The Transition from ''National'' to ''Transnational'' Model and Related Measures of Countries' Performance

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The transition from a national science model in which the national language is used for publications and other communications, to a transnational model in which a single international language (English) is used and the market is dominated by Anglo-Saxon publishers, has continued in recent decades. The transition was still in progress for some countries and disciplines throughout the period examined here (1981–1992). The transition process was analyzed in terms of the Science Citation Index database, first by assessing direct manifestations through specific indicators, and then by checking increases in performance by considering transition as a global process. The number of publications and citations followed the expected trend, whereas changes in impact appear to have been governed by non-transition factors.

Introduction

The power structure in science is largely shaped by U.S. scientific and editorial actors. The dominant configuration is English-language publication in American (and British) journals. This situation has intensified in recent years, and the former national practices, i.e., use of the native language and an important role for domestic publishers, have been severely challenged. The last decade has witnessed an almost complete transition from (partially) ''national'' models to the ''transnational'' model.[1]

This transition may be considered as constituting a set of individual and collective behaviors and strategies among scientists seeking to improve their visibility in the mainstream of scientific activity, through the use of appropriate publication and communication channels. In Science Citation Index (SCI) from Institute for Scientific Information (ISI), an efficient transition is expected to involve three related transfers of publication activity from low to high visibility channels:

- The transfer (A) of publication activity from non-SCI to SCI journals (i.e., toward internationally visible journals);
- the transfer (B) of publication activity from non-English to English language (respectively, from non-U.S./U.K. to U.S./U.K. publishers) with respect to SCI journals;
- the transfer (C) from low-impact to high impact journals, mostly within the mainstream of English-language SCI journals (published in U.S./U.K. journals).

Hence, all things being equal, an efficient transition is likely to have a positive influence on classical performances indicators, namely the publication volume and the citation volume measured in the SCI (through transfer A), and the impact ratios (mainly through transfers B and C). If this is confirmed, it will raise questions concerning the interpretation of performance evolutions for countries involved in transition processes. Does an improvement in such indicators merely show that the transition process is continuing and translating basically unchanged capabilities into visible performances? Or does it reveal, beyond the publication/communication strategy, a real change in scientific efficiency? To what extent is it possible to distinguish between scientific capabilities and the ability to communicate in international networks, especially over the long run?

The data in this article are derived from an extract of the ISI-SCI database (plus ISI-COMPUMATH) covering the period 1981 to 1992, plus a separate ISI file for the country of origin of journals. The following points are considered:

- An assessment of the transition process at country and discipline levels using simple specific indicators of transition: Change in the language employed and in the publishing channels, namely the national origin of journals (part 1);

[1] The word transnational is used rather than international to emphasize the dissymmetry of the process.

- a preliminary consideration of the relationship between these specific transition indicators and the classical performance indicators likely to be influenced by the transition process (part 2).

We will conclude by a short discussion about the interpretation of the performance evolutions in connection with the transition process.

1. Countries/Disciplines between the ''National'' and ''Transnational'' Model: A Transition in Completion Process (1982–1991)

1.1. The Context

We will here limit ourselves to the particular source SCI (+ COMPUMATH) which can give only a partial account of transition; changes concerning journals not included in the SCI are ignored. This approach is debatable, but SCI journal set cannot be dismissed, as such, as a symbol of international visibility. The study was limited to a few countries with a non-English native language which cannot be neglected in the SCI, plus the United States and the United Kingdom, and was carried out with respect to disciplines. Original data and country aggregations at the document level were obtained from ISI, whereas other aggregations, as well as counting and assignment options such as discipline definition,[2] are from the Observatoire des Sciences et des Techniques (OST). The changes between 1981 and 1992 were determined by using 3-year averages centered on 1982 and 1991.

Several indicators characterize the transition. Shifts in language or publishers' structure are not performances as such (even though corresponding strategies aim to reinforce impact performance) and may be considered as fairly specific indicators of the transition strategy.[3] In part 1, we attempt to describe the transition process using these indicators as markers of transition.

The national model does not basically characterize low-level scientific countries, but rather ''second-best'' cores, such as large European countries, Russia,[4] or Japan, which have strong scientific traditions, allowing the survival of domestic publishing companies and of the national language as a vehicle for scientific information, within the national frontiers and sometimes in a regional area of linguistic and cultural influence.

The domination of the English language in science is an amplified image of a general phenomenon, the development of this language as the planetary lingua franca. In science, as in many other areas, this is the result of a natural conjunction of a strong central power (U.S. and U.K. as dominant forces) and the need for a common medium of expression. English is the natural choice, a process reinforced by feedback effects: ''Success brings success,'' for example through citation processes. The dominant role of English-speaking countries in scientific production may be held as the key phenomenon. Stankus, Schlessinger & Schlessinger (1981) noted that before World War II, German, and, to a lesser degree, French were considered as very important by American scientists who studied these languages. Conversely, after World War II, they consider research in their own country to be increasingly dominant, and are persuaded that ''most if not all substantive research output would eventually be available in the English language.''p. 55[5] Thus many U.S. scientists, and librarians, gradually tend to ignore foreign-language papers. One result is that increasing pressure is applied to non-U.S. authors to publish in English if they wish to be read by the largest scientific community.

While the transition to almost-all-English is not completed, the language problem, from the point of view of English-speaking countries, is chiefly viewed in terms of ''language barrier'' for accessing non-English literature. Chan (1976) reviewing academic surveys on the subject of language (particularly Wood, 1967, and Hutchins, Pargeter, & Saunders, 1971) concludes that the rates of the actual use of foreign language literature is low at this time. However, there is no convincing evidence that this was attributable to poor mastery of foreign languages (which were generally practiced in reverse order to their scientific importance which is: 1. Russian, 2. German, and 3. French) rather than to any inferiority of this foreign-language literature (Chan notes that an evaluation of the intrinsic importance of this material is needed).

