The disciplines of national wealth

Sir — Your leading article "Strategy needs disciplines" urges institutes and industries representing specific disciplines to sharpen their lobbying skills in the keen competition for funds[1]. The way a country spreads its research effort across disciplines is indeed not innocent and can be gauged from its publications. A 'publication pattern' can even become a useful yardstick for comparing the scientific competitiveness of economies of different size.

Figure 1 shows a 'world' publication pattern based on the average output of the 48 most prolific countries in 18 scientific disciplines from 1981 to 1992 (a total of 6.58 million articles, proceedings, reviews and notes; calculated from data from the Institute of Scientific Information (ISI)). (The ISI database has separate entries for the Federal and Democratic Republics of Germany for the years 1981–91 and subdivides the United Kingdom into regions — England, Scotland, Wales and Northern Ireland.) In Figure 2, the further a country lies from the centre of the spiral, the more its publication pattern differs from this average pattern and the more priority it gives to specific disciplines.

England was closest to the centre, confirming the evenness of its scientific effort already noted by Sir Robert May[2]. Close on its heels were other West European countries (Federal Republic of Germany, France, The Netherlands, Belgium, Switzerland and Italy), the United States, Israel and Canada.

This top-ten ranking does not correspond to output over the same period[3,4] because Japan (no. 3 in output), India (no. 9) and Australia (no. 10) lie further afield, but it does include all the G7 countries (the world's largest economies) except Japan. Japan and Australia were abreast of non-G7 European countries and well ahead of the Asian 'dragons' which specialized more heavily.

In Southern Europe, Italy helped to set the average pattern more than Spain, Turkey or Greece, whereas in Northern Europe the Scandinavian countries formed a closely knit cluster.

In Eastern Europe, an avant-garde of two countries (German Democratic Republic and Hungary) displayed the most Western-style publication patterns although, in terms of output, they were superseded by the Soviet Union (no. 4) and Poland (no. 18, on a par with East Germany).

We have already noted the regional variations in UK publication patterns which reflect research council spending in England, Wales and Scotland[5].

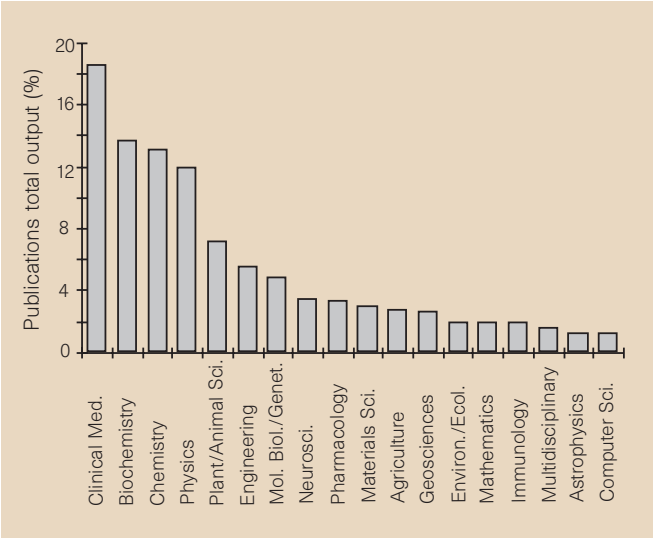

Figure 1 **Average publication pattern of the 48 countries. (The disciplines are defined by ISI on the basis of journals.)**

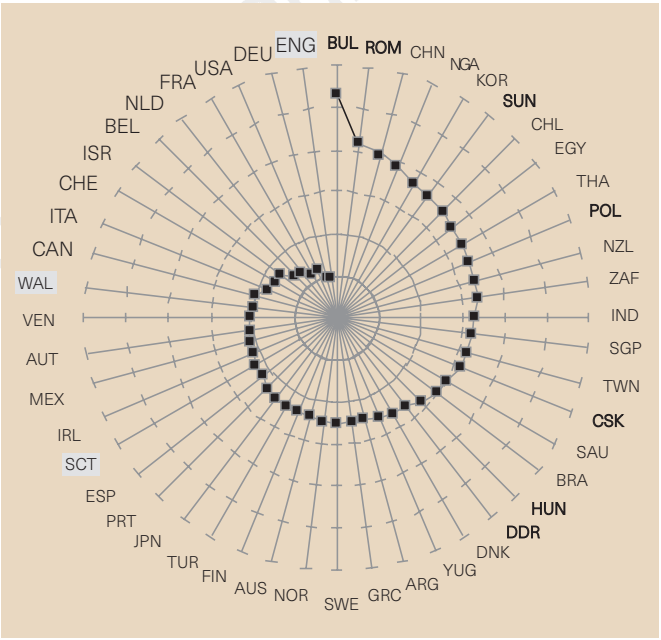

Figure 2 **Chi-squared distances (log_{10} scale) of the publication patterns of the 48 countries with the highest publication outputs from the centre of gravity of the multidimensional system (48 countries × 18 disciplines). Two intervals along the radial axis are equal to 1.0. International Standards Organization country codes except for England (ENG), Wales (WAL) and Scotland (SCT). Figure adapted from ref. 3.**

An average pattern depends on financial and human resources that permit research on many fronts. Excentric countries in Figure 2 may be small, suffer from an overall lack of resources motivating heavy specialization, give prominence to research based on natural resources, be governed by *dirigiste* political regimes and so on, but may also gain a leading edge in specific disciplines to become fierce competitors. Indeed, is evenness of a country's effort "a good thing"?[2]

Distances from the centre of gravity calculated on a yearly basis between 1981 and 1992 indicate that most countries are converging toward the centre of the spiral, that is, conforming to a world model[6,7]. Might this increasing lack of diversity among countries not reflect increasing publication of 'me-too' science rather than original research? Disciplines do not advance at the same speed and, at a specific time, it may be of strategic importance to be more productive in some disciplines than others.

The full data on which these comments are based are published in refs 2–7.

Tiiu Ojasoo
69 Alexandra Road,
Kew, Surrey TW9 2BT, UK
e-mail : ojasoo@tribunes.com

1. *Nature* **390,** 101 (1997).
2. May, R. M. *Science* **275,** 793–796 (1997).
3. Miquel, J. F., Ojasoo, T., Okubo, Y., Paul, A. & Doré, J. C. *Scientometrics* **33,** 149–167 (1995).
4. Doré, J. C., Ojasoo, T., Okubo, Y., Durand, T., Dudognon, G. & Miquel, J. F. *JASIS* **47,** 588–602 (1996).
5. Ojasoo, T., Doré, J. C. & Miquel, J. F. *Nature* **370,** 172 (1994).
6. Ojasoo, T. Science Tribune, http://www.tribunes.com/tribune/art96/ojas1.htm.
7. Okubo, Y., Doré, J. C., Ojasoo, T. & Miquel, J. F. *Scientometrics* (in the press).