netherlands. Canada was an outlier. The ratio of Canadian scholars in the States to those in Canada was 12.2%, though this is much more of a two-way street than in any of the other cases.

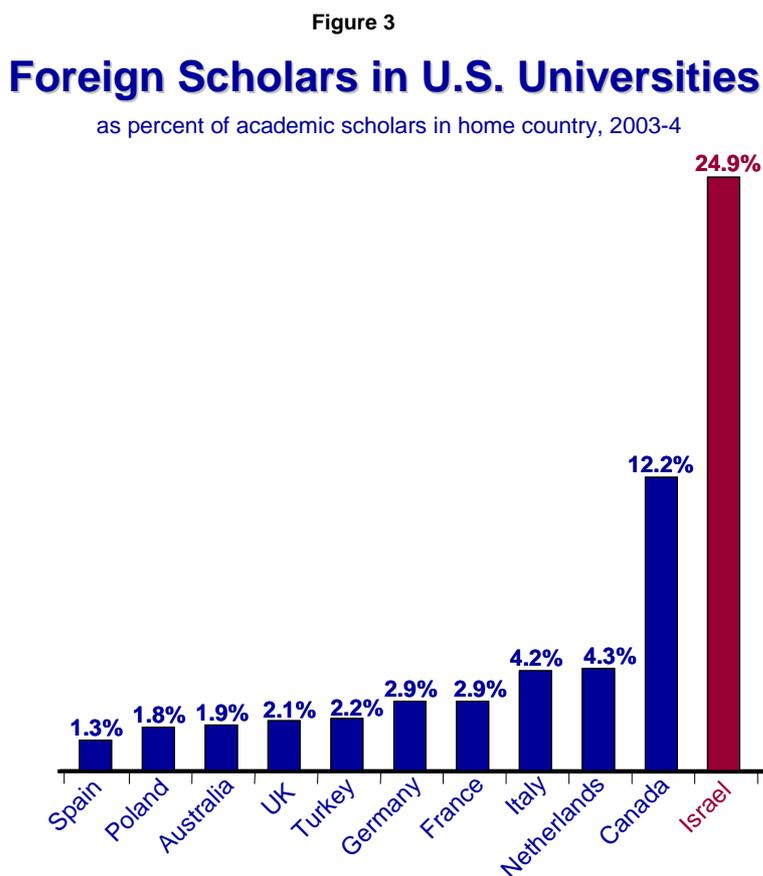
While Canada is an outlier, Israeli scholars in America are in a class by themselves. The 1,409 Israeli academics residing in the States in 2003-2004 represented 24.9% of the entire senior staff in Israel's academic institutions that year – twice the Canadian ratio and over 5 times the ratio in the other developed countries.

On the one hand, the Israeli academics in America consist of those who are on sabbatical or on leave, as is the case with professors from other countries. On the other hand, the official number of Israeli academics in the States does not include those Israelis who obtained American citizenship over the years and are no longer considered “foreign”.

The extraordinarily high number of professors from Israel who reside in the United States reflects a merging of two facts. First: the quality of Israeli academia is at a level that enables Israeli faculty to easily get absorbed in the States. The second fact: employment conditions in Israel, compared to the States, represent a large incentive for an outward exodus to America.

III. Israelis in the American Top 40

What are Israeli universities missing as a result of the near freeze in senior academic positions for the past three decades? An examination of five fields – physics, chemistry,



computer science, economics and philosophy – provides an indication of the caliber of those who left and of the relative magnitude of their loss.

These fields include some of the disciplines in which Israeli academia is considered to hold world-class scholars. In two of these fields, economics and chemistry, Israelis received 3 Nobel Prizes in recent years: Daniel Kahneman, 2002 prize in economics (he no longer lives in Israel), Aaron Ciechanover and Avram Hershko, 2004 prize in chemistry, and Robert Aumann, 2005 prize in economics.

The ISI Web of Knowledge (2007) ranks universities according to the number of academic citations that the work of their faculty received from January 1997 through June 2007. Since departments vary in size – and, as will be shown below, Israeli departments are considerably smaller than the top American departments – and because the ISI rankings are not in citations per department member, this comparison is not ideal. Nonetheless, it does provide some ballpark indications as to the academic level in 4 of the 5 fields (there is no ISI ranking for philosophy).

Among the top 150 institutions in chemistry, there are two Israeli universities: Hebrew and Weizmann. In economics, both Tel-Aviv and Hebrew are among the top 150. The four top 150 institutions in physics include Weizmann, Tel-Aviv, Technion and Hebrew while the top 150 in computer science include all of these four plus Ben-Gurion.

The examination is as follows. The American National Academy of Sciences (1995) rated the scholarly quality of program faculty in 41 different fields in American universities. It ranked each department according to the rating received by that department. The top 40 departments in each of the five fields list their faculty on departmental websites. The list of faculty compiled for this paper is from September-October 2007. The focus here is only on tenured and tenure-track faculty and excludes visitors, adjuncts, emeritus and others. The tenured or tenure-track Israelis were determined and corroborated via email with each department.

For the purposes of this study, Israelis are defined as those who grew up in Israel and/or received academic degrees in the country. It does not include Israeli citizens born and raised abroad, or even those born in Israel and raised elsewhere. The idea is to focus only on

those who had some form of physical attachment to the country and who could reasonably be expected to include a position in Israel as a possible career option.

Table 1 provides details on the size of the senior faculty

in each of the five fields in Israel and in the top 40 American departments. Each of the fields, except philosophy, is represented in each of the 7 major Israeli universities.⁵ In the States, Israeli faculty members have established a presence in the top departments in each field. As indicated in the table, a few of these scholars have joint appointments with Israeli universities. In the analysis that follows, those individuals with joint appointments will not be considered among the faculty in the American departments.

Of the five fields, the smallest departments, on average, are in philosophy and economics (Figure 4). The Israeli departments in these two fields number approximately 18 members in each. While the top 40 philosophy departments in the States are 12% larger on average, American departments of economics are roughly double the size of their Israeli counterparts.

Chemistry and computer science departments in Israel have just under 30 members each while the

Table 1
Israelis in Selected Academic Fields

In Israel and in top American Universities, 2007

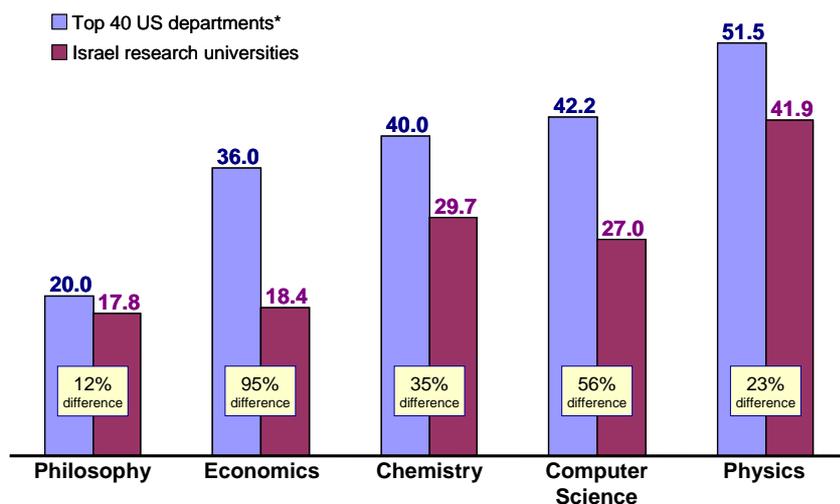
field	number of research departments in Israel	number of faculty members			
		in Israeli departments	in top 40 American departments		
			total	total	excluding those with positions in Israel
Physics	7	293	2,061	30	28
Chemistry	7	208	1,600	26	25
Computer Science	7	189	1,689	64	62
Economics	7	129	1,439	45	37
Philosophy	5	89	798	13	13

Chemistry and computer science departments in Israel have just under 30 members each while the

Figure 4

Average Size of Academic Departments, 2007

in United States and in Israel



* Top 40 departments in each field according to 1995 ranking by National Academy of Sciences

⁵ The two Israeli universities without a philosophy department are the Technion and the Weizmann Institute. The former focuses primarily on engineering and technology-related disciplines while the latter emphasizes science.

American departments in these two fields average 40 and 42 members respectively. The largest departments of the five, in both countries, are the physics departments, with an average faculty of 42 in Israel and 52 in the States.

The size differences in departments within disciplines between the two countries are non-trivial. To the extent that a critical mass of researchers is necessary to develop ideas at the levels generated by America's top research departments, then the Israeli departments would appear to be at a handicap.

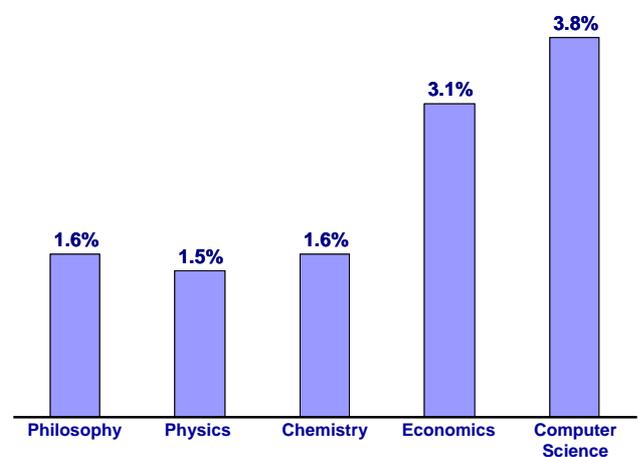
While, as figure 3 suggests, the number of Israeli scholars in the United States is very high in proportion to the size of the senior faculty in Israel, it is no more than a drop in the bucket – just 0.1% – when compared to the size of senior faculty in the States. This is not the case, however, in the top American research departments. There, the share of Israelis is substantially higher. In the top 40 departments in philosophy, physics and chemistry, Israelis account for about 1.5%-1.6% of the total senior faculty members (Figure 5). In Economics, 3.1% of the faculty in the American departments is Israeli. In computer science, the Israeli share rises to 3.8%.