Large (1983) combined his own results on online databases (BIOSIS, CASEARCH, MEDLINE, INSPEC) with

[2] Computing options: Counts on four types of documents (articles, reviews, notes, letters); fractional counting on authors' addresses and fractional assignment of journals to subject category classes; aggregation of subject category classes into disciplines. These options are further detailed at RASCI 1995 workshop (Zitt & Teixeira, 1996). All indicators are based on the SCI/COMPUMATH combination, with 3-years averaging. The citations used here were those received by the cited document over a short period (2 years, including the year of publication) in order to synchronize publications and citations within the span of a decade. Short-term impacts have some drawbacks, e.g., sensitivity to the within-country immediacy of citations (''citation time anomaly''; Stevens & Narin, 1989), and the position of fast-citing fields in the activity profile of the country.

[3] Other markers could be used, for instance indicators of the degree of internationalization of countries' publications (such as the proportion of international co-authorship). A rich literature is devoted to the internationalization of science and patterns of international collaboration (see, for instance, Luukkonen, Tijssen, Persson, & Silversten, 1993; Miquel & Okubo, 1994). This point is not addressed here.

[4] In this text, Russia stands for Community of Independent States (CIS).

[5] In the same line, a recent survey of cross-mobility of scientists U.S.A.–France (Martin-Rovet & Carlson, 1995, p. 188) reports that a majority of American scientists visiting France feel that American science is generally indifferent to foreign science (to its detriment), indifference which ''stems from the assumption that all of the best work in a field will eventually come to the United States if it is not already being done there, or will appear in scientific journals based in the United States.''

the previous studies on abstracts by Wood (1967) and Ellen (1979), in order to provide an overview of language usages between 1965 and 1980 for most disciplines. Publications in physics and biology were already two-thirds in English in 1965, and in chemistry and medicine, about half. In the last three disciplines, English had gained about 12 points over the previous 15 years. German and French had declined, whereas Russian held on firmly as the second language in science and increased its audience. In recent years, Japanese had progressed. Mathematics was not part of this 1983 survey, but the role of the English language in this discipline was studied in detail by Diodato (1990) in more than a hundred non-U.S. science journals from three U.S. library collections for the period from 1970 to 1985. English usage increased from 52 to 65% and Russian usage from 13 to 16%, whereas French usage declined from 17 to 10% within the first years and German usage from 10 to 7%. The progress of English was due to the choice of this language by most new journals, as well as the increasing proportions of English in older journals.

Several studies devoted to particular disciplines and countries/languages are available for different periods. Kosin (1972) stressed the increasing importance of Russian. In the 1980s, Stankus et al. (1981) focused on English language trends in basic German science. Gablot (1982) gave a detailed account of the usage of French in PASCAL database documents in 1975–1980. Garfield used SCI data to study French research and language practices. In 1976, he published an influential article in *La Recherche:* ''Is French science too provincial?'' stating that ''the more conspicuous symptom of French Research's decline is that French scientists are reluctant to acknowledge that French is no longer the international language'' (Garfield, 1976, p. 757). A decade later, he reported a significant change of behavior (Garfield, 1988). Developments in France are illustrative of a country in which the promotion of the native language has added to the common ''language barrier'' problem of securing access to foreign-language literature. This situation has gradually changed in recent years, as indicated in the debates in the collection edited by Cassen (1990). In Ronai's contribution to this work, we can read that:

> There are two problems, a false one and a true one; the false one is the choice of a language to publish the results of research, the true one . . . is maintaining an access in French to results validated by a publication in another language (P. Join-Lambert). (p. 83)

A different question is the advantage of English- over non-English-speaking countries and associated biases. Looking at the high performances of a few non-English-speaking countries, Braun and Schubert (1993) warn against an overestimation of the mother-tongue problem.

Another phenomenon is the linkage of editorial and linguistic aspects. In the stronger instances of the national model, they are closely bonded. However, the figures given about commercial publishing must be considered carefully, because of the particular rules of ISI assignments[6] and the changes in ownership in this industrial sector.

1.2. The Shift Towards the Transnational Model: A Process in the Completion Stage

1.2.1. The Dominance of the English Language. This English-language dominance is now overwhelming, and is being continually reinforced, from 89% in 1982 to 93% in 1991 (Table 1). As expected, these figures are higher than in inquiries on non-SCI sources. Russian, the second most-important language, represents less than 5% in 1983, to compare to the figure cited above, and about 3.3% in 1991. The German contribution is halfed in the period (3 to 1.6%); French goes from 1.7% to 1.2%. At a lower level, Japanese is steady about 0.4%. Other languages now record less than 0.1%. It is noteworthy that the Netherlands had virtually dropped their national language, in SCI coverage, by 1982. However, some differences appear, depending on the discipline. Despite national traditions generally reported in clinical medicine or mathematics, chemistry is the only discipline to be clearly late in the process, though with a strong effort at catching up (from 80% to ca 88% in 1991). Life Sciences

[6] Consider assignments for multi-national companies, and for consolidation, for instance: Journals published by the Elsevier subsidiary in France appear as French.

TABLE 1. Languages usage.

	1991				1982			
	All disciplines	Chemistry	Physics	Life sc I	All disciplines	Chemistry	Physics	Life sc I
English	93.2	87.6	94.3	97.3	89.2	80.2	91.6	94.9
Russian	3.3	7.4	5.3	1.9	5.1	10.2	7.4	2.9
German	1.6	2.7	0.1	0.3	3.0	5.4	0.3	1.0
French	1.2	0.8	0.3	0.4	1.7	2.0	0.7	0.9
Japanese	0.4	0.9	—	0.0	0.4	1.2	—	0.1
Subtotal	99.7	99.4	99.9	100.0	99.5	99.0	100.0	99.8

TABLE 2. National origin of journals (commercial publishers).

