International Coauthorship and Citation Impact: A Bibliometric Study of Six LIS Journals, 1980–2008

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International collaborative papers are increasingly common in journals of many disciplines. These types of papers are often cited more frequently. To identify the coauthorship trends within Library and Information Science (LIS), this study analyzed 7,489 papers published in six leading publications (ARIST, IP&M, JAMIA, JASIST, MISQ, and *Scientometrics*) over the last three decades. Logistic regression tested the relationships between citations received and seven factors: authorship type, author's subregion, country income level, publication year, number of authors, document type, and journal title. The main authorship type since 1995 was national collaboration. It was also the dominant type for all publications studied except ARIST, and for all regions except Africa. For citation counts, the logistic regression analysis found all seven factors were significant. Papers that included international collaboration, Northern European authors, and authors in high-income nations had higher odds of being cited more. Papers from East Asia, Southeast Asia, and Southern Europe had lower odds than North American papers. As discussed in the bibliometric literature, Merton's Matthew Effect sheds light on the differential citation counts based on the authors' subregion. This researcher proposes *geographies of invisible colleagues* and a *geographic scope effect* to further investigate the relationships between author geographic affiliation and citation impact.

Introduction

With the recent improvements in information and communication technologies (ICT) and the rise of globalization come the potential for a more effective global flow of scholarly information. In the field of scholarly communication and bibliometrics, interest in the internationalization level of journals, a core avenue for research dissemination for many disciplines, is increasing. Scholars have observed an increase in papers involving international collaboration.[1] These developments suggest that ideas, scientific resources, and expertise are shared more among scholars around the world than in the past. Coauthorship can enhance a scholar's productivity and visibility. In addition, such exchange can contribute to the growth of a discipline (de Beaver & Rosen, 1979; Luukkonen, Persson, & Sivertsen, 1992).

Many governmental and research institutions are now promoting international collaboration (Sonnenwald, 2007). This may be encouraged by findings that international collaborative papers often attain a higher impact, as measured by the citations received (Katz & Hicks, 1997). International collaboration can be especially favorable to scholars in developing nations, as their papers have traditionally been less visible and less frequently cited in prestigious journals (Cronin & Shaw, 1999). Recent research suggests, however, that the effects of international collaboration may vary across disciplines and the authors' countries (Moed, 2005). The current research question is: Is international coauthorship favorable for enhancing the citation impact of papers in Library and Information Science (LIS), a field that plays a crucial role in understanding and facilitating scholarly communication? The answer is unclear, as research about international collaboration on LIS journal papers is rare.

The current study is the first step toward greater understanding of the trend in LIS international coauthorship and its relationship with citations received. Specifically, we asked the following research questions: (1) What has the trend in authorship types (international collaboration, national collaboration, and single authorship) been over the years? (2) Are international coauthorship and an author's geographic affiliation related to the number of citations received?

Research question 1 (RQ1) was examined by analyzing the shares of international, national, and single-author papers for

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[1] In this paper, international coauthorship is conceptualized as a subset of international collaboration. Not all international collaboration leads to international collaborative papers (Cronin, Shaw, & La Barre, 2003). Coauthorship may also not reflect informal collaborations (Laudel, 2002).

the whole sample set, for individual journals, and for each region. Research question 2 (RQ2) was tested using logistic regression. The explanatory variables of interest included authorship type, author's geographic region, and the income levels of the author's country. The number of authors, year of publication, document type, and journal title were included as control variables, as they have been found to be salient in previous citation research.

This study can further our understanding of the trend in international coauthorship for select top LIS journals. We tested whether international coauthorship is positively related to citation count for LIS papers, as found in other disciplines. The findings will be relevant to scholars interested in the evolving pattern of journal publications in the LIS field, and to those in the science research policy community. Scholars interested in publishing in LIS journals and maximizing their research impact may also find the results of interest.

Literature Review

The LIS field has long contributed to bibliometrics and scholarly communication research, which enhance our understanding of the production, communication, and consumption of scientific knowledge (Narin & Moll, 1977; White & McCain, 1989; Wilson, 1999). Pritchard (1969) defined *bibliometrics* as research on the "processes of written communication and of the nature and course of development of a discipline . . . by means of counting and analyzing the various facets of written communication" (p. 348). The current study focuses on authors' geographic affiliations. Compared to citation analysis (e.g., Moed, 2005), cocitation analysis, and visualization of literature (e.g., Börner, Chen, & Boyack, 2003; Morris & Van der Veer Martens, 2008; White & McCain, 1997), author characteristics are relatively less examined. Information about an author's geographic affiliation, however, is important in evaluating national research performance (Moed, De Bruin, & Van Leeuwen, 1995). Recently, advances in ICT have changed the way that scholars read, communicate, collaborate, and publish (Borgman & Furner, 2002; Tenopir, Wilson, Vakkari, Talja, & King, 2010). Technological changes and increasing globalization heighten interest in analyzing authors' geographic affiliations, with the goal of evaluating the internationalization level and scientific collaboration pattern among journals in various disciplines (Zitt & Bassecoulard, 2004).