The other comparison with figure 3 is probably the most important. With European scholars in the States ranging from 1.3% to 4.3% of the total number remaining at home, the European Commission (2003) has begun to raise concerns about the implications of the academic brain drain from its member countries.

Saint-Paul (2004) also focuses on the migration of skilled workers (not just academics) from Europe to the States and notes that the problem may be particularly acute for those in the high end of this group.

The number of Israeli physicists in just the top 40 American departments is one-tenth the entire number of physicists in Israeli research universities (Figure 6) – more than double the *overall* migration rate of the Netherlands, the

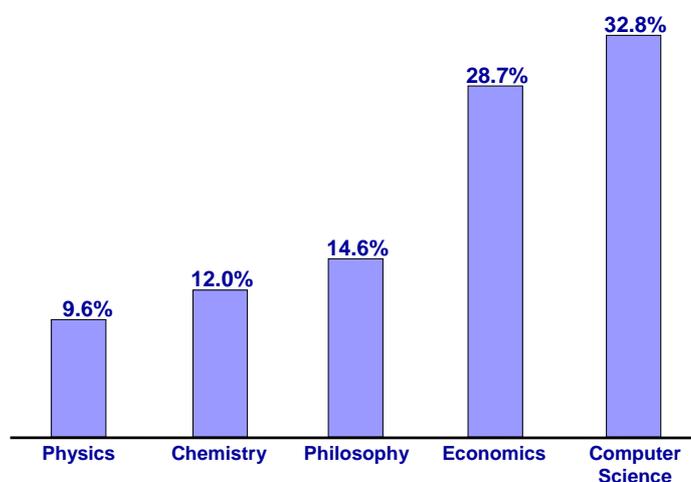
Figure 5
Israelis in top American departments, 2007*
share of Israelis in each department



* Top 40 departments in each field according to 1995 ranking by National Academy of Sciences

European country with the greatest rate of academic emigration to the States. The number of Israeli physicists in just the top 40 American departments is one-tenth the entire number of physicists in Israeli research universities. In addition to the Israeli physicists in top American academic departments, it is important to note that there are also a number (there is no way to accurately gauge this number) of leading Israeli physicists today in several important American national labs – both public and private – that account for a substantial part of US basic and applied research (not necessarily military-related).

Figure 6
Israelis in top American departments, 2007*
 as percent senior faculty in Israel, by field



The share of top Israeli chemists in the States accounts for one-eighth the entire discipline in Israel. The number of Israeli philosophers in top American departments accounts for 15% of the philosophers remaining in Israel.

While the emigration rate by top-end researchers in physics, chemistry and philosophy is very high, that rate is doubled by the economists. The number of top Israeli economists in the States is 29% of those still remaining in Israeli departments of economics. This particular case was analyzed in a separate paper (Ben-David, 2007).

The group with the greatest proportional representation in the top American departments is computer science. The number of Israelis in just the top 40 U.S. computer sciences departments represents a full third of the entire contingent remaining in Israel. Some of the leading American departments have no less than 5-6 Israelis each.

IV. Higher Education and Economic Growth

Why did they leave and what kind of a loss might it represent for Israel? Beginning with the latter question, one needs to understand the importance of universities in the economic growth process of nations. Sustained growth in output per capita is driven by

productivity advances, which in turn are largely influenced by innovation – domestic and foreign. Helpman (2003) examined the sources of the rise in total factor productivity in Israel in the 1970s and 1980s and found that “slightly more than half the rise in TFP can be attributed to R&D investment and the rest to a rise in the level of education.”

Israel has spent, in the past and in the present, a considerable amount on research and development. A recent comparison conducted by the country’s Central Bureau of Statistics shows that the ratio of civilian R&D to output equaled 4.4% in 2005, more than that of every other OECD country and more than twice the OECD average of 2.0%.

However, as Romer (2000) points out, it is not enough to fund private sector R&D while ignoring the need for universities to increase the supply of scientists and engineers. An excess demand for such high-skilled workers may lead primarily to higher wages in the R&D sector instead of to greater output.

Aghion, Boustany, Hoxby and Vandenbussche (2005), develop a multi-state endogenous growth model that shows how higher education becomes increasingly important in the growth process as the country nears the technological frontier. Countries that are farther behind concentrate primarily on imitation, which mainly requires physical capital and less-educated labor. The authors find that an emphasis on primary and secondary education is more growth-enhancing in these countries than is an emphasis on higher education.

However, as a country nears the technological frontier, it shifts from imitation activity toward innovation. It is in this context that higher education – or what the authors refer to as “high brow” education – which is oriented toward frontier research, becomes a more important source of productivity growth.

In an empirical examination of U.S. states, Aghion, Boustany, Hoxby and Vandenbussche (2005) find strong support for their hypothesis.⁶ Specifically, they find that increasing the budgets of research universities has a differential effect on the economic growth of a country. The more advanced the state of a country’s research – what the authors refer to as “at-the-frontier” – the greater the growth impact.

⁶ The model is tested on a panel comprising U.S. states and 26 birth cohorts from 1947 to 1972.

It is important to underline the difference between level and growth effects in this context. While the former represents a jump in the standard of living, a policy that can affect the latter leads to successive jumps in the standard of living – each higher than the increase that preceded it. To the extent that Israel might be considered “at-the-frontier”, the relative importance of investing in its system of higher education becomes magnified.

This is one of the important roles that universities play in the innovation process. But it is not the only one. The initial part of many an innovation process begins with publicly-funded research in academic or in non-academic non-profit institutions. As Nelson (1959) and Arrow (1962) originally pointed out, and as articulated more recently by Aghion, Dewatripont and Stein (2005), the existence of knowledge spillovers and imperfect protection of intellectual property rights implies that the initial developers of an idea are often unable to appropriate its full economic value. The result can manifest itself in private sector underinvestment in basic research – hence, the need for basic research to be subsidized by the government.

V. Higher Education Resources

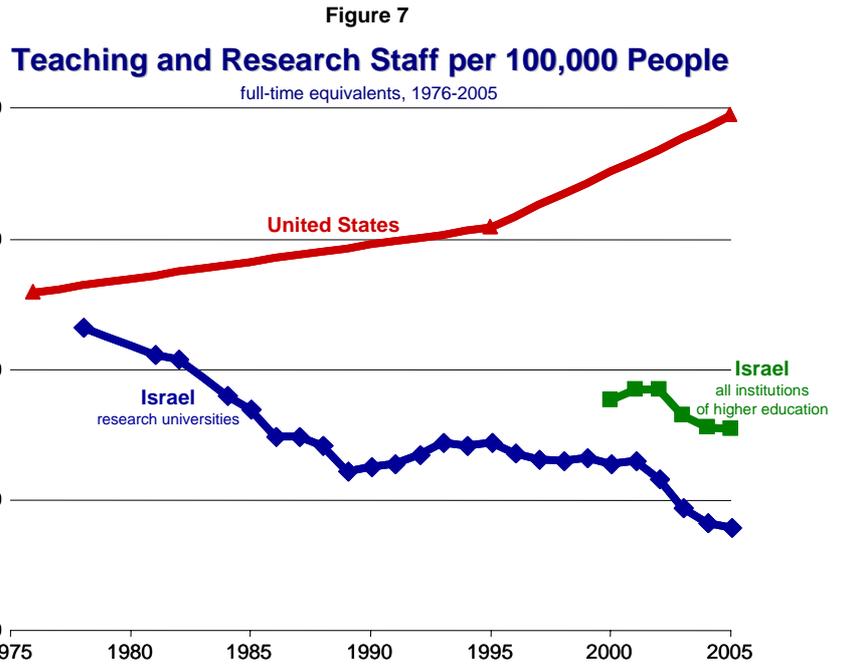
a. Academic Positions

In light of the importance that higher education plays on the living standards of a country, does Israel invest enough – and wisely – on its higher education? The fact that the number of senior faculty positions per capita has steadily declined over the past three decades may simply be a corrective response to what may have been overindulgence during the 1950s and 1960s. Also, it is possible that the decline in the number of positions per capita might reflect a similar process taking place abroad. However, neither one of these possibilities reflects reality.

A comparison with the United States is illustrative in this regard. The size of teaching and research staffs in higher education per 100,000 people is depicted in Figure 7. While the United States and Israel had roughly the same staff size per capita in the mid-seventies, the two countries followed distinctly divergent paths since then. The number of teaching and research personnel per 100,000 people in the States rose by 29% from 230 in 1976 to 297 in

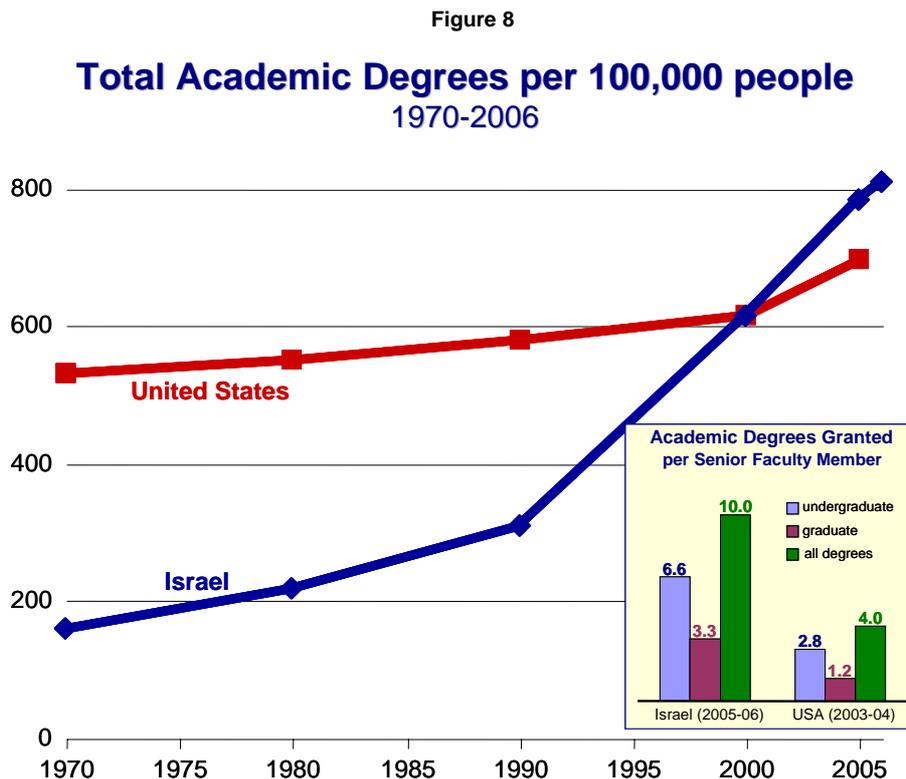
2005. Over a nearly identical period, this measure fell in Israel by 35%, from 216 in 1978 to 140 in 2005.