	1991				1982			
	All disciplines	Chemistry	Physics	Life sc I	All disciplines	Chemistry	Physics	Life sc I
USA	44.8	31.6	47.4	47.1	42.5	27.2	43.4	44.4
UK	19.5	19.9	13.5	20.0	17.3	16.0	12.9	17.9
Netherlands	9.9	10.0	16.5	15.0	8.5	8.5	15.6	14.2
Germany	6.7	7.4	4.7	6.7	7.8	8.6	6.2	8.6
Russia	5.1	11.5	8.6	2.8	7.6	16.1	12.0	4.0
Japan	2.6	4.1	3.9	1.6	3.2	5.0	4.0	2.4
France	1.7	1.0	1.6	0.9	1.6	0.8	1.1	1.2
Italy	0.4	0.2	0.7	0.4	0.6	0.7	1.6	0.5
Spain	0.1	0.2	—	0.2	0.1	0.3	—	0.3
Subtotal	90.9	85.9	96.8	94.6	89.2	83.2	96.7	93.4

I is ahead,[7] from more than 95% in 1982 to 97% in 1991. These disciplines also appear as slightly deviating in other databases (e.g., PASCAL; see Gablot, 1982, p. 36sq.). Others disciplines get close to the all-disciplines average in 1991 (93%).

Shifting towards the international language involves several changes: The behavior of scientists looking for more international media; the behavior of scientific/editorial committees and publishers, favoring English in multilingual journals, or adopting English when creating new journals; and the way ISI's choices reflect these tendencies.

1.2.2. The Dominance of U.S./U.K. Publishers. The country of origin of journals shows a similar trend towards concentration (Table 2), with the reservation made about assignments. The U.S.A. accounts for 42.5% (1982) to 45% (1991), the U.K. from 17 to 20%, the Netherlands from 8.5% to 10%. The figures of other countries (in decreasing order: Germany, Russia, Japan, France, and Canada for 1991) decrease in the period, except for France. A crude measure of the position of countries as publishers is obtained by the ratio of the world share in journal commercial publishing to the world share of authored publications (Table 3). The Netherlands ratio (5.0) is, as might be expected, the top-ranking one. The U.K. comes next (2.4), followed by the U.S.A. and Germany, still above 1. Russia is below (0.8) and the ratios of France and Japan do not reach 0.5. This ratio should be carefully interpreted. It represents a very limited point of view on publishing power and may underestimate the consolidated power of leaders, to say nothing about intermediate views between publishing and authoring, such as editorial power which has been receiving attention since early works of the Information Science and Scientometrics Research Unit (ISSRU, Budapest) (Braun & Bujdoso, 1983).

[7] In OST current discipline definition, Life Sciences I is roughly equivalent to ''Biomedical Research,'' LS-II to ''Clinical Medicine'' and LS-III to ''Animal and Vegetal Biology.''

1.3. Specific Indicators of Transition: Language and Origin of Journals' Pattern of Change in SCI

In the view adopted here, the most direct sign of transition, at the country and discipline level, is the decreasing linkage between commercial publishers, authors, and language in a country's activity. Let i indicate the language, j the country of the publisher, k the country of the author (when i is the major national language of the country k, we note by convention $k = i$; see Table 4). Only bidimensional indexes will be considered here:

1.3.1. Fixation Ratio of Research by the National Language.

$$f1(i, \bullet, k = i) = \text{pub}(i, \bullet, k = i)/\text{pub}(\bullet, \bullet, k = i)$$

is the proportion of national research (country's authors) written in the national language, or *fixation ratio* of the national research by the national language.

$$a1(i, \bullet, k \neq i) = \text{pub}(i, \bullet, k \neq i)/\text{pub}(\bullet, \bullet, k \neq i)$$

is the proportion of foreign research written in the national language, or *attraction ratio* of the foreign research by the national language. By construction:

$$\text{pub}(i, \bullet, \bullet,) = f1.\text{pub}(\bullet, \bullet, k = i) + a1.\text{pub}(\bullet, \bullet, k \neq i)$$

1.3.2. Fixation Ratio of Research by the Country's Publishers.

$$f2(\bullet, j, k = j) = \text{pub}(\bullet, j, k = j)/\text{pub}(\bullet, \bullet, k = j)$$

is the proportion of national research published in the country's journals, or fixation ratio of the national research by the national publishers.

$$a2(\bullet, j, k \neq j) = \text{pub}(\bullet, j, k \neq j)/\text{pub}(\bullet, \bullet, k \neq j)$$

TABLE 3. Publishing power ratio.

	1991*			1982*		
	Publications[a]	Com publishers[a]	Ratio	Publications[a]	Com publishers[a]	Ratio
Netherlands	2.0	9.9	5.0	1.6	8.5	5.2
UK	8.3	19.5	2.4	9.1	17.3	1.9
USA	35.2	44.8	1.3	37.0	42.5	1.2
Germany	6.2	6.7	1.1	6.5	7.8	1.2
Russia	6.2	5.1	0.8	8.4	7.6	0.9
France	4.8	1.7	0.4	4.3	1.6	0.4
Japan	7.9	2.6	0.3	6.8	3.2	0.5
Italy	2.8	0.4	0.1	2.2	0.6	0.3
Spain	1.6	0.1	0.1	0.7	0.1	0.2
Subtotal	75.1	90.9	1.2	76.6	89.2	1.2

* All disciplines.
[a] World shares.

is the proportion of the foreign research published in the country's journals, or attraction ratio of the foreign research by the national publishers.

These indexes are named after Gablot (1982, p. 10). We can extend the definitions as follows:

1.3.3. Fixation Ratio of Publishers by the National Language.

$$f3(i, j = i, \bullet) = \text{pub}(i, j = i, \bullet)/\text{pub}(\bullet, j = i, \bullet)$$

is the proportion of the country's journal articles written in the national language, or fixation ratio of the country's commercial publishers by the national language.

$$a3(i, j \neq i, \bullet) = \text{pub}(i, j \neq i, \bullet)/\text{pub}(\bullet, j \neq i, \bullet)$$

is the proportion of foreign countries' journal articles written in the national language, or attraction ratio of foreign publishers by the national language.

