THE DELINEATION OF SPECIALTIES IN TERMS OF JOURNALS USING THE DYNAMIC JOURNAL SET OF THE SCI

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In order to attribute journals to specialties in a dynamic journal set by using aggregated journal-journal citations derived from the Science Citation Index, it is necessary to complement the multi-variate analysis of this data with a time-series perspective. This calls for a more analytical approach to the problem of choice among the many possible parameters for clustering. Changes in the disciplinary structure of science are tracked by using the differences among the multi-variate analyses for the various years. It is impossible to attribute change systematically to structure, noise, or deviance if these uncertainties are not clearly defined ex ante. The study discusses the various choices which have to be made, in both conceptual and methodological terms. In addition to hierarchies among journals, one has to assume heterarchy among journal groups (and their centroids). For comprehensive mapping, a concept of "macro-journals" as representations of a density of points in the multi-dimensional space is defined. Empirical results indicate the feasibility of dynamic journal-journal mapping by using these methods.

The science policy problem

In the 1950s, when the National Science Foundation was first setting up its statistical systems for tracking scientific and technical manpower and other resources of the US, a category scheme for scientific disciplines was developed. It used seven broad disciplinary categories: physical sciences, life sciences, environmental sciences, mathematics, engineering, psychology, and social sciences. Within the broad categories, several different sets of "detailed fields of science" are used. "Detailed fields" are occasionally added, but almost never dropped. Major structural shifts in the sciences are introduced into this scheme only with difficulty; take for example the emergence of the computer sciences, a shift which was reflected in some statistical series in the mid-1960s and in other in the mid-1970s.
Has the disciplinary structure of the sciences been as static over the last three decades as the stability of this set of categories would suggest? We suspect not. While differentiation within fields may be the major form of structural change in the sciences, there are other common forms as well, such as, merging among existing areas and the emergence of new fields between the boundaries of existing disciplines. Furthermore, the interdependence of the broad disciplinary categories themselves may be changing. Each of these types of change may be the result of policy actions (for instance, when needs identified through the policy process pose practical problems which bring the sciences together in new ways). In turn, these changes may suggest policy responses: the reorganization of funding programs or the establishment of coordinating mechanisms, for example. For these reasons, it would be of value to depict them.

Journals as indicators of disciplinary organization

In relation to the scientific literature, disciplines are currently operationalized in terms of journal sets. For example, the number of papers in physics is approximated by the number that appear in journals which have been classified as physics journals, plus an estimate based on the proportion of physics articles in some multidisciplinary journals (e.g. Science). The classification of journals was originally done in the early 1970s through a combination of subjective assignment and the examination of cross-citation patterns among journals.\(^1\) The journal sets, at aggregate and disciplinary levels, are held constant over the years to facilitate calculation of all of the literature-based indicator series.*

The contrast between the dynamic structure of science and these constant journal sets presents specific problems for bibliometric indicators of national participation in the various fields of science. It has been shown for science in the aggregate that over time, the shares of literature produced by certain major scientific countries decline when the journal set is held constant, but increases when the full dynamic journal set of the Science Citation Index is used.\(^2\)\(^-\)\(^5\).\(^6\)\(^-\)\(^9\) (The full SCI shows a turnover rate in journals of about 7 percent annually.) One possible cause of this discrepancy is that the older journals which are maintained in the constant journal set may gradually

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*In 1981, the 1973-journal set was expanded, and the new journals were categorized according to the existing scheme; but there was no major overhaul of the placement of journals into categories nor of the categories themselves. Many relative indicators (e.g. citation ratios) have about the same value in the 1973 and 1981 journal sets, although publication counts are obviously much larger in the 1981 set.