Even the addition of non-research academic institutions in recent years did little to change this overall picture. The number of teaching and research personal in all of Israel's institutions for higher learning was 40% lower than America's in 2005.



It is possible that the reduction of academic positions per capita in Israel might be justified by possible declines, or negligible increases, in the student population. But, as Figure 8 shows, nothing of the kind occurred.

In 1970, the number of academic degrees granted per 100,000 people in Israel was 173. That same year, three times as many degrees per 100,000 people (533) were granted in



the United States. Over the course of the next three and a half decades, the number of academic degrees per capita rose by 31% in the U.S., to 699 per 100,000 people in 2005. In Israel, the number of degrees per capita rose by 355% and surpassed the American mark by 13% in 2005.

The outcome of this can be seen in the insert to Figure 8. The number of undergraduate degrees conferred per senior faculty member in Israel is 2.4 times the number in the States. The ratio of graduate degrees to senior faculty in Israel is 2.8 times the U.S. ratio.

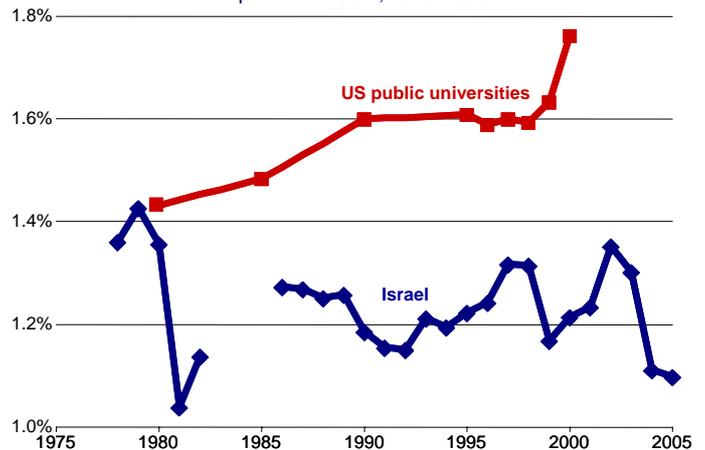
The combined implications of the upward trend in students and the downward trend in professors has a negative impact on the quality of teaching and a concurrent negative impact on the quality of research. As the number of students per faculty member increases, classes become more crowded and more outside teachers (who are not researchers and whose links to state-of-the-art findings are often minimal) are hired to teach the overflows.⁷ In addition, senior faculty in Israel have a relatively higher teaching load than is common in American research universities: 216 instruction hours per year – roughly two times the number of hours taught by their peers in Harvard, Chicago and Stanford, and about a third more than at American state universities (Burda, 2006). As a result, there is less time for class preparations, for grading papers and tests, and possibly the most important of all, less time for supervising students, particularly graduate students. The greater the teaching load, the less time remains for research – with all that this implies on the subsequent quality.

In addition to these static effects, there are possible dynamic effects as well. When these are the work conditions facing a leading researcher who has options abroad, particularly a newly minted PhD needing to make the conversion from student to full-time researcher within an unforgiving tenure clock, then it is not particularly surprising if some promising prospects decide to take their chances abroad. When top new researchers stop returning, the

⁷ In fact, many of these outside teachers begin as recent PhD graduates who are definitely up-to-date with frontier research and some are even researchers in their own right who are simply unable to penetrate the relatively closed universities for permanent slots. However, in light of the poor compensation and work conditions that the universities provide for these individuals, the majority are unable to support themselves as outside lecturers and eventually have to shift their primary work to non-academic positions, while continuing to supplement their incomes as external academic teachers.

current crop of students is missing out on what these researchers could have brought back with them. Instead, the ever-increasing need to look outside the senior academic staff for teachers whose primary job is non-academic means that the exposure of students to edge-of-the-envelope work is reduced even more. This, combined with less available supervision time may mean that the country's future crop of researchers is receiving a poorer training that may limit its chances to evolve into first-rate scientists. It may also mean that this potential future crop could lose a number of top prospects who may decide to altogether forgo the graduate path leading to an academic career.

Figure 9
Total University Revenue
as percent of GDP, 1978-2005

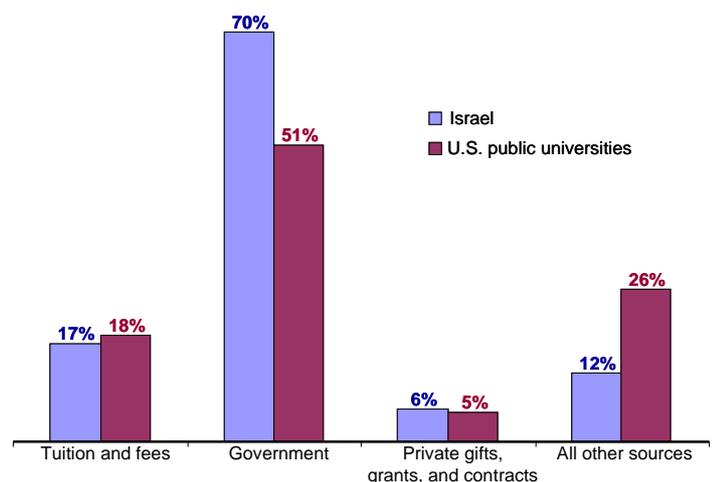


b. University Revenues

Total university revenue, as a percent of GDP, was fairly similar between Israel and the U.S. in 1980 (Figure 9): 1.36% in Israel, compared to 1.43% in public universities in the States (in fact, a year earlier, in 1979, this ratio equaled 1.43% in Israel as well). Over the subsequent decades, the ratio of university revenue to GDP changed for both countries, rising to 1.76% in the U.S. by 2000, and falling to 1.10% in Israel in 2005.

As can be seen in Figure 10, Israeli universities are much more dependent on government funding than are public universities in America. In 2000, the most recent year for which there exists comparable data, tuition and private contributions accounted for roughly the same share of revenues in both countries, less than a fifth for the former and just over 5% for the latter. On the other hand, over two thirds of the higher education income in Israel came from

Figure 10
Breakup of revenues in public universities, 2000

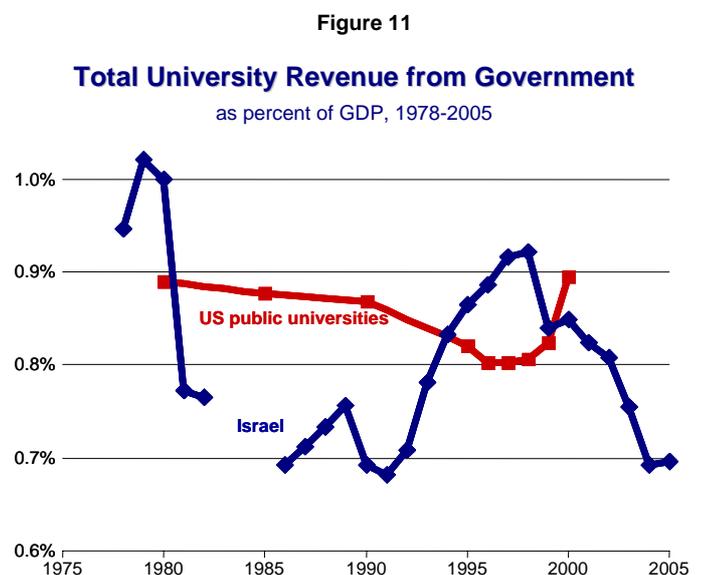


the government, compared to 51% in American public universities. The latter rely on a host of other revenue sources to increase their income (for example, hospitals). In lieu of these, the resultant increased dependency of universities in Israel on the state of the economy, and on the whims of political currents and undercurrents, has considerably reduced the degrees of freedom available to them in the realm of planning, growth and emphasis.

An indication of how problematical any long-term planning can be under these circumstances may be understood from a multi-year look at the data. When examined from a long-run perspective, the government component of public university revenues has been much more volatile in Israel than in the States. Averaging 63% between 1977 and 2005, it spent 7 years (in different periods) above 70% and 10 years below 60%, settling on the average of 63% in 2005. The government component of public American universities, on the other hand, exhibited a steady decline from 62% in 1980 to roughly 50% during each of the years in the latter half of the nineties.

These differences in government financing of universities between the two countries are brought into relief in Figure 11. From a peak of approximately 1% of GDP in the late seventies, revenues from the Israeli government fell to roughly 0.7% from the mid-eighties to the early nineties – and then rose to 0.9% by the end of the decade, only to return to 0.7% by 2005. By comparison to these fairly large fluctuations in Israel, the American ratio of government-sourced university income to GDP exhibited a moderate decline from 0.89% in 1980 to 0.80 in the mid-nineties, and then rebounded back to 0.89% by 2000.

Public spending per student on tertiary education, normalized by GDP per capita to account for differences in standards of living, exhibits considerable variance across countries. A comparison of Israel with the OECD in 2004 indicates that public spending per student places the country below 19 of the 26 OECD countries in Table 2 (UNESCO, 2006).