1.3.4. Reciprocal Ratios. Conversely, we may consider the following indexes:

$$g1(i = k, \bullet, k) = \text{pub}(i = k, \bullet, k)/\text{pub}(i = k, \bullet, \bullet)$$

based on the $f1$ pattern, is the fixation of the domestic language by the national research. On the $a1$ pattern:

$$b1 = (i \neq k, \bullet, k) = \text{pub}(i \neq k, \bullet, k)/\text{pub}(i \neq k, \bullet, \bullet)$$

is the attraction of the foreign language by the national research; and thus mutatis mutandis for each authoring country, $g2$ and $b2$, and for each country's publishers, $g3$ and $b3$.

Other indexes are appropriate in this particular context, such as:

$$p1(i, \bullet, k = i) = f1(i, \bullet, k = i)/((\text{pub}(i, \bullet, \bullet)/\text{pub}(\bullet, \bullet, \bullet))$$

which is the proportion of the national language in the corresponding country's publications, over the proportion of this language in the world's publications. This probabilistic ''activity index'' embodies both attraction and fixation effects. Thus, for a country whose language has a direct area of influence (France, for instance), this index may reflect the relative evolution of the language in the mother country and this area. Probability indexes are not shown in following tables.

Tables 4–7 display the set of fixation and attraction indexes, for all science. Highly versus lowly internationalized disciplines (LS-I/Chemistry) are detailed for $a1$ and $f1$.

1.4. Patterns of Transition

Russia has the highest fixation ratio for a national language among non-English speaking countries (Table 4); Russian is still used in half of SCI Russian publications, although with a downward trend (59 to 53%). Interpretation of trends in Russia is affected by the current situation of science in that country. For other second-best languages, a sharp decrease is recorded: From 36 to 21% for Germany, and similarly for France. Starting from a lower level, Spain has now almost achieved its conversion to English in SCI coverage (10 to 2%). Japan's portion of SCI articles in Japanese is slightly declining (6 to 4%). Italian has virtually disappeared from SCI journals, and the same for Dutch, already marginal in the first years. The attraction is practically zero for non-English languages in 1992, except German and French with very low levels (0.3–0.2%) and a downtrend. For all these non-English-speaking countries, with the exception of Russia, English clearly threatens the other languages; the expression of scientists in a third language other than English and the national language, has practically vanished.

Table 8 lists, in decreasing order, the countries/disciplines with the 10 strongest downtrends of fixation by national language (all disciplines except multidiscipli-

nary; largest changes and largest rates of change). France and Germany appear alone in the area of largest changes; Spain and Italy (life sciences) have the highest scores in the rates of change.

Strong positions in national language and commercial publishing are generally associated, except for the well-known case of the Netherlands, in which very strong editorial power co-exists with a nearly zero level of authoring in the national language in the SCI. Gablot (1986), observing the shift towards the use of the English language in French journals, feared that ‘‘a loss of attracting power of the French language causes a loss of attracting power of French publishers’’ (p. 14); but of course this attracting power of publishers may be regained by a competitive conversion to the transnational model, with, as milestones, the addition of English abstracts, the increasing proportion of papers in English, or a total disconnection from the domestic language (see Stankus et al., 1981, who describes the process in Germany, in the 1970s; for reactions to a similar process in French publishing activity, see, for example, Coles, 1989). In 1992, (Table 6), the fixation ratio is higher than 70% for the U.S.A. and Russia, about 60% for the U.K., 39% for Germany, and between 30% and 20% for Japan, France, and the Netherlands. The fixation ratio is decreasing for all non-English-speaking countries. For the countries under examination, the attraction ratio is high over the period for the U.S.A. (29% in 1991), and at a lesser degree for the U.K. (16%), the Netherlands (10%), and Germany (5%). For the first three countries, this ratio increased over the period. Other countries are below 1%, steady or increasing, as most publishers probably wish to maintain at least a symbolic foreign participation.

Table 9 shows the country–discipline pairs with the greatest changes and rates of change of fixation of national research by the national publishers in the period 1982–1991. Spain again, Italy, and Japan are the top-ranking countries for change rates. The largest changes are generally recorded in life sciences. The link between publishing power and language may also be detailed by looking at the Table 6, and first at fixation indexes showing the proportion of articles published by domestic journals that are written in the national language. As far as the SCI is concerned, the trend among German, French, and Spanish publishers toward a gradual conversion to English does not appear to affect Russian or Japanese publishers. It is also apparent that French commercial publishers are becoming more isolated when they use the French language (Table 7).

Another way to look at the linkage between domestic language and commercial publishing is considering the evolution, as it appears on the scatterplot of corresponding fixation of research (rates of change, 1982–1991, Fig. 1); the disconnections from domestic language and domestic commercial publishing evolve in a similar manner throughout the period. Almost all points representing countries–disciplines pairs are located in the

TABLE 4. Fixation of national research by the national language.

		1991						1982							
		All disciplines		Chemistry		Life sc. I		All disciplines		Chemistry		Life sc. I			
Author's country	Language	Fixation	Attraction	Fixation	Attraction	Fixation	Attraction	Fixation	Attraction	Fixation	Attraction	Fixation	Attraction	Change of fixation*	Rate of change of fixation*
USA	English	99.9	89.6	99.9	83.7	100.0	95.6	99.9	82.9	99.9	74.7	99.9	91.4	—	—
UK	English	99.9	92.6	99.9	86.9	99.9	97.1	99.9	88.1	99.8	78.8	100.0	94.5	—	—
Russia	Russian	53.2	0.1	56.6	0.1	52.1	0.0	59.3	0.1	59.3	0.2	58.7	0.0	−6.1	−10.3
Germany	German	21.0	0.3	29.9	0.4	4.2	0.1	36.3	0.6	51.4	1.0	12.3	0.2	−15.4	−42.3
France	French	20.7	0.2	13.8	0.1	5.2	0.1	33.3	0.3	35.1	0.3	14.8	0.2	−12.6	−37.7
Japan	Japanese	4.4	0.0	7.8	0.0	0.3	—	6.4	—	11.3	0.0	1.1	0.0	−2.0	−30.9
Spain	Spanish	2.0	0.1	7.2	0.1	0.8	—	9.8	0.1	17.2	0.1	15.3	0.0	−7.8	−79.9
Netherlands	Dutch	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Italy	Italian	0.1	—	—	—	—	—	2.3	—	—	—	1.5	—	−2.2	−94.2

* All disciplines.

