A SCIENTOMETRIC LOOK AT SCHOLARLY COOPERATION BETWEEN EUROPE AND ISRAEL. AN EXPLORATIVE STUDY OF A CHANGING LANDSCAPE



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Introduction

The international flavor of Israeli research and development is changing. The United States have till recently been the largest foreign supporter of science in Israel. Lately, however, other international players have entered the field – notably the European Union through the Research Framework Programme.[1] The European Union is altering the Israeli S&T landscape – creating a new alliance.

There is evidence of a decrease in USA federal funding levels vis-à-vis Israeli basic research. Some argue that this funding decrease, combined with Israeli's entry into the European Union Research Framework Programme signals a shift in Israel's orientation away from the United States. Europe will soon reach parity (if not surpass) the USA with regard to the funding of research and the joint conduct of science in Israel.

Empirical evidence from the large multidisciplinary bibliographic database *Science Citation Index Expanded* (SCIE) of *Thomson Scientific* (Philadelphia, PA, USA) clearly supports this assertion. In what follows, we will have a closer look at the evolution of scientific collaboration between Israel and the US, the European Union and Israel's most important partners in scientific research. The analysis is based on the three years 1991, 1998 and 2005 to the study the evolution during the fifteen-year period 1991-2005. In order to maintain continuity and to avoid possible biases caused by publications in 2005 from the new member countries joining the European Union in 2004, we restrict the analysis on the EU15 for the full period 1991-2005.

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Methods and results

Although scientific collaboration cannot always be depicted by co-authorship in an adequate manner (e.g., *Katz* and *Martin*, 1973), joint publications are one of the most tangible and well documented forms of collaboration in research. Above all, international collaboration, which is usually well acknowledged in the published literature, is a good indicator of co-operation at this level (*Glänzel* and *Schubert*, 2004).

A first look at the publication data reveals a strong increase of Israel's international cooperativity. Israel increased publication output according to the SCIE by about two thirds in the period 1991-2005 but the number of internationally co-authored papers has more than doubled in the same time. Thus, Israel's share of internationally co-authored papers in the sciences grew from 31.8% in 1991 to 38.8% in 1998 and finally to 41.9% in 2005. With regard to authorship statistics, the percent of papers published by Israeli researchers and co-authored with US authors, that is, the share of US-Israeli co-operation in all internationally co-authored publications of Israel has indeed gone down. The share of EU15 collaboration in all Israeli 'international' papers, on the other hand, has considerably grown. This trend is presented in Figure 1. Nevertheless, with more than 50% of all international papers of Israel, the United States is still Israel's most important partner. These results are in line with the calculations prepared for the United States-Israel Educational Foundation (USIEF) by Gideon Czapski[2] (Hebrew University in Jerusalem, HUJI) on the basis of the *Science Citation Index* (SCI) database (Thomson Scientific, Philadelphia, PA, USA). A further look reveals that among the European countries Germany, France, UK, Italy and the Netherlands are presently Israel's most important partners in Europe. The evolution of their contribution to Israel's international co-publications can be found in Table 1. Only those countries, which are contributing with at least 5% to all international co-publications of Israel, are presented here.

Table 1 Evolution of the share of international collaboration of Israel's most important partners in all Israeli co-publications in 1991, 1998 and 2005

Country	1991	1998	2005
USA	64.3%	55.1%	53.2%
Germany	12.2%	16.1%	15.2%
France	6.8%	9.0%	10.6%
UK	6.5%	9.4%	9.5%
Italy	2.4%	5.9%	7.4%
Canada	6.0%	6.8%	6.7%
Netherlands	1.8%	4.0%	5.3%

Of course, the question arises of in how far this trend mirrors the decline in the overall percentage of the US output in world total in scientific articles that has already been reported in several European studies (e.g., REIST-2, REIST-3). The share of the US output was shrinking from 35.6% in 1991 to 30.5% in 2005 (cf. *Glänzel* et al., 2007). The decline in the relative prominence of the US as a scientific partner for Israel as measured by article coauthorship may to a certain extent be explained by a decline in the relative prominence of the US in the world science overall. Taking into account that also the EU15 is losing weight in the world total since about the Millennium change, mirroring the relative decline of the USA and Japan (*Glänzel* et al., 2007), and intensification of EU-Israel co-operation has continued after 1998, this global