In their analysis of spending cuts in Israel’s higher education since 1998, Volansky and Limor (2006) state that public expenditure on academic research was reduced both directly and indirectly via a shifting of a greater portion of the remaining funds from research to teaching.

According to Volansky and Limor, the finance ministry cut the country’s higher education budget with the professed intent of increasing efficiency in the academic institutions. However, the authors point out that the spending cuts were not accompanied by any reform plan that would enable the universities to become more efficient. Instead, Volansky and Limor report that the reduced government financing was accompanied by heightened governmental involvement in the operation of the universities – which further limited the ability of these institutions to allocate the resources available to them.

Total revenue from tuition in Israel equaled 0.17% of GDP in 1977, not too different from the 0.18% in the United States in 1980 (Figure 12). In Israel however, this share fell to 0.06% by 1980. Since the mid-eighties, the share of tuition revenue from GDP in Israel remained fairly constant at around 0.20% - falling slightly in recent years – while in the United States, it has risen steadily since 1980, reaching 0.32 in 2000.

The decline over the past decade in the tuition-GDP ratio is due to a government decision to reduce tuition. The impact on university revenues from tuition was partially offset by a corresponding increase in student enrollment.

On the one hand, higher tuition increases the burden per student, and

Table 2

Public Spending on Tertiary Education in the OECD and Israel

Public expenditure per student as percent of GDP per capita, 2004

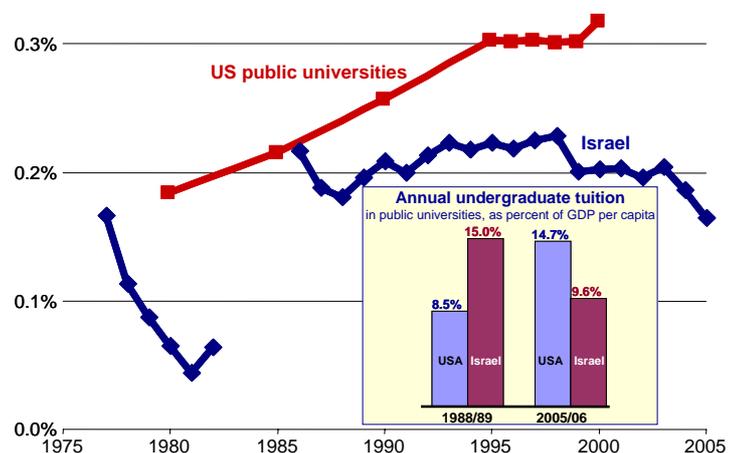
1	Denmark	74.6
2	Switzerland	59.9
3	Sweden	50.6
4	Turkey	50.3
5	Mexico	49.8
6	Norway	48.5
7	Austria	47.0
8	Netherlands	39.8
9	Belgium	38.6
10	Finland	38.1
11	Hungary	36.1
12	New Zealand	35.2
13	Iceland	32.5
14	Czech Rep	31.8
15	Slovak Rep	31.1
16	France	29.3
17	United Kingdom	28.8
18	Italy	27.4
19	Greece	26.8
20	Israel	26.6
21	Ireland	26.6
22	Portugal	26.0
23	United States	25.9
24	Spain	23.1
25	Australia	22.6
26	Poland	22.1
27	Japan	17.1

source: UNESCO (2006)

Figure 12

Revenue from Tuition

as percent of GDP, 1977-2005



increasing the likelihood that some of those qualified for higher education may opt out in the absence of sufficient scholarship and loan mechanisms. On the other hand, lowering tuition while at the same time reducing government outlays on higher education further complicates the financial problems of public universities.

In the insert to Figure 12, annual undergraduate tuition in public universities per student is normalized by GDP per capita. Over the span of one and a half decades, the two countries appear to have switched positions. In America, the share of tuition out of GDP per capita rose from 8.5% during the 1988/89 academic year to 14.7% in 2005/06. The situation in Israel was nearly the mirror image, with the tuition to GDP per capita ratio falling from 15% to 9.6%. Since undergraduate degrees take four years to complete in the States and three years in Israel, the total cost of an undergraduate public university education in the U.S. rose from 34% to 59% in terms of GDP per capita, while falling in Israel 45% to 29%.

c. Research Funding

A recently completed report by a governmental commission headed by a former finance minister, Avraham Shohat (2007), provides an international comparison on the level of academic research funding in Israel and in other countries. In the United States, where two-thirds of the scientific research is funded by the government (compared to 50% in Israel), Congress recently decided to double the research budgets of the NSF and other Federal funding agencies. Great Britain doubled its real expenditures on research over the past decade. Other examples of increased funding for academic research are provided for individual nations as well as the European Commission. The Shohat commission finds that, in contrast with all other developed countries, overall academic research funding in Israel has been reduced.

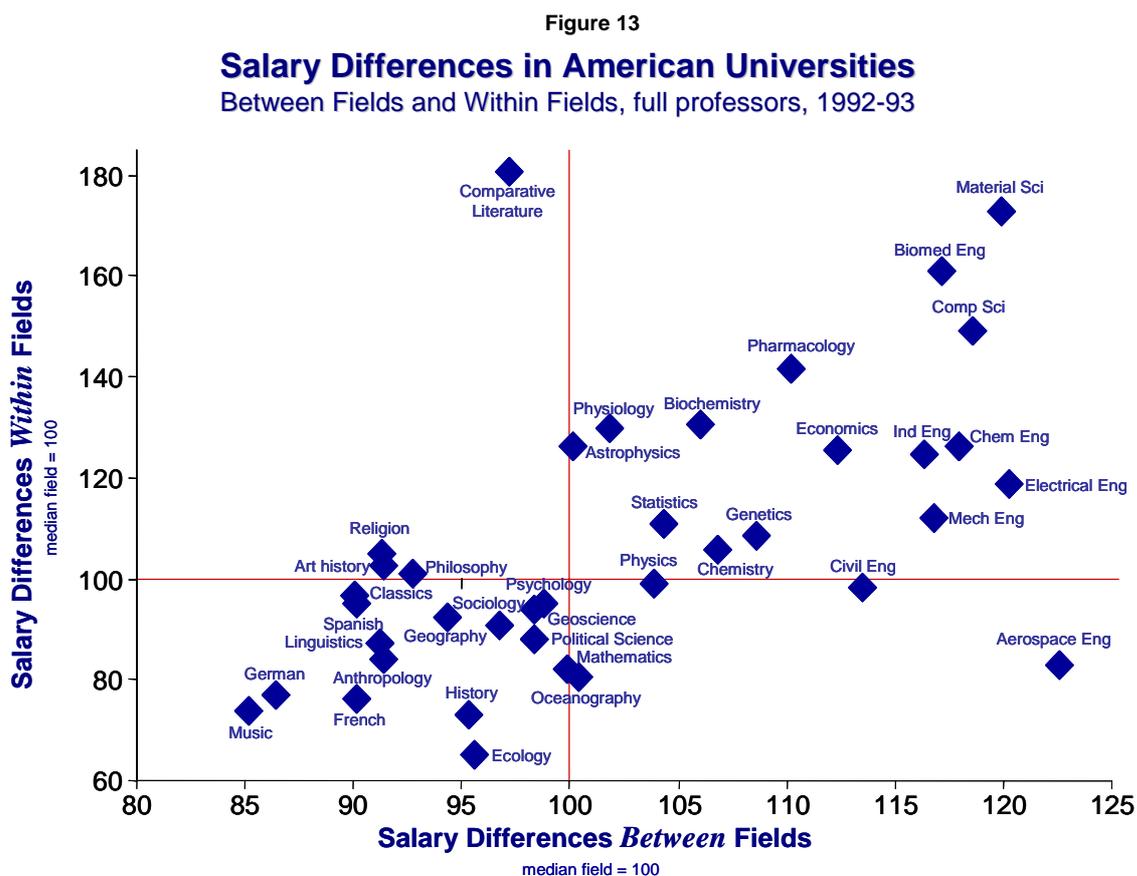
The report states that Israel's national expenditure on academic research equals 0.54% of GDP – which is less than the total amount spent by just one public American university

(among the top 12).⁸ Therefore, concludes the Shohat report, there is a need to substantially increase research budgets.

c. Academic Salaries

Salaries in Israel’s universities are determined according to a uniform pay scale. There is no distinction between universities nor between disciplines. Rank and seniority are the primary factors distinguishing between paychecks.⁹ There are a couple of major salary supplements that senior faculty are eligible to receive, provided they meet certain criteria.

American academic salaries, on the other hand, vary quite a bit (Figure 13). Ehrenberg, McGraw and Mrdjenovic (2006) show that over a decade ago, average salaries of full professors in the top-paying field (aerospace engineering) were 44% higher than in the lowest-paying field (music). There is no reason to assume that these difference fell



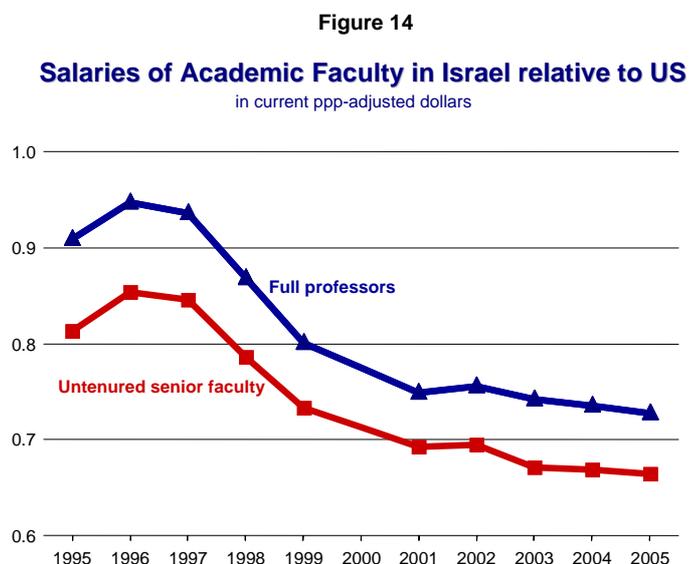
⁸ The report states that the official statistics on the national expenditure on scientific research are incorrect. Using what the commission terms as “the most liberal definition of research expenditures possible”, it determines that the national expenditure on academic research is not 0.72% of GDP, as the country’s official statistics list, but rather 0.54% of GDP.

substantially in recent years. Salary gaps within fields are large as well. Standard deviations in comparative literature were 177% greater than standard deviations in ecology. The large majority of fields with below-median salaries also exhibited below-median wage disparity. Conversely, nearly all of the fields with above-median salaries were characterized by above-median disparity.