TABLE 5. Fixation of national language by the national research.

Author's country	Language	1991 All disciplines Fixation	1991 All disciplines Attraction	1991 Chemistry Fixation	1991 Chemistry Attraction	1991 Life sc. I Fixation	1991 Life sc. I Attraction	1982 All disciplines Fixation	1982 All disciplines Attraction	1982 Chemistry Fixation	1982 Chemistry Attraction	1982 Life sc. I Fixation	1982 Life sc. I Attraction	Change of fixation*	Rate of change of fixation*
USA	English	37.8	0.5	27.5	0.2	40.8	0.5	41.4	0.3	27.6	0.2	43.5	0.4	—	—
UK	English	8.9	0.1	6.8	0.1	7.9	0.2	10.2	0.1	8.3	0.1	9.1	0.1	—	—
Russia	Russian	98.6	3.0	99.0	6.0	98.0	1.8	98.4	3.6	98.8	7.7	98.6	2.1	0.2	0.2
Germany	German	81.4	5.0	87.1	5.6	83.8	6.1	80.1	4.3	83.8	4.5	84.1	5.8	1.3	1.6
France	French	82.1	3.9	83.6	4.3	76.6	5.0	82.0	2.9	85.7	3.2	80.7	4.1	0.1	0.1
Japan	Japanese	98.7	7.6	98.9	10.6	94.7	8.6	99.0	6.4	99.3	9.4	94.0	7.1	−0.4	−0.4
Spain	Spanish	27.9	1.6	70.0	2.4	76.7	1.8	39.8	0.6	70.6	1.1	90.9	0.9	−11.9	−29.9
Netherlands	Dutch	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Italy	Italian	93.0	2.8	—	—	—	—	95.7	2.2	—	—	97.1	2.2	−2.7	−2.8

* All disciplines.

transition quadrant (southwest); the trend is significant with a moderate linear correlation (r-square ca 0.56 removing two particular cases: Japan in Engineering, with growing usage of Japanese; France in Mathematics, with growing domestic publishing).

It must be emphasized once again that these developments have occurred within the SCI. In most cases, the phenomena probably reflect what is happening on a larger scale, although the case of Japan, in particular, shows some uncertainty as to whether all high-level research, especially that paid by public funds, is available in English.

2. A Sketch of the Relationships between Transition and Scientific Indicators

2.1. The Expected Effect of Global and Efficient Transition on Performances

The transition process is intended to achieve increased international visibility by the selection of appropriate channels. Although many manifestations of this process take place outside the SCI and cannot be described here, the important features can probably be measured accurately using this database. First, inclusion in SCI-covered journals is an indisputable sign of progress in international visibility. Within the SCI, search for better channels for audience and citation performance, either by a language change or a further effort to obtain higher impacts in the English-speaking mainstream, is a second factor. However, two points need to be emphasized.

First, the transfers between different level of visibility are not shaped only by the transition process, but by changes in other factors determining the productivity and efficiency of research systems. In this respect, a fairly specific transition marker is the B-type transfer, i.e., the language/publisher shift.

Then, classical performance indicators will reflect these transfers in various ways:

- Publication volume (and corresponding citation volume, to a large extent[8]) modified only by A-type transfers (non-SCI/SCI), is expected to react positively to transition.
- The same is expected for impacts, all things equal, from B and C transfers. However A-type transfers may also affect impacts, in either direction: for instance a strong flow of newcomers, entering low visibility journals, can have an adverse influence on the global impact performance. The B-type of transfer, involving shifts in language/publishers, has a very direct relation to impacts, because of large differences in average citations rates attached to different languages/publishers.

[8] Count of citations considers all citations from articles in ISI Citation Indexes to the four major types of SCI/COMPUMATH documents used for publication counts.

TABLE 6. Fixations research—publishers.

Publisher's country	Author's country	Fixation of national research by the national publishers						Publisher's country	Author's country	Fixation of national publishers by the national research					
		1991*		1982*						1991*		1982*			
		Fixation	Attraction	Fixation	Attraction	Change of fixation*	Rate of change of fixation*			Fixation	Attraction	Fixation	Attraction	Change of fixation*	Rate of change of fixation*
USA	USA	74.7	28.6	77.1	22.3	−2.4	−3.2	USA	USA	58.7	16.2	67.0	14.7	−8.3	−12.4
UK	UK	62.2	15.6	64.7	12.5	−2.4	−3.8	UK	UK	26.4	3.9	34.1	3.9	−7.7	−22.5
Russia	Russia	80.6	0.1	89.4	0.1	−8.8	−9.8	Russia	Russia	98.5	1.3	98.9	1.0	−0.3	−0.3
Germany	Germany	38.7	4.6	52.5	4.7	−13.8	−26.3	Germany	Germany	36.1	4.1	43.7	3.4	−7.6	−17.4
France	France	22.6	0.7	27.4	0.5	−4.8	−17.6	France	France	62.9	3.8	72.8	3.1	−9.9	−13.6
Japan	Japan	28.8	0.4	42.8	0.3	−14.0	−32.7	Japan	Japan	86.9	5.8	91.2	4.0	−4.2	−4.7
Spain	Spain	3.0	0.0	11.8	0.0	−8.8	−74.8	Spain	Spain	57.2	1.6	73.8	0.6	−19.6	−25.5
Netherlands	Netherlands	21.3	9.7	26.9	8.2	−5.6	−20.9	Netherlands	Netherlands	4.2	1.7	5.2	1.3	−0.9	−18.1
Italy	Italy	7.0	0.2	14.8	0.3	−7.8	−52.9	Italy	Italy	48.9	2.6	52.6	1.9	−3.7	−7.0

* All disciplines.