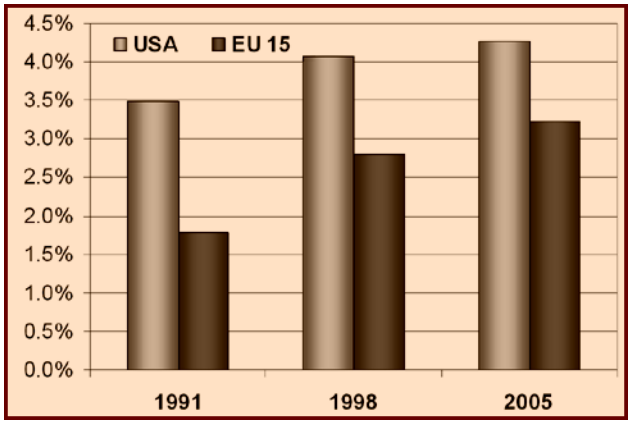


Figure 1 The evolution of the share of US and EU co-authorship in all Israeli SCIE-publications with nonIsraeli co-authors

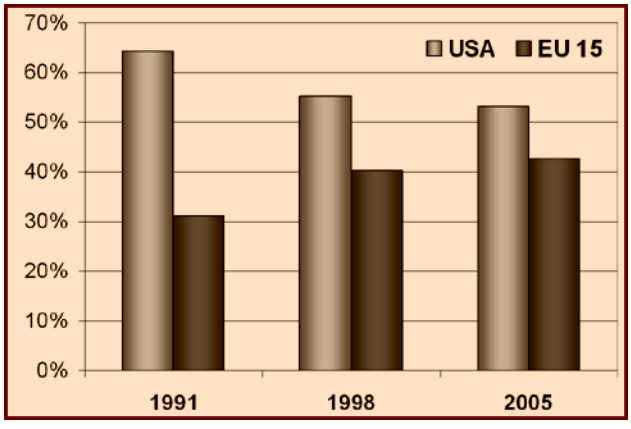


Figure 2 The evolution of the strength of Israel's co-authorship links with US and EU according to Salton's measure

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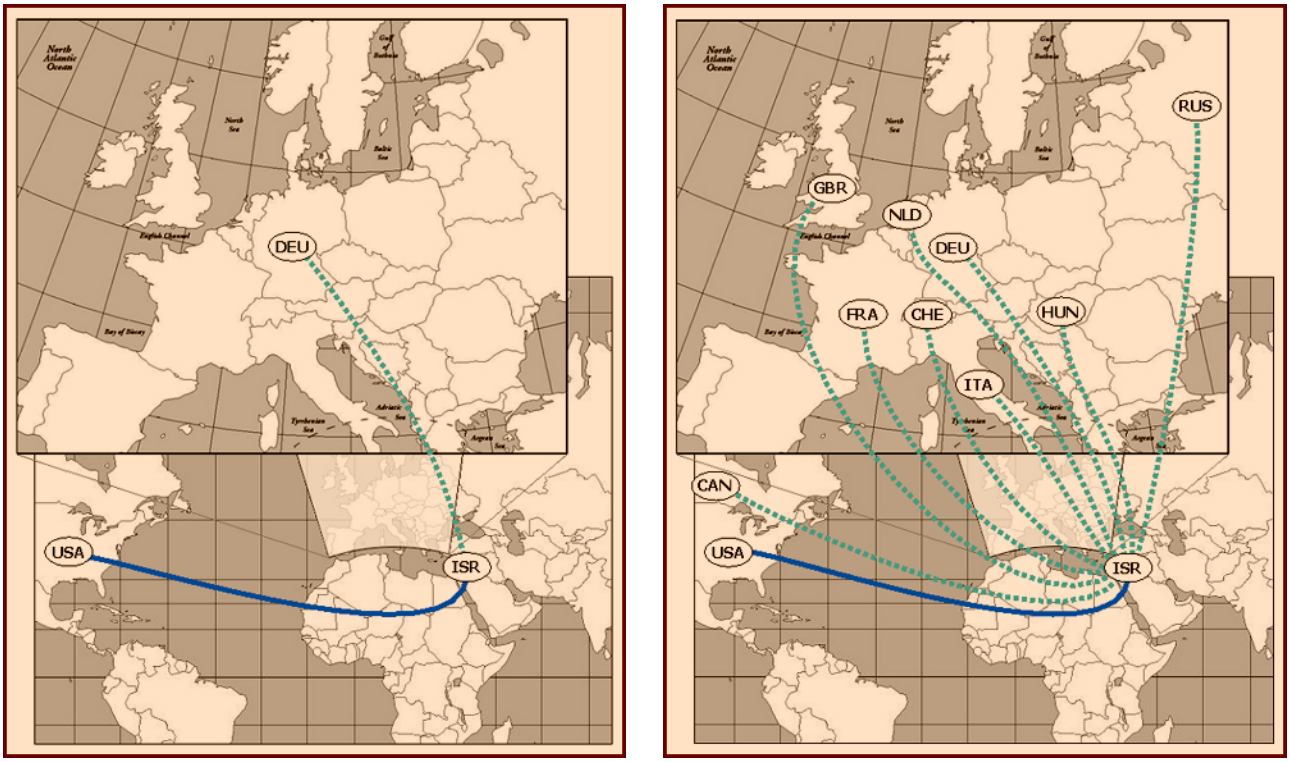