Despite the high variance in academic salaries in the U.S., it is nonetheless insightful to see how average salary gaps between the two countries behaved since the mid-nineties. Taking into account the various wage supplements in Israel, the average salaries of full professors in Israel were 5-10% below the American average in the mid-nineties (Figure 14). Since then, the average salary of the Israeli professor fell to a level 27% below that of the American professor. The gap between untenured senior faculty (assistant professors in the States and lecturers in Israel) is even greater, and it too has increased over the past decade.

In light of the fact that a sizable share of Israel's academic brain drain is among leading researchers who hold positions in America's top departments, it is important to note that the Figure 14 income gaps between the two countries are far smaller than the actual gaps faced by these scholars who receive substantial compensation premiums that are above and beyond the average academic salaries in America.

Those fields in which the rate of Israeli migration to the top American schools was the heaviest were also fields that paid considerably higher salaries (Figure 15).⁹ Salaries in physics, chemistry and philosophy are within 10% of the American academic median. Average salaries in economics are 15% higher,

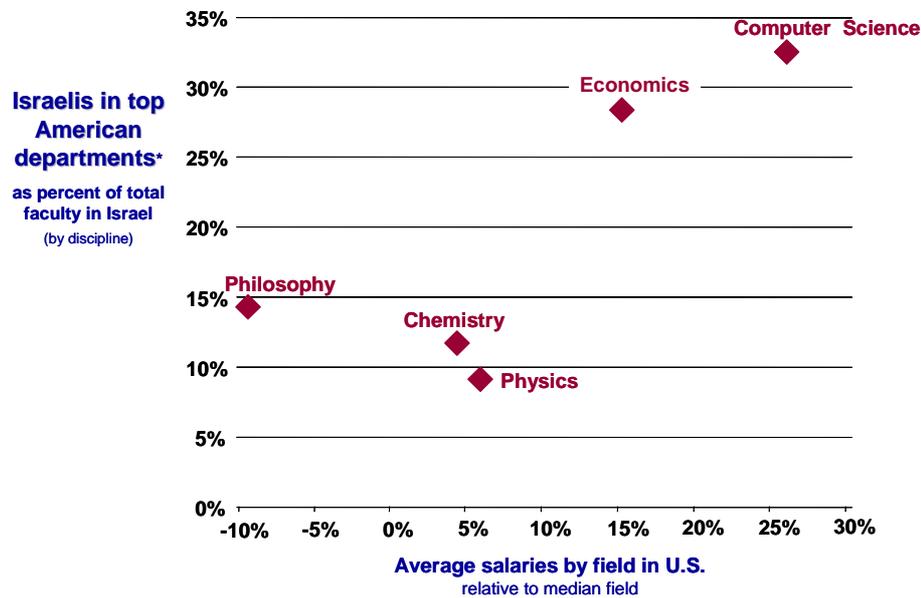


⁹ Ben-David (2007) provides more details on the composition of academic salaries in Israel.

¹⁰ In a corollary to this finding, Boyle (2007) shows that interdisciplinary salary gaps within the U.S. are related to research quality in New Zealand. The higher the salaries within an American academic discipline, the lower the quality of New Zealand research in that field. The better researchers have alternatives, and when these alternatives become relatively more attractive, be they in academia abroad or in the business sector at home, then the impact on academic research follows.

Figure 15

**Salary differences between fields
and emigration by top Israeli academics**



while salary disparity within the field is also considerably higher (by 46%) than the median standard deviation. This suggests that leading economists, who are presumably at the top end of the field's salary ladder, receive quite a bit more than the 15% difference between economics and the academic median.

This scenario is even more pronounced in computer science. Average salaries in the field are 26% greater than the academic median while income disparity within the field exceeds the academic median standard deviation by 60%. Hence, it is not too far-fetched to assume that the large number of Israeli computer scientists with positions in America's best departments are also probably receiving the highest salaries, compared to the four other groups.

The fact that there is a considerable brain drain in the three fields close to the median American salary would appear to indicate that salaries alone are an insufficient explanation. However, when salary differences become particularly large, then it is possible to see that emigration rates increase as well.

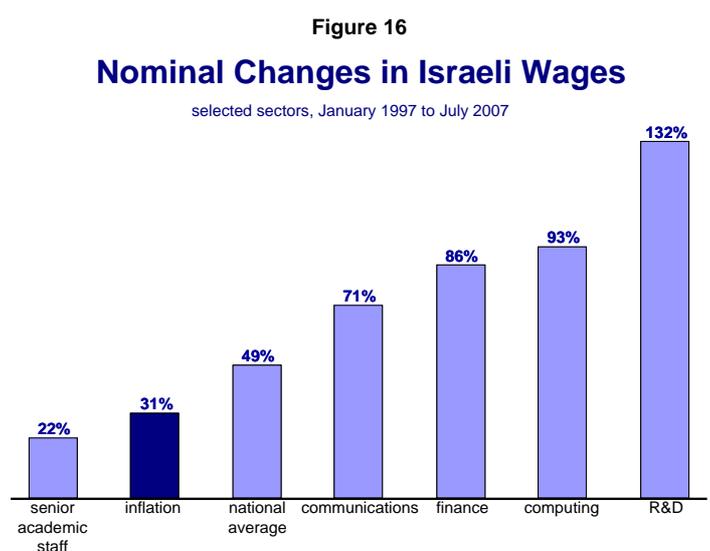
Growing salary gaps with academic institutions abroad are not the only factor drawing leading Israelis away from the country's universities. There has been a substantial erosion of

academic salaries in relation with what other sectors – private *and* public – within the country can offer.

Israel's universities are just one small segment in the vast public sector's tangled web of interrelated wage bargaining agreements – bound together in ways that are often asymmetrical. A relative improvement of one sector in relation with another sector is often less related to economic sense than to the relative ability of a given sector to cause considerable public pain by striking. On the one hand, raising academic faculty salaries in such an environment immediately causes demands for wage hikes in other sectors whose wage bargaining agreements tie them to university salaries. On the other hand, the substantial lack of support for university faculty in the public discourse – including a high level of media disdain – have contributed to a severe erosion in academic salaries versus many other public sectors.

The country's finance ministry, which ultimately decides how much each professor makes, is solely preoccupied with preventing a run on the public sector's purse. It has no mandate nor interest in strategic planning (this is reflected in other, non-academic, realms as well). As a result, it neither cares nor is ever held accountable for any of the long-term consequences of its policies.

The former head of the country's Central Bureau of Statistics, Joseph Yahav (2007) recently compiled a comparison of changes in the salaries of academics and some other fields (Figure 16).¹¹ These changes include the 1990s wage agreement to correct for past erosion in salaries. Not only was past erosion not eliminated, the wage bargaining agreements with the country's finance ministry allowed inflation to further erode these salaries, as can be seen in the figure.



¹¹ R&D in Yahav's data refers to the non-academic sector.

Over the course of the course of ten and a half years, from January 1997 to July 2007, average salaries in Israel rose by 49% (a real increase of 13%). Salaries in the communications sector rose by 71%, in finance by 86%, in computing by 93% and in research and development, nominal salaries more than doubled (they rose by 77% in real terms). Academic salaries, however, rose by just 22% – and actually fell in real terms.

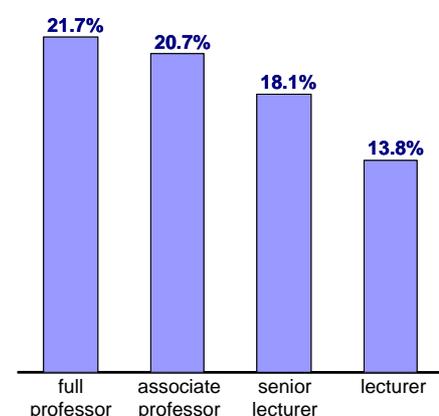
In other words, compensation in Israeli academia fell not only in comparison with American institutions of higher learning, it also declined in comparison with leading alternative fields within Israel. It even declined in comparison with the price of living.

The failure of the collective wage-bargaining agreements in preventing the erosion of academic wages is all the more ironic when it turns out that these agreements, which are based on the cornerstone of preventing any form of wage differentials across disciplines, turn out to be a major contributor to increasing the already large gaps that exist between the ranks.

For example, an agreement between the finance ministry and the academic union in the nineties intended at correcting an earlier erosion in salaries resulted in a 26% increase in salaries – but not for everyone. A detailed list of qualifications and criteria was devised between ministry officials and the union to determine how much of the 26% a faculty member could receive in any given year.

Figure 17 shows the actual salary increase received by each of the different ranks between 1998 and 2005. Full professors received 22% of the 26% possible while associate professors received 21% (keeping in mind that these are percent increases on salaries that are already distinct from one another on the basis of rank and seniority). The portion of the criteria that senior lecturers managed to meet yielded them only an 18% increase, while untenured lecturers did even more poorly and received just 14% – i.e. barely half of a salary increment officially designed to compensate for past erosion in faculty salaries over the years.