Scholars now favor publishing in international journals, which offer wider readerships (Bottle & Efthimiadis, 1984; He & Spink, 2002; Zitt, Perrot, & Barre, 1998). Research in the sciences suggests a trend toward more collaboration generally (Glänzel, 2002), and more international collaboration specifically (Glänzel & Schubert, 2004; Wagner & Leydesdorff, 2005). Interestingly, the level and pattern of international collaboration in LIS journals are less widely known, as He and Spink (2002) pinpointed. For the LIS field, more is known about the increase in coauthorship in general (i.e., without distinguishing national from international collaboration). However, whether the LIS field has also seen a rise in international coauthorship specifically is unclear.

Traditionally, when compared to those in the sciences, scholars in the humanities and social sciences are less likely to coauthor papers (Cronin, Shaw, & La Barre, 2004; Nederhof, 2006). Collaborations in these fields have increased over the years, nonetheless (Cronin et al., 2003). The LIS field is interdisciplinary; it includes computer science and social sciences, for example. Its coauthorship rates thus require further examination. Ding, Foo, and Chowdhury (1998) analyzed papers in the information retrieval (IR) area. The study included IR papers in more than 300 journals indexed in the *Social Sciences Citation Index* (SSCI) and published from 1987 to 1997. The authors found that the number of coauthored papers had risen from 28.1% to 63.1% during that decade.

Scholars have found a similar pattern for leading LIS journals. Studies of JASIST showed an increase in coauthorship before the turn of the century (Koehler, 2001; Lipetz, 1999). A recent study by Chua and Yang (2008) analyzed articles in JASIST. The authors found that coauthorship grew from 47.4% in the 1988–1997 period to 61% in the 1998–2007 period. External collaboration (with authors from different institutions) rose from 20% in 1998 to 36% in 2007. In recent years, it has become more prevalent than internal collaboration.

In summary, the extant findings point to increasing coauthorship in LIS. The next step is to distinguish the trend of international collaboration from national collaboration, and to evaluate the relationships with citations received. Differentiating international from national coauthorship is worthwhile; research suggests that the citation impacts differ. In general, a larger number of contributing authors correlate with higher citation counts. When further analyzing this finding, most studies have found that international collaboration has a higher citation impact than national collaboration (Narin, Stevens, & Whitlow, 1991). For instance, Katz and Hicks (1997) analyzed the United Kingdom's papers in the sciences. Collaboration with an author who is working in the same country contributed to a citation count increase of 0.75. The increase was 1.6 citations when the collaboration involved an author in a foreign country. Various government bodies and research institutions have increasingly favored international collaboration, in part due to the studies' broader reach and greater potential impact (Katz & Hicks, 1997).

For LIS publication, Levitt and Thelwall (2009) suggested that collaboration generally is associated with a higher citation count. This finding is based on a longitudinal analysis of data from the SSCI LIS category for every even year between 1976 and 2004. The rate of international coauthorship in the LIS field and its relationship with citation impact, however, are still not frequently measured. International coauthorship rates and patterns vary across disciplines (Glänzel & Schubert, 2005). In addition, the effects of collaboration on citation impact can differ across fields and countries (Glänzel, 2001; Moed, 2005; Persson, 2010). Further empirical analyses of LIS papers will provide insights into the viability of

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international coauthorship as a publication strategy for this field.

Collaboration may be of particular interest to authors in developing and emerging nations. The relationship between authorship affiliation, publication avenues, and citation impacts is intricate (Cronin & Shaw, 1999; Osareh & Wilson, 1997). Cronin and Shaw (1999) examined four journals in terms of authors' geographic locations, citations, and acknowledgement of funding sources. The authors found that most articles have first authors based in North Atlantic countries—the United States, the UK, and Canada (513 out of 716 articles). Papers with a first author outside the North Atlantic countries were found more likely to be uncited (28%) than papers with North Atlantic authors (14%). A chi-square test demonstrated that this relationship was statistically significant. Uzun (2002) reviewed 21 LIS journals and found that only 7.9% of the articles were by authors from developing countries or former Eastern European countries. Articles written by those authors were more often published in less prestigious journals.