The influence of publication language on citation rate has been stressed many times, particularly by Garfield on several occasions (including 1976, 1988). Scholars investigating the situation for their own country can hardly avoid noticing this, among many others, Mitra (1972) who studied the citation patterns of Indian scientists with a special attention to language. An attempt at determining the pure effect of language is facilitated in the case of multilingual journals which equalize diffusion conditions. Even in this case, in a work specifically devoted to East German journals, Czerwon and Havemann (1992) found that, although a minority of journals can obtain better citation rating in the national language, the general rule is favorable to English.

Without going into that detail, relative impact ratios (share of citations/share of publications), reveal low levels and sharp decreases of non-English languages impact in the period: For all science, no language reaches .5; German was above 0.4 and is now below 0.3; French was above 0.3 and is now 0.2; Japanese and Russian are below, and decreasing. There are strong disciplinary deviations (chemistry, for German, is still almost 0.8, though decreasing). This illustrates the differences of expectations for the various channels. Let us take the example of language. In a somewhat simplistic way (because of very large deviations for a given language), an ''expected impact'' for a country/discipline can be calculated according to the language profile of its publications and the language's average impacts. Changes in expected impact depend on both terms. For countries/disciplines with the less-weak fixation by the domestic language, the downtrend observed for this ratio, reinforced by the growing discrepancy between the impacts of English and other languages, tends to increase the expected impacts over the period. This concerns chiefly Germany and France (Russia's fixation is more stable), but of course only for a minority of their national-authored publications. For most other countries, the low level of fixation by national language makes imperceptible the difference between the expected impact for these countries and the average impact of publications in English. Hence, the global effect of the quasi-mechanistic enhancement of impact by language shift, within SCI, should not be overestimated.

Citations' expectations are also very different when the origin of journals is considered. The relative citation ratio of U.S. commercial publishing is the only one above 1 (with a high value, above 1.3 in 1991), while Dutch and English commercial publishers stand at about 1. German, Japanese, and French publishers were at about 0.6, 0.5, and 0.4, respectively.

Let us summarize: If the transition is global, we can expect a convergence between its various independent forms (contribution to transfers A, B, C), and it seems reasonable to use the specific indicators language/publisher (B-type) as a measure of transition as a whole; if the transition is efficient, not masked by other phenomena ruling the transfers, we can expect a certain amount of

TABLE 7. Fixations language—publishers.

Publisher's country	Language	Fixation of national language by the national publishers						Publisher's country	Language	Fixation of national publishers by the national language					
		1991*		1982*		Change of fixation*	Rate of change of fixation*			1991*		1982*		Change of fixation*	Rate of change of fixation*
		Fixation	Attraction	Fixation	Attraction					Fixation	Attraction	Fixation	Attraction		
USA	English	48.0	0.8	47.6	1.0	—	—	USA	English	99.9	87.8	99.7	81.4	—	—
UK	English	20.9	0.7	19.2	1.6	—	—	UK	English	99.8	91.6	99.0	87.1	—	—
Russia	Russian	99.8	1.8	99.3	2.7	0.4	0.4	Russia	Russian	65.8	0.0	66.2	0.0	−0.4	−0.6
Germany	German	85.1	5.4	83.9	5.5	1.2	1.4	Germany	German	20.4	0.3	31.6	0.5	−11.2	−35.5
France	French	81.8	0.7	65.8	0.5	16.0	24.4	France	French	57.4	0.2	70.8	0.6	−13.4	−18.9
Japan	Japanese	99.6	2.3	99.8	2.8	−0.2	−0.2	Japan	Japanese	13.4	—	13.6	—	−0.3	−2.0
Spain	Spanish	28.4	0.1	41.7	—	−13.3	−31.8	Spain	Spanish	38.4	0.1	66.6	0.1	−28.2	−42.4
Netherlands	Dutch	—	—	—	—	—	—	Netherlands	Dutch	—	—	—	—	—	—
Italy	Italian	75.4	—	95.7	0.6	−20.2	−21.2	Italy	Italian	0.8	0.0	8.7	0.0	−7.4	−90.7

* All disciplines.

convergence between these specific transition indicators and general performances. What does a preliminary examination indicate?

2.2. The Relationship between Transition-Specific Indicators (Language and Commercial Publishers) and Performance Indicators (Volume of Publication and Citation Impacts)

We compared over the period, for each country/discipline, the rate of change of publication and citation volume (world share), and of fixation ratios (language, publishers); the analysis is limited to five countries: France, Germany, Japan, Russia, and Spain. The multidisciplinary class is excluded.

The plot of publication (world shares) versus fixation ratio by national language (rates of change 1982–1991, Fig. 2) describes the relation in the expected direction. Spanish publications in life sciences III, have a very high rate.[9] Evolution of France–mathematics and Japan–engineering are atypical. Removing both of them, the expected negative relation between trends of fixation ratio and publication is significant at any sensible level; the linear correlation is moderate (r-square > 0.4). Not surprisingly, a quite similar outcome is obtained for citation volume evolution. The results suggest that a lot of other factors are at work, but that the existence of a global transition effect cannot be dismissed.

The relationship between publication and fixation ratio by the national publishers, in terms of change in 1982–1991, designates France–mathematics again, and at a lesser degree Japan–earth & space, as outliers recording a gain both in performances and domestic publishing. Removing them leads to a significant correlation in the expected direction. The linkage citation–domestic publishers is quite similar, with similar pretty high values for the r-square (about 0.7). This suggests that a global publication strategy is at work: More visible channels are searched both inside and across SCI boundaries.

In contrast, a preliminary analysis of the linkage between short-term impact changes and transition-specific markers does not indicates a significant correlation. The expectations from language/publishers shifts are obscured by other factors. It suggests that transition as a whole is inefficient as far as impact is concerned, with two types of explanations:

- There is the effect of non-transition factors: Internal evolutions of research systems, competition from new countries, etc. This is probably the major point.
- In some cases, for the countries/disciplines achieving strong transfers of publication activity towards SCI (A

[9] The transition phenomena in Spanish science are particularly spectacular, with strong gains in SCI visibility during the decade. Several studies of the Spanish situation have been published by the CINDOC-CSIC team (for instance, Gomez, Fernandez, Zulueta, & Cami, 1995).