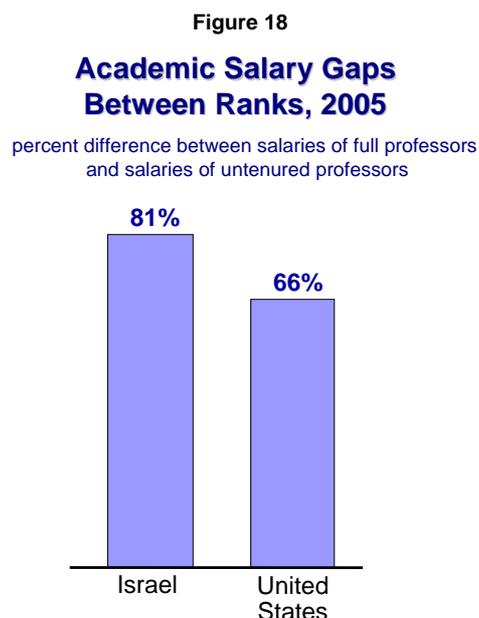
Figure 17
Academic Salary Supplements in Israel
as a proportion of base salaries, 1998-2005
(26% is the maximum increment)



The wage agreement resulted in a skewed compensation for salary erosion that heavily favored the higher academic ranks. While the declared purpose of the agreement was to compensate the senior faculty for salary erosion, the actual outcome suggests a very partial compensation – that became increasingly lower as the academic rank fell.

Another example of how pay scales determined by collective wage agreements compare to competitively determined wages: In America, where individual faculty members are afforded no unionized protection, full professors earned 66% more than the untenured senior faculty (Figure 18) in 2005. In Israel, the wage agreements agreed upon jointly by the union and the government created a gap of 81% between full professors and their untenured colleagues.

One could claim that the difference between the two countries may be due to there being just three ranks in the States compared with four ranks in Israel. While there can be little argument that the lowest ranks of untenured assistant professors and untenured lecturers – in the U.S. and in Israel, respectively – are comparable, one might argue that the two ranks of full and associate professors in the States span the same range as the three ranks of full professor, associate professor and senior lecturer in Israel. Hence, under this line of argument, the rank of associate professor in Israel may include, quality-wise, the lower level of full-professor in the States while the Israeli full professor compares with the higher end American full professor – and should therefore be compensated more in relative terms. However, even in this instance, had all else remained equal, the salary gap should have risen to 72% rather than 81%.¹²



¹² Suppose that salaries of the untenured ranks in both countries range from 100 to 140 and that the top salaries of full professors are 220 in both countries (in the States, there is no such upper bound, but this will be ignored here since non-truncation at the top only makes this example stronger). In this case, the difference of 80, between 220 and 140, represents the full range of salaries for tenured academics in the two countries. This range is divided into 2 equal parts in the States (one per rank) and into 3 equal parts in Israel. Assuming a uniform distribution of salaries within each rank, then average salaries of the untenured in both countries are 120 while the average salary of full professors in the States is 200 versus 207 in Israel. In other words, while

While it is not obvious that the two above outcomes which bias salaries so much in favor of full professors were actively sought, or even envisaged, by the union, this still does not change the fact that the wage agreements signed by the union resulted in skewed outcomes. In the name of generating greater equality between different disciplines and between different levels of academic excellence among union members, a wage structure was instituted that (a) created greater inequality between the more versus the less established in the profession, and (b) substantially eroded academic wages in general.

Another example of the academic priorities in Israel can be found in the allocation of teaching loads. In the States, it is common to provide young tenure-track faculty just out of graduate school with reduced teaching loads in order to assist them in making the conversion from students to full-fledged academic researchers in time to beat the tenure clock. In Israel, a different logic is in effect. While untenured faculty in Israel receive a 25% reduction in their teaching load – similar to the States – this reduction holds for the first two years. Full professors, on the other hand, are granted a 25% reduction in their teaching loads from the time that the rank is obtained until retirement.

When academic wages and work conditions are determined at the national level – by the finance ministry and the union representing senior faculty – there remain no degrees of freedom for those directly affected by these decisions at the departmental level. Department chairs cannot provide serious monetary incentives to promote and reward excellence, nor do they have any discretion in altering the individual teaching burdens.

The severe lack of academic positions, the relatively low and distorted salaries, a relatively rigid institutional structure and a number of other issues act as a backdrop for the unparalleled academic brain drain from Israel's universities.

VI. Why do they leave?

Israel has never been an easy country to live in. All-out wars and continued terrorism have taken a large human toll as well as a mental toll. Mandatory military conscription of

full professors in the States would earn 67% more in this example than untenured assistant professors, the gap would increase to 72% – rather than the actual 81% in Israel – in the country with 3 tenured ranks.

both sexes, annual reserve duty and an extraordinarily high defense budget that needs to be financed by taxes and smaller budgets in other areas all combine to create a particularly excessive tax – be it in actual taxes or in lost incomes – on those who shoulder the burden.

On the one hand, terrorism has been on the rise and the tax burden – which, as a share of GDP, is similar to western levels – is unevenly distributed. Evasion of military service and an underground economy below the tax radar have come to characterize increasing swaths of Israeli society, creating an even greater relative onus on those who do serve and do pay taxes.

On the other hand, the military intensity of the conflict has fallen, as far as all-out wars are concerned. The defense budget has declined precipitously from the heights that it held in the seventies and early eighties. And, in recent years, overall spending has been reduced and tax rates cut – both direct and indirect taxes. Israel's economy, while not growing as fast as it did in the past, or could in the present, is nonetheless much wealthier today and living standards in all income deciles reflect this.

Be these reasons for emigration as they may be, they are outside the realm of higher education policies that may reduce or increase whatever the underlying academic brain drain. The focus in this paper is to try and isolate policies that have contributed to the current situation and which might be able to turn things around.¹³

In light of the severe lack of official data at the departmental level, department heads in each of the disciplines examined here, from each of the 7 Israeli universities, were asked about their hiring experiences. Additional senior faculty members – some who currently, or in the past, hold or have held senior administrative positions – were also consulted.

A. Physics

The difficulty in recruiting new faculty from abroad depends on whether the scientists are academically younger or older. Salary gaps, differences in the level of research funding, family issues and so on combine to make it is extremely difficult to entice top senior faculty to return. While the majority of younger scientists express an interest in returning, this broad

¹³ Many of the problematic policies plaguing Israel's universities and their potential negative impact on the brain drain were already known a couple of decades ago, as highlighted then by Czapski (1989).

inclination to return does not always appear to be the case among the best of these, who are also able to find positions in leading American institutions. Of those top scientists planning to return, competition between Israeli universities is intense.

At this point, other problems sometimes emerge. When a person leaves a department or retires, the department loses his/her position and it returns to the university's provost (this is the case in all fields). In light of the overall reduction in slots in recent years, there is intense competition between departments for the few positions that a university may fill in any given year. Therefore, a decision to make an offer is contingent on the provost and dean agreeing that a particular department is more deserving of the scarce position than any of the other departments. The bureaucratic process can take months, often considerably longer than a candidate with other offers on the table can afford to wait.

Another problem, that is faced primarily by the experimentalists, is also joint with other disciplines requiring labs. In the Israeli research university environment, in which available funds are considerably smaller than those available to public universities in the States – not to mention private American universities – there is a serious difficulty in putting together sufficient resources to get such a lab up and running. Young scientists, whose future careers are greatly affected by the quality of these labs, often face a very difficult choice when having to decide whether or not to return.

Changes in department sizes over the past ten years have varied, from negligible changes in one physics department, to a 30% reduction in another. A number of reasons were provided for the decline: reduction in the allocation of new slots, sporadic departure of some senior people to overseas institutions, and a dearth of good candidates (though one dean reported that this latter aspect appears to have recently been reversing). As one department chairman stated, the “smaller number of highly qualified candidates [has led] to strong competition between Israeli universities, especially in recruiting experimental physicists.”

This latter issue raises an interesting point. In contrast with American departments, once a young scientist decides which department to join, the competition between Israeli departments often desists for the remainder of that person's career. Mobility tends to be only in the direction of departments abroad by those who are at the top of the field, or by those

who may not have received tenure at one of the leading Israeli universities. One might think that in light of the difficulty that the lower ranked Israeli departments have in competing with the higher ranked departments for young talent from abroad, there might emerge a secondary domestic market – as is the case in the United States – for those who may not have met the standards of the top departments, but still might conceivably meet the quality standards of others.

However, this does not appear to be the case. There is very little movement between departments in Israel. What is true for those not receiving tenure also holds with regard to tenured faculty. In the atmosphere of non-competition between Israel's universities, senior scholars wanting to improve salaries, get promoted sooner, or even skip steps in the promotion process, often have nowhere to turn inside the country and can only look abroad to change things.

There are mixed feelings reported by the deans and department chairs as to a possible drop in the quality of research students intent on pursuing an academic career. Some report negligible changes while others point “to a general decline in the quality of the new generation in physics.”

B. Chemistry

There is a considerable amount of similarity in what has transpired in the fields of physics and in chemistry. One difference, however, appears to be in the area of funding labs. In chemistry, private companies and donors sometimes step in to fill the funding void. However, these contributors are not interested in funding basic research. While applied academic research is important, the asymmetry that results between available funding of popular topics – such as nanotechnology and “green”-related projects – may lead to an overemphasis on the trendy and fashionable at the expense of the classic and basic. When that is where the money is, then top young scientists often choose to forego classic chemistry areas, with all that this entails regarding future generations of chemists who will be learning the basics from people who did not specialize in them.

Another problem associated with the creation of research laboratories is finding funding for the necessary support staff. This is a serious problem that is often met with short-term patchwork solutions. Individuals considering job offers need to consider not only what will be available upon their return, but what will be available tomorrow as well.

In economics, the best students who are interested in getting a PhD are strongly encouraged to study at leading American universities with the top researchers. The practice in chemistry – as well as in physics and other fields with laboratories – is to encourage the top students to remain in Israel for their doctorates and then to continue for a post-doc in the States. A major reason for this is the need for high quality – and relatively cheap – assistance in the laboratories. One can argue about where the students receive the best training and what course of study is in their best interests, but the bottom line is that stronger, more personal, ties are forged between PhD students and the faculty than is the case in economics. This may have an effect when decisions are later made regarding the possibility of return to Israel.