In summary, in the LIS field, as in other disciplines, the visibility and impact of research conducted by scholars from developing and non-Western countries were more limited. In light of these findings, international coauthorship may be a strategy worth exploring. The current study investigated whether international collaborative LIS papers indeed have a higher citation impact.

Research Method

Sample Frame

This bibliometrics study focuses on the longitudinal changes in research papers that were published in selected top LIS journals in the last three decades. Because citation impact and prestige do not always coincide, the study incorporated two selection criteria: (1) a publication that is listed under the Information and Library Science category in the *ISI Journal Citation Report Social Science Edition* (2009 edition) and ranked in the top 15 in terms of the Journal Impact Factor; and (2) the top 15 journals in terms of prestige as ranked by directors and deans of LIS schools (Nisonger, 2005). Six publications met both criteria and were selected for this study. They are, in alphabetical order: *Annual Review of Information Science and Technology* (ARIST), *Information Processing & Management* (IP&M), *Journal of the American Medical Informatics Association* (JAMIA), *Journal of the American Society for Information Science and Technology* (JASIST), *MIS Quarterly* (MISQ), and *Scientometrics*.

The study frame consists of research papers published in these journals from 1980 to 2008 that are indexed in the ISI Web of Science (WoS) database. This study focuses on research papers, which are operationally defined here as papers listed under the document type of Article, Review, and Bibliography in the ISI database. These categories were selected since the articles are longer, with a strong focus on specific subject matter. The citation count data for all articles were obtained from WoS in November 2010. Because of publication cycles, in general, articles published in 2009 and 2010 are too recent to have accumulated substantial citations. Thus, only papers published from 1980 to 2008 were included in this study. Papers without author information and geographic affiliations were excluded. The resultant dataset contains 7,489 articles.

Limitation of Study Frame

Different LIS subfields have their own prominent journals. Evaluating all of them is beyond the scope of this exploratory study. This research focused on a subset of highly visible LIS journals. The goal was to explore the longitudinal change in authorship within this journal subset, rather than to generalize the findings to all LIS publications.

The selected journals reflect a stronger U.S. focus than when examining all journal publications in the LIS field. Scholars have discussed the coverage of WoS. Moed (2005) presented ISI's coverage of journal literature across countries and subfields. The Overall ISI Coverage Indicator for the Other Social Sciences category ranged from 20% for Germany to 43% for Taiwan. The coverage was 24% for the UK and 33% for the U.S. (The U.S. is ranked fifth in coverage for this category.) While the coverage varies, ISI is a well-established database most frequently used for bibliometrics analysis. Nisonger's study used here also represented a stronger U.S. focus, as the survey respondents were mainly based in the U.S. As the goal of this study was to identify the changes within a subset of publications, the above criteria were used to select prestigious and high-impact journals. It should be noted that this study is not an evaluation of country research productivity or impact. Further studies may include additional databases such as Scopus and Google Scholar (Meho & Yang, 2007), and include other selection criteria to provide a more comprehensive review of LIS journal internationality.

Counting Method

Authors' geographic affiliations were coded based on an author's country of employment, as indicated in the correspondence address. Hereafter, *author country* or *author region* refers to the country or region in which the author's institution is located. For brevity, a *U.S. author*, for example, refers to an author with a correspondence address in the United States, and not to an author who is a U.S. national.

Scholars have identified various ways to count multiauthored papers. Egghe, Rousseau, and Van Hooydonk (2000) offered a review, demonstrating that different methods can yield quite different findings. The present paper focuses on collaboration. The total author counting method was selected such that the data of all contributing authors could be captured.[2] The correspondence addresses of all authors were coded.

[2]This method is also called full, normal, or standard counting. An alternative is to count only one author. In that case, researchers may elect to count only the first author, the last author, or the corresponding author.

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When counting a country's contribution, this study used the absolute country counting approach, a variant of the total author counting method, discussed by Egghe et al. (2000). This method is an integer counting scheme, one that is most frequently used in research on collaboration (Bordons & Gomez, 2000). Under this scheme, the countries of all contributing authors were first recorded. Then each participating country received one (and a maximum of one) count. An alternative method is the fractional approach, where each participating country receives a fraction of the count.[3] Moed (2005) maintains that the integer method measures a country's participation, whereas the fraction count method more closely represents the number of papers creditable to a country (p. 274). The current study is interested in the longitudinal changes in authorship types, rather than each nation's exact productivity. Therefore, the integer count scheme was selected.