TABLE 8. Changes at the discipline level: Languages.

Top fixation changes of nat research by nat language			Top fixation rates of change of nat research by nat language		
Discipline	Country	Rank	Discipline	Country	Rank
LS-III	France	1	LS-II	Italy	1
LS-III	Germany	2	LS-I	Spain	2
Chemistry	Germany	3	LS-II	Spain	3
Chemistry	France	4	LS-III	Italy	4
Engineering	France	5	Earth & space	Germany	5
Maths	Germany	6	LS-III	Spain	6
Earth & space	France	7	Maths	Italy	7
Engineering	France	8	LS-I	Japan	8
LS-II	France	9	LS-I	France	9
LS-II	Germany	10	LS-I	France	10

transfers), there is the adverse effect of this catching up process. The simpler interpretation of transition is in terms of exploitation of a reserve of visibility: First underestimated because of poor international communication, a national research system gradually approaches its ''normal'' visibility, reached when transition is completed. However, diminishing returns cannot be excluded, within a more dynamic view of transition: In the first stages of a transition process, high potential research is available for introduction on the international scene; in the last stages of transition, transfer to SCI is likely to concern lower-impact research.

Conclusion and Perspectives

We have shown that the transition process towards the transnational model of science, as observed in the SCI, was still taking place during the last decade for some countries/disciplines and has now almost been completed, except for Russia. German and French are threatened as international communication languages. In the space left, the linkage between language and commercial publishing remains, but national research systems have gradually separated from both native language expression and domestic publishers; disconnecting from the domestic language also seems to be a condition required for national publishers to compete in the leading fraction (SCI-type) of the market.

More specifically, our results show a moderate correlation between transfers of publication activity towards SCI (and associated citation flows) and specific transition changes (language, publishers) at the country/discipline level, suggesting that transition is a global and efficient strategy from this point of view.

In contrast, we observed the near-independence of evolution of impacts and transition markers. Transition strategies seem inefficient as far as impacts are concerned. The direct benefits expected from shifts in language/publishers, that concern a small part of countries' literature, are overshadowed by non-transition factors, and perhaps in some cases by diminishing returns from transition. But this needs to be checked for long-term impacts, which for a decade-based study would need a broader window of citation data.

The scope of this study is limited from several points of view: Taking SCI as source may appear quite restrictive when language/publisher issues are addressed. But as stressed above, SCI is to a certain extent a symbol of mainstream (besides, a particular effect of achieved

TABLE 9. Changes at the discipline level: Publishers.

Top fixation changes of nat research by nat publishers			Top fixation rates of change of nat research by nat publishers		
Discipline	Country	Rank	Discipline	Country	Rank
LS-II	Japan	1	LS-III	Italy	1
LS-I	Spain	2	LS-II	Spain	2
LS-II	Germany	3	LS-I	Spain	3
LS-III	Italy	4	LS-I	Italy	4
LS-II	France	5	Physics	Italy	5
LS-III	France	6	Chemistry	Spain	6
LS-I	Japan	7	LS-I	Japan	7
Maths	Russia	8	LS-II	Japan	8
Maths	Japan	9	Physics	Canada	9
Physics	Italy	10	LS-I	France	10