While there appears to be a supply of post-docs willing to return, the relatively small size of the departments in Israel and the very limited number of positions often makes it difficult to find a match between top available talent and current teaching needs. Unlike top American departments, Israeli departments – in chemistry and in other fields – often do not have the luxury of bringing someone who exhibits exceptional promise regardless of the area of specialization.

Chemistry department sizes in some universities have remained stable over the years while in others, there has been a drop of up to 20% in faculty slots during the past decade. Even in the case of this latter department, which experienced a 20% loss in positions (and is considered one of the best in the country), there was a considerable difficulty in enticing top candidates. The department remained with several positions unfilled.

One issue raised in the dialogue with the chemistry department heads – and raised in other fields as well – is that promotions have become extremely difficult to pass. The general feeling is that this heightened difficulty is due to cost-cutting by the universities as budget pressures have become increasingly difficult to bear. One university provost even admitted

as much in off-the-record discussions, stating that the budget crises leave the universities no option but to make promotions more difficult than in the past.

When this unstated – at least, formally – policy is combined with a lack of competition between Israeli universities, the primary safety valve available for the dissatisfied is the option of moving abroad. A corollary to this is that potential PhDs will avoid the increased difficulties of academic life and look for other alternatives. Young researchers abroad, who have already completed their studies, will hear and see the non-academic related reasons for making seemingly academic decisions – and they may subsequently decide to skip the process altogether, at least until they reach the rank of full professor abroad. By then however, it is generally too late to cut the roots that have taken hold and move back to Israel.

While there is money for chemistry labs – at least in certain areas – the relative erosion in salaries and work conditions compared to the private sector has resulted in a drop in the quality of the research students who choose the life of academic research. There are still top PhD candidates, but a greater portion of these is getting their doctorates with the intention of heading into the private sector rather than pursuing an academic life. This increases the possibility that the future chemistry departments will slide into a mediocrity trap.

C. Computer Science

In contrast to the situation in the two fields discussed above, computer science departments have not declined in size but have exhibited a very moderate increase compared to a decade ago. This is due primarily to Israel's substantial advances in high-tech-related fields. On the other hand, the actual increase in positions was even greater at the beginning of the decade, only to fall as a result of budget cuts since then. During this entire period, student applications have been rising and enrollment, to the extent that it has been allowed to rise, has increased as well.

While a number of prominent computer scientists have left Israel in recent years, there are no real attempts at recruiting senior researchers from abroad. Recruitment of young

researchers appears to vary across universities. One department head states that the main problem is not in finding top people but in the lack of positions available for making offers to those who are willing to return. But as a dean in a different university put it, “difficulties in recruiting young researchers coming from abroad are primarily due to (a) salaries, (b) employment for spouses, (c) competition from abroad, and (d) lack of funding for labs and engineers.”

As academic careers in the field of computer science have become less attractive compared to private-sector alternatives, there appears to be a decline in interest among top students in pursuing academic careers – with all that this implies on the overall research caliber of future faculty.

D. Philosophy

The brain drain issue in the field of philosophy appears to substantially differ from what is occurring in the other disciplines examined here. There is a large degree of unanimity among the department heads who feel there are many top young (up to the age of 40) researchers trying to return to Israel. However, a severe shortage in positions is preventing their hiring. Some departments have remained relatively unchanged in size while others have been reduced by up to 30% over the past decade.

One reason that so many of the top Israeli junior researchers abroad are applying for positions locally may be due to the fact that American academic salaries in this field are relatively low compared to the other fields (Figure 13), hence salary gaps between the United States and Israel – where there are no salary differences across fields – are much smaller. As one department head put it, many of the top individuals who have positions abroad chose to remain there only after trying to return to Israel and not being able to find jobs in the country.

While there does not appear to be a problem in attracting Israeli researchers from abroad, the issue of senior faculty deciding to leave for the States is virtually non-existent. Private sector alternatives for philosophers are also quite negligible compared to other disciplines. Hence, in contrast – once again – to the other fields, the department heads agreed that the quality of MA research students in philosophy has increased over time – though the

increased concern about being able to garner an academic position afterwards is affecting those who would like to continue their studies toward a doctorate.

E. Economics

Economics and philosophy appear to represent the two ends of the spectrum. While both fields exhibit a high rate of emigration, some of the prime reasons for the outflows are different in each. The number of academic positions in economics is not the main problem facing the departments. Razin (2007) writes that top newly-minted PhDs have simply stopped returning to Israel while several of the leading tenured academic economists have left – either to universities abroad or outside the academic sector within Israel.

As Razin states explicitly, and other leading Israeli economists note informally, the field may be reaching the precipice. Ben-David (2007), which focuses on the academic brain drain from Israel in economics, describes a decline in the number of faculty in the Tel-Aviv University economics department from roughly 25 in the mid-nineties to 18 in 2007, of whom only eight were full-time and did not hold positions elsewhere. The top two departments of economics, at Tel-Aviv and Hebrew Universities, have reached the point where there are so few faculty members in each, that the out-sourcing to non-academic lecturers – the current stop-gap measure for undergraduate courses – is insufficient for graduate studies. As a result, the graduate programs in the two departments will be united from the 2008-09 academic year, a situation not seen in Israeli academia since its inception.

Ben-David (2007) provides a number of reasons for the flight of the economists. A large and increasing wage gap between the top American departments and the Israeli ones, as well as domestic private sector alternatives in Israel, have combined to played a major role in the decisions by many to leave the country's universities and by others not to return. Bureaucratic rigidities and inconsistencies, not the least of which in areas of promotion, have also been an important source of discontent. As in the other disciplines, an institutionally-imposed lack of competition between local universities in this regard leaves many a frustrated economist with no alternative outlet other than looking outside the country for the recognition afforded by quicker advancement and better compensation.

The result is that while Israel was far and away the top-ranked country outside the United States in terms of academic citations in blue-ribbon economics journals per faculty member between 1971 and 1990 (Coupé, 2003), its universities no longer attract leading young economists from abroad and they are being increasingly abandoned by those who returned in the past.

F. Other fields

The disciplines examined above provide an idea of the extent of outward migration from Israel's universities, but they are by no means all-encompassing. The situation in finance departments is similar to that of the economics departments and possibly even worse. Chowers (2006), a former chairman of the political science department at Tel-Aviv University describes an exodus of about a third of his department within the span of just a few years.

The field of electrical engineering, for example, is one of the cornerstones of Israel's high-tech industry and R&D workforce. However, the fierce competition with American universities and research labs as well as with startup companies and Israeli R&D centers has led to what one dean refers to as a "chronic shortage in relevant faculty" that has led to 20% of the existing slots remaining unfilled while newer departments in other universities are unable to "take off". This is a field with so many opportunities available outside academia that its salaries are near the top of the American academic scale (Figure 13). Fewer Israeli students opt for PhDs than American students and they have more stumbling blocks on their way to an academic career (universities in the States recruit candidates right out of graduate school while Israeli universities recruit only post-docs). A large portion of those Israelis who do complete their PhDs in electrical engineering sub-fields end up in the private sector.

G. The Shohat Solution

As this paper was being completed, Israel's senior academic staff ended a three month strike, its longest ever. The collective wage agreement signed between the finance ministry

and the union representing the senior faculty is intended to reduce the erosion of recent years vis-à-vis inflation and some of the other sectors.

Several months before the strike began, the Shohat (2007) report was completed and presented to the government that appointed it. The Shohat commission recommended that the budget of Israel's public higher-education system be gradually increased over a span of 6 years, reaching a total increment of 2.475 billion shekels (what amounts to a 36% increase) by the end of the period. Of these additional revenues, 600 million shekels are to come from increased tuition.

Among the report's stated objectives, a 25% increase in students in the non-research colleges and a 5.7% increase in the number of research university students. The commission recommended that all of the universities' increased enrollment be solely in MA programs in science and engineering. The commission further recommended that the universities reduce the number of undergraduate students in the social sciences (shifting these to the non-research colleges) to enable an increase in the number of undergraduates in science and engineering at the research universities.

As far as faculty in the research universities, the report mentions the need to add 600 new tenured and tenure-track positions each year for a period extending beyond the 6 years covered by the report (no final target number or target student-faculty ratio is specified). However, all of the report's recommended budgetary increment is explicitly earmarked for specific uses: increased research grants, salary incentives and so on. The only part that clearly connects funding to additional positions is the recommended inclusion of 30 slots per year for new young faculty (at 1.7 million shekels per position, as specified in the report). Given the cost of hiring new faculty, the total size of the budgetary supplement recommended by the commission, and the stipulations on how that money is to be spent, it would appear that the commission did not intend for the proposed 600 additional positions per year to come from the recommended budgetary supplement.

But if the commission meant that the universities reorganize their existing budgets in order to increase academic staffs by over 10% a year, then it did not recommend a requisite reform of Israel's public university system that would enable such changes. No attempt was

made to seriously reduce the level of micromanagement from outside each university. In fact, the degree of detail in the report regarding how the universities are to spend the additional budgets suggests that increasing the degrees of freedom to operate at the institutional level – not to mention at the departmental level – was not an issue deemed important by the commission.

In the case of salary supplements, for example, it is not obvious that the recommended budgetary additions, to be spent in a manner that is still heavily tied to myriad bureaucratic stipulations required by the present form of collective wage agreements, will lead to a serious change in the willingness of top Israeli academics to return home or to decide to remain in Israel. Hardly any attempt was made to increase competition between the academic institutions, continuing to leave foreign universities and the domestic private sector as the only real alternatives for improvement by current faculty who are dissatisfied with their conditions of employment – salaries, research funds, promotions, teaching loads and so on.

Hence, since no recommendations were made to increase the universities' independence in the use of their budgets, it is far from clear how the commission expects these institutions to actually divert revenues toward the funding of the 600 new faculty positions a year that it recommended for the foreseeable future.

In any event, even with its limitations, six months have passed since the commission completed its report in mid-July and the writing of this paper. The government has yet to decide if and when it will even deliberate – let alone, come to a decision – on the commission's findings and recommendations.