Because each country receives a full count instead of a fractional count, the absolute country counting method used here will yield a higher total count for each contributing country. To compare whether the result would differ significantly, further studies of LIS papers using multiple counting methods should be conducted. Recently, Huang and Lin (2010) analyzed a large set of physics journal articles and tested the effects of five author counting methods on country ranks. The researchers found that while small variations in rankings existed for certain clusters of countries, the counting methods did not greatly affect the country ranks.

When capturing citation counts, instead of using a fixed, short-time citation window, this study followed the total period method discussed by Moed et al. (1995). This method permits evaluation of the long-term impact of an article. Under this method, the citation counts received from a paper's publication through November 2010 were included.[4]

Analysis Method

SPSS, the open source R statistics program, and the ggplot2 package were used to analyze and plot the data (R Project, 2011; Wickham, 2009). RQ1 included measures of the share of three authorship types (international collaboration, national collaboration, and single authorship). This analysis was conducted for the whole sample set, each journal, and six regions. Logistic regression was used to address RQ2. In bibliometrics research, the number of times an article is cited is considered a measure of the article's impact (Wilson, 1999). RQ2 tested whether citations received are related to authorship type, the author's geographic affiliation (in terms of the subregion), and the income level of the author's country. Scholars have found these variables to be significant: for example, the coauthorship type, Katz and Hicks (1997); the author's geographic affiliation, Cronin and Shaw (1999); and the country's income level, Akre et al. (2011) and Sin (2005). This study's geographic subregion categories were derived from the classification system of the United Nations Statistical Division (2010). Table 1 presents the relationships among the regions, subregions, and countries. The income level category for each country was based on the World Bank classification (2010).

The three variables discussed above are the main emphases of this study. Based on findings from previous research, four more variables were included to account for variance in citations received. The year of publication was included, as articles that are published earlier have more time to accumulate citations, but there may also be aging of older articles (White & McCain, 1989). The number of authors is related to a larger number of citations (Katz & Hicks, 1997). Thus, this variable was included. Lastly, the document type and journal title were included to account for the varying citation patterns related to different paper types (Moed & Van Leeuwen, 1995), subfields (Wilson, 1999), and journal citation impact (Larivière & Gingras, 2010).

In summary, this study tested seven explanatory variables: (1) authorship type, (2) author's subregion, (3) income level of the author's country, (4) publication year, (5) number of authors, (6) document type, and (7) journal title.

The outcome variable, citations received, is not normally distributed. Seglen (1992) demonstrated the highly skewed distribution for all articles within a discipline, a journal, or even for articles written by the same scholar. A few studies are cited frequently, while a large portion of the articles is uncited. Albarrán and Ruiz-Castillo (2011) analyzed about 3.7 million articles published from 1998 to 2002. The authors found that about 9% of the papers accounted for 44% of all citations received. This skewed distribution exists in the present study as well. Thus, for the outcome variable, citations received were categorized as less cited and more cited using the median (seven citation counts for this study) as the cutoff point.

This research does not aim to build a model for citation count prediction. The literature on the theory of citing highlights that citation behavior is influenced by complex scientific, disciplinary, and institutional norms, as well as individual peculiarities (Cronin, 1984; Moed, 2005; Nicolaisen, 2007). Modeling such factors is beyond the scope of the present study. In addition, the variables tested here are not conceptualized as the ultimate causes of differential citation count. Scholars have cautioned against inferring causal relationships from such analysis (Moed, 2005). In addition, oft-used variables such as the income level of the author's country (e.g., in Price, 1986) often stand as a proxy for a host of related factors, including education level, R&D funding, national ICT infrastructure, and so on. The current logistic regression analysis aims to test whether geographical factors are, indeed, related to significant different citation counts.

[3]To illustrate, assume a paper has three authors, one from country A and two from country B. Under the integer counting scheme used here, countries A and B will each receive one count. If a fractional method were used, the countries' contributions will sum to 1. For example, country A will receive 1/3 count, while country B will receive 2/3 count. Under the fractional methods, there are also different ways of distributing the credit across countries (see, for example, Moed, 2000).

[4]In the logistic regression analysis, the publication date was included to control for variations related to the difference in years since publication.

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TABLE 1. Regions, subregions, and countries.