Figure 3 Co-authorship map for Israel in all fields combined in 1991(left) and 2005 (right) based on Salton's measure (dotted line ≥1.0%, solid line ≥2.5%, thick line ≥5.0%)

trend cannot explain all aspects of the evolution of bilateral relations alone. Thus, the 'weight' of the US might be lessening because the 'weight' of others like China, Brazil, Taiwan, Korea, India and Turkey is rising, but this phenomenon presently holds to a lesser extent for the EU15, too (*Zhou* and *Leydesdorff*, 2006, *Glänzel* et al., 2007). Although changes in national publication output might not have an immediate effect on bilateral relations, they do influence the strength of bilateral co-publication links.

We use Salton's (cosine) measure as an indicator of international collaboration strength. This measure is defined as the number of joint publications divided by the square root of the product of the number (i.e., the geometric mean) of total publication outputs of the corresponding pair of countries (cf. *Glänzel*, 2001). Consequently, the strength of a bilateral co-operation might change even if the share of bilateral papers in the output of one of the countries is unchanged but that of the other one increases or decreases. Thus, Figure 2 supplements Figure 1 by taking into account the publication dynamics of Israel's partners, as well. According to the Salton measure, the strength of co-operation link with the US is still increasing, however, to a lesser extent than that with the EU. The change of scholarly co-operation between Israel and Europe can best be visualized by 'scientopograhical' maps. Figure 3 presents Israel's most important scientific co-operation partners in the world in 1991 and 2005. We have used three different thresholds 1.0%, 2.5% and 5.0% to visualise the intensity of co-operation. The strength of 5% is however not reached by any link. The growing number of medium strong links substantiates the increasing role of Europe as Israel's partner in scientific research.

Conclusions

The emergence of the European Framework Programmes has resulted in more co-operation between European countries among themselves and with others (see, e.g., REIST-2, REIST-3). This holds for Israel, Greece, and other countries that were focused on the US but have since widened their co-operation net, and this has included increases within Europe. The increase in collaboration has been documented in the above-mentioned European studies.

In future papers (*Zimmerman* et al., 2007) we will also include citation analysis in order to measure the reception of the results of joint Israel-EU research by the world's scientific community as well as technology transfer

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agreements and patent data to broaden the scope of the study. Furthermore, we will discuss the Israeli culture/model of research and innovation financing (e.g. entrepreneurship, venture capital and Office of the Chief Scientist programs) and how this might serve as a model for Europe, given the Lisbon Agenda aimed at promoting economic growth, fostering competitiveness and stimulating job creation.

Acknowledgement

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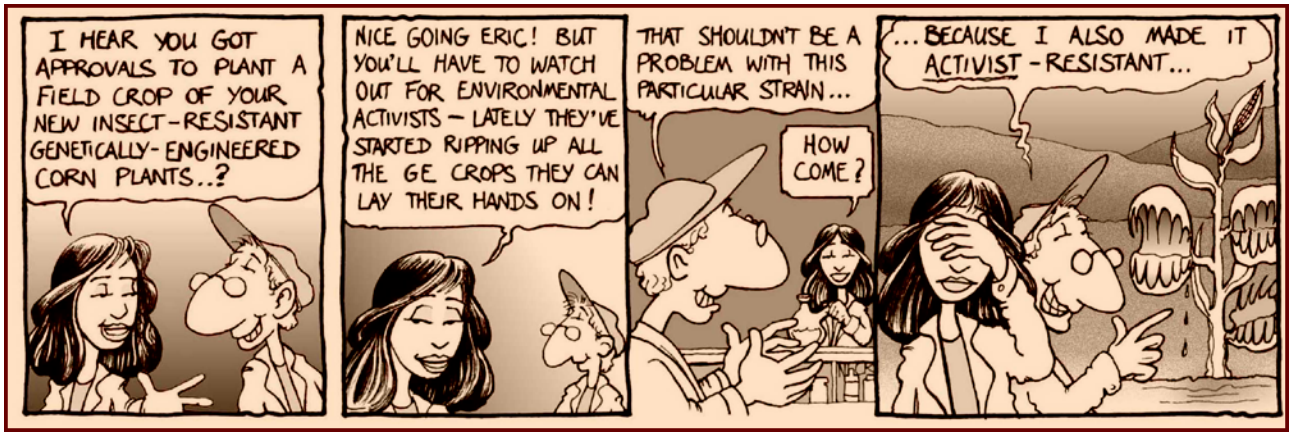
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Footnotes

[1] Israel has been an associate Member state of the Framework Programs since mid-way through the FP4; we are now in FP7.

[2] Presented at a Fulbright Israel workshop, Herzliya, 2005.

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