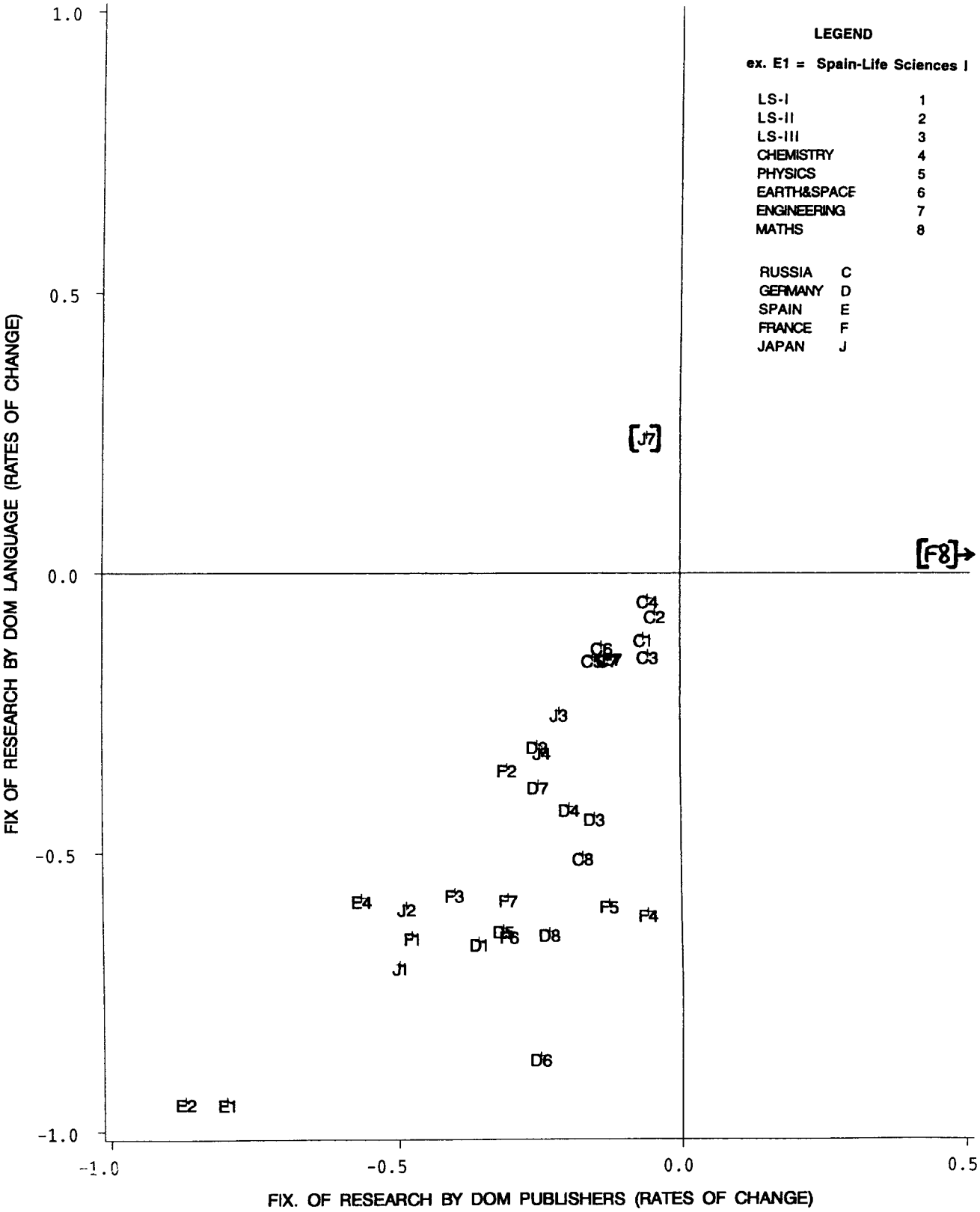

FIG. 1. Fixation by language versus fixation by publishers (rates of change).

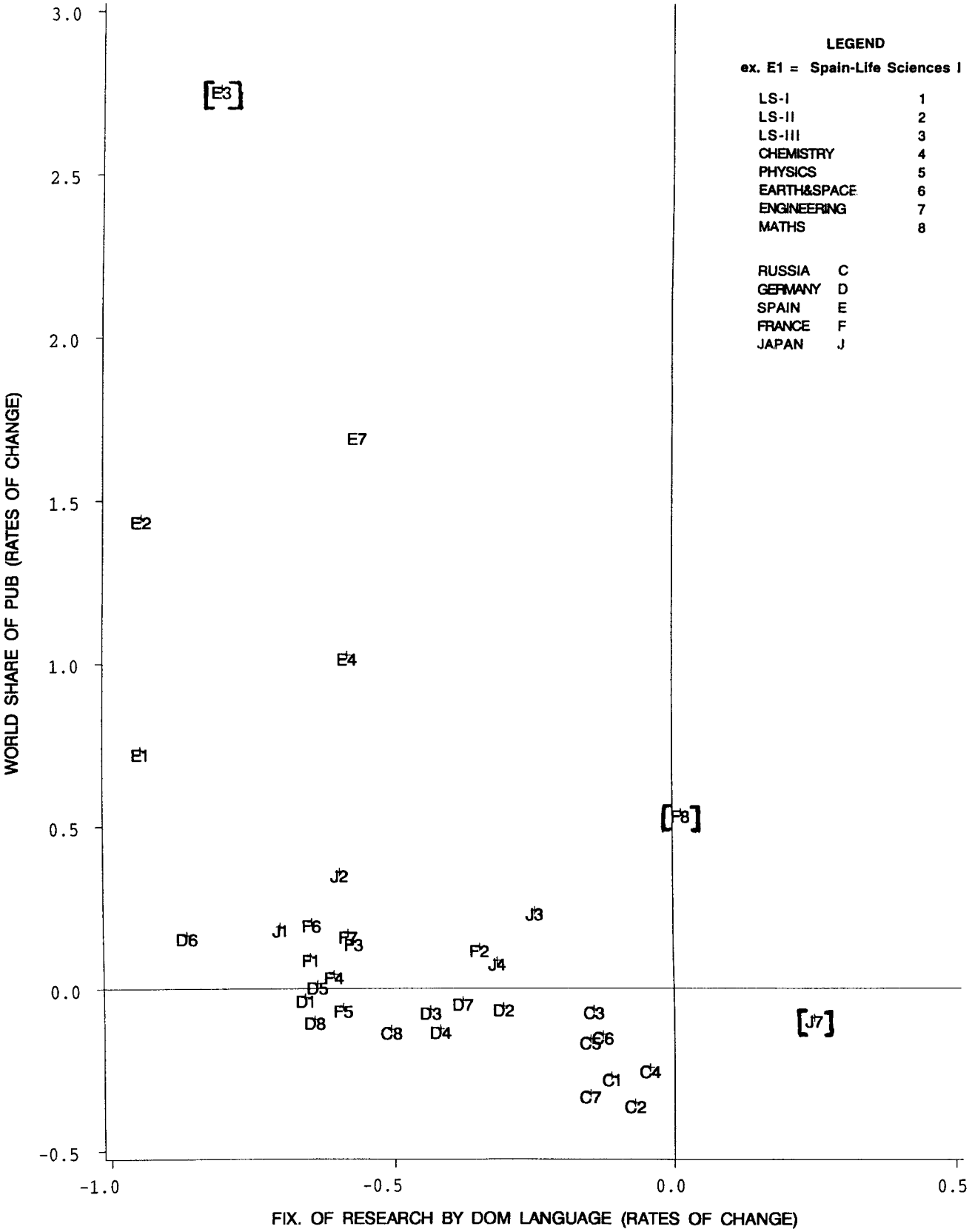

FIG. 2. World share of publication versus fixation by language (rates of change).

transition will be the disappearance of one class of biases in this database). It can also be argued that changes in journal selection by ISI may not reflect the ''real facts'' with fidelity, and it is probably true that a detailed study of each pair country/discipline would point out local abnormalities. We only intend to treat the general landscape. Additional work is also required for addressing the relationship between transition and other measures of internationalization, such as propension to international collaboration, or positions in editorial gatekeeping.

Finally, the interpretation of transition behavior in the evolution of research systems raises questions: The exploitation in terms of a stock of visibility, within basically unaltered research structures, may hold up in the short run. Interpretations of performance enhancements (publication or citation volume measured in SCI) should consider transition effects, and not attribute to internal evolutions of a research system what may, in fact, be the result of a better communication policy. In the long run, the situation is more complex: First, the transition may be a dynamic process involving diminishing returns; then, as sociologists of science stress it, the ability to face international competition through better communication, and the internal capability of research systems can hardly be separated. To deal more completely with the transition process would need a long-term view. In particular, it would be of interest to test whether early transitions of non-English speaking countries have been rewarded in terms of long-range performances.

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