VII. Policy Implications and Conclusion

It is ironic, to say the least, that a country with no natural resources, which has discovered the high-tech route to raising per capita incomes, could have adopted policies that have led to such a predicament. In the very fields necessary for fueling the minds that enter the high-tech market, Israel has allowed itself to lose an unparalleled proportion of its top researchers.

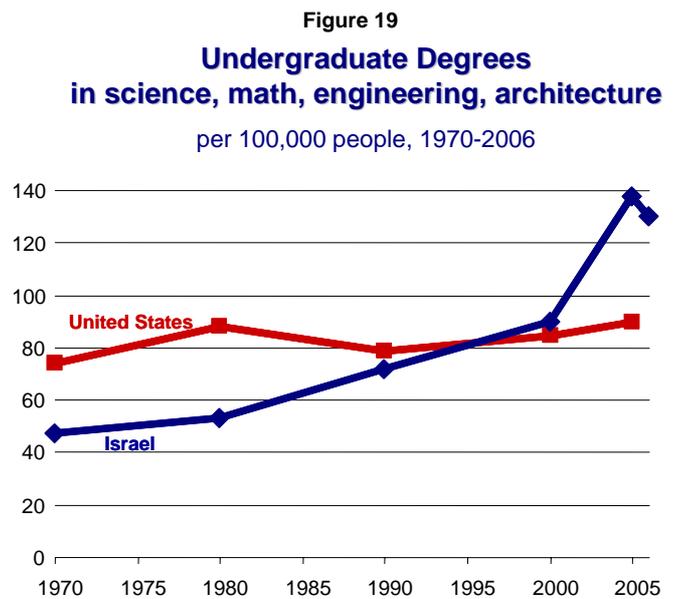
When put into perspective, this loss becomes even less fathomable. A country with a GDP of more than \$200 billion is unable to find the wherewithal to attract several hundred of its top minds (on the assumption that there are similar percentages in fields other than the five covered here) to its research universities.

There are four main reasons for the emigration of many of Israel's leading researchers from its universities: insufficient positions, relatively low salaries, inadequate funding of research laboratories and an archaic institutional organization that inhibits change, adaptation and competition. Not all fields are affected equally in each of these areas. However, these four problems represent the main thread tying together the most of the primary ills afflicting Israeli academia as a whole.

The number of research faculty positions in Israel is small according to two important measures. The number of senior faculty members available to teach and advise students is considerably lower in Israel than in the States. As shown in the Figure 8 insert, the student-faculty ratio is two and a half times higher in Israel than in America, and it has been rising steadily for decades. The situation among graduate students is even further out of line – compared to U.S. average and not just limited to the top research departments – than it is for undergraduates. The greater the need for faculty guidance and supervision, the poorer the academic education being provided in Israel.

The other main reason for increasing the number of research faculty positions has to do with the links between frontier research, innovation, productivity and economic growth. At the front end of this “food chain” is academic research – basic or otherwise. While this link in the chain is important for all countries intending to increase their standards of living, it is particularly important in countries lacking natural resources and economies of scale such as Israel. The primary hope that countries like this have in working their way up the income ladder is to invest in processes that yield new ideas which can be translated into new/better products that can be sold at a lower prices. The heavy investments in the past – in per capita as well as per GDP terms – in higher education paid off later as Israel became better-placed to take advantage of the future high-tech revolution.

Looking at what the future holds in store, including competition from burgeoning giants like China and India, Romer (2000) points to the increasingly important role that scientists and engineers will play and suggests policies that will increase their number. Figure 19 shows that the number of American undergraduate degrees in science, math, engineering and architecture per 100,000 population exhibited 20% increases and decreases over the past three and a half decades, beginning at 74 in 1970 and ending at 90 in 2005.



In Israel, this number rose steadily over the years, from 48 – far below the United States – in 1970 to slightly eclipsing America in 2000 and reaching 138 in 2005, with a slight drop in 2006. The question is, who will teach the future students in these fields and what will be their level of scholarship? The lack of sufficient academic positions in Israel’s research universities limits their ability to substantially increase enrollment while the increasing unattractiveness of these positions (compared to the alternatives in the States and in the private sector) may lead to a situation in which future professors will not be as able as today’s generation to draw students toward the frontiers of knowledge – with all that this implies about the subsequent ability of those students to then push that envelope forward on their own.

A parallel problem has to do with the relatively young age of the universities and the fact that several departments were created just a few decades ago. These departments hired enmasse a large number of people – which is not always synonymous with choosing only the best in each period – who have grown older together. In a country that only negligibly increased the number of research faculty positions over the three decades following the 1970s, this generation of faculty did not leave much room for new hiring. This problem does not end there. As the current cohort reaches retirement, the universities will once again be

faced with a disequilibrium between the large number of positions that will open up within a very short span of time and the more limited number of top candidates available during that span.

To prevent such massive ebbs and lows in the future, when old cohorts retire and new ones are hired, there is a need to increase the number of positions in each department by 1 or 2 slots each year – enabling sufficient hiring flexibility in years characterized by outlier crops of talent – so that in 30 years, the annual number of retirees will roughly equal the annual number of new hires. This will provide a relatively uniform age distribution that will provide the departments with diversity in knowledge, in classic versus topical subfields, in teaching and in academic administrative experience.

It should be noted that the emphasis here is on research institutions only and not on lower level (in terms of academic quality) colleges that focus primarily on teaching. These are important for reaching the many individuals unable to study at university levels. However, the emphasis needs to be on increasing the numbers of students academically capable of succeeding at the higher levels of research universities.¹⁴

This raises one key issue not addressed here, but absolutely vital if the country expects to reap the benefits of higher education: the state of Israel's primary and secondary education system. As the country neglected its higher education, it virtually destroyed its lower education. The country's schools fell from the heights of the western world in the sixties to become the worst by the nineties. International test scores in math, science and reading today place Israel's children at the bottom rung – with the lowest national averages and the highest educational gaps among OECD countries. If this educational funnel into higher education is not significantly improved and enlarged, a large portion of Israeli society will be left farther and farther behind. Not only does this put this segment of society at a severe disadvantage, it also greatly limits the country's utilization of existing natural abilities.

¹⁴ In the more technical and math-based fields, there has been a sharp and continuing drop in the level of incoming undergraduates who know less and less and require all kinds of ad hoc – and expensive – arrangements at the university level to make up for material not encountered in high school. This development coincides with increased public pressure on the universities to lower admission standards.

Should the increase in academic positions be channeled into new universities or into the enlargement of current ones? The social, economic and political reasons for creating new institutions needs to be balanced against the economies of scale from enlarging current departments in existing universities. That discussion is beyond the scope of this paper.

Research laboratories in the sciences require a much greater investment, if they are to attract and retain leading researchers – on the one hand – and if they are to produce frontier research and top PhD candidates who will carry the mantel onward. This entails not only direct funding for purchase of the equipment. It also means creating the conditions that will better utilize the scientists' time, i.e. providing sufficient funding for laboratory staffs.

The Shohat commission (2007) recommended a substantial increase in government funding of academic research. Additional funding should come from the private sector, be it from abroad or domestic, since many of the benefits will be subsequently translated into higher earnings for the private companies. While private funding diverts scientific activity from basic research in classic fields to more contemporary and possibly transient applied research areas, it is possible to “tax” these funds in order to subsidize the other areas. This can be done concurrently and it should also be formalized in contracts that guarantee the institutions and relevant faculty members with attractive shares of future earnings in the event that the research bears fruit.¹⁵

When the science departments will include a greater number of faculty, it will then be possible to house under one roof those who are doing the more trendy – but possibly more financially rewarding (in the short run sense) – research with those who focus on the basics and provide the scientific infrastructure that will enable future academics to be able to concentrate on future trends.

The twin issues of salaries and archaic institutional organization characterized by pervasive governmental central planning are related. The bureaucratic mindset that pervades all of Israel's public sector – including its universities – is one of extensive micromanagement by external bodies. Among other things, this environment mandates that

¹⁵ To a certain extent, this is the situation that exists today.

all salaries be determined on a universal scale that distinguishes primarily by rank and seniority rather by accomplishment and contribution. There is a need to separate between determination of priorities, allocation of budgets and oversight on the one hand, and the merging of accountability and the authority to implement on the other hand.¹⁶

This is not about inventing the wheel. It is about learning what works and what doesn't in universities abroad and reforming Israel's higher education framework along lines that have proven successful elsewhere. In the area of revenues, for example, the concept of out-of-state tuition in American universities, which works well in other countries too, can be applied extensively in Israel. There is no reason why Israeli universities could not create similar programs for foreign students on a much greater scale than is currently the practice in the country.

A comprehensive reform will cost a considerable amount of money. Can Israel afford to up its academic investment? Other than the more obvious response "can it afford not to?" a glance at the past is as instructive as it is illuminating. Even if it may not be possible to reach current American rates of senior faculty per capita, Israel should begin by returning to its own rates three and a half decades ago (see Figure 2).

Returning from the current 71 senior research faculty per 100,000 people to the level of 134 that the country had in 1973 means adding another 4,300 positions. As noted above, this should not be implemented in a one-time increase but done gradually so as to create a uniform age distribution in the steady state.

That year, 1973, Israel was a much poorer country, with an income per capita of just \$16,000 (in ppp-adjusted 2005 dollars), compared to \$28,000 in 2007. However, that poorer country allocated its resources such that it financed 26.1 senior research faculty positions for each billion shekels of output produced – compared to just 8.4 such slots per billion shekels output in 2005.

¹⁶ The issue of a very high dependency on government financing, combined with a lack of freedom that individual universities have in determining their budget allocations, is not unique to Israel's academia – though the subsequent problems that they have wrought have put the country's universities in a particularly problematic state. In his discussion of the severe crisis facing German universities, Burda (2006) cites this lethal combination as a primary contributor to the German predicament.

What this essentially comes down to is an issue of recalibrating national priorities – rethinking what the value of a higher education means for those who attain it and what the resultant knowledge spillovers mean for the economy and society in general.

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