Regions	Subregions	Countries		
Africa	Eastern Africa	• Ethiopia	• Kenya	• Tanzania
		• Zambia		
	Northern Africa	• Egypt		
	Southern Africa	• South Africa		
	Western Africa	• Nigeria		
Asia	Eastern Asia	• China	• Hong Kong Special Administrative Region, China	• Macao Special Administrative Region, China
		• Japan	• South Korea	• Taiwan
	South-Eastern Asia	• Malaysia	• Philippines	• Singapore
		• Thailand		
	Southern Asia	• India	• Iran	• Pakistan
	Western Asia	• Bahrain	• Cyprus	• Israel
		• Jordan	• Kuwait	• Lebanon
		• Oman	• Saudi Arabia	• Turkey
Europe	Eastern Europe	• Belarus	• Bulgaria	• Czech Republic
		• Hungary	• Poland	• Romania
		• Russia	• Slovakia	• Ukraine
	Northern Europe	• Denmark	• Estonia	• Finland
		• Iceland	• Ireland	• Lithuania
		• Norway	• Sweden	• United Kingdom
	Southern Europe	• Croatia	• Greece	• Italy
		• Portugal	• Slovenia	• Spain
		• Former Yugoslavia		
	Western Europe	• Austria	• Belgium	• France
		• Germany	• Luxembourg	• Netherlands
		• Switzerland		
Latin America and the Caribbean	Caribbean	• Cuba		
	Central America	• Mexico		
	South America	• Argentina	• Brazil	• Chile
		• Colombia	• Uruguay	• Venezuela
North America	Northern America	• Canada	• United States	
Oceania	Australia and New Zealand	• Australia	• New Zealand	

Based on United Nations Statistics Division – Standard Country and Area Codes Classifications (2010).

If significant differences are found for this sample set, further research is encouraged to test for more explanatory variables and to investigate the reasons behind such differences.

Findings

Description of the Dataset

The sample dataset included 7,489 papers. Among them, 93.6% belonged in the Article category, 6% of them were Review, and 0.3% were Bibliography. The number of papers published in each journal and its share of the sample dataset were as follows: ARIST, 255 (3.4%); IP&M, 1,425 (19%); JAMIA, 1,119 (14.9%); JASIST, 2,330 (31.1%); MISQ, 631 (8.4%); and *Scientometrics*, 1,729 (23.1%).

All authors were included in the analysis, yielding 17,626 author counts. The mean number of authors per paper was 2.35 (SD = 1.71). The median was 2. The highest number was 30, from a paper published in JAMIA. Authors from 73 countries contributed papers to the six publications. Under the absolute country counting method, there were 8,394 country counts. The papers with the highest number of countries involved authors from six nations.

Overall, authors based in the U.S. contributed the largest number of papers: 4,095 papers out of the total 7,489 papers (54.7% of all papers). The U.S. is followed by authors in the UK, who contributed 554 papers (7.4%), Canada (435 papers, 5.8%), the Netherlands (275 papers, 3.7%), Belgium (212 papers, 2.8%), Germany (196 papers, 2.6%), Spain (195 papers, 2.6%), France (169 papers, 2.3%), Australia (165 papers, 2.2%), and India (165 papers, 2.2%). In sum, the top two countries (the U.S. and the UK) contributed to 62.1% of all papers. The top five accounted for 74.4%, and the top 10, 86.2%.

Table 2 shows the top 10 contributing countries for each 5-year interval. The top-10 lists for the six 5-year periods showed notable variations. A total of 19 nations were found on the lists. Only four countries (the U.S., the UK, Canada, and the Netherlands) appeared in the top-10 lists throughout

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TABLE 2. Top-ten contributing countries in 5-year intervals.

1980–1984				1985–1989				1990–1994			
Country	Num. of papers	Share of papers ($n = 731$)	Cumulative %	Country	Num. of papers	Share of papers ($n = 711$)	Cumulative %	Country	Num. of papers	Share of papers ($n = 1{,}210$)	Cumulative %
US	481	65.8%	65.8%	US	411	57.8%	57.8%	US	685	56.6%	56.6%
UK	45	6.2%	72.0%	Canada	54	7.6%	65.4%	Canada	85	7.0%	63.6%
Canada	43	5.9%	77.8%	UK	51	7.2%	72.6%	UK	82	6.8%	70.4%
Hungary	21	2.9%	80.7%	Hungary	28	3.9%	76.5%	Germany	59	4.9%	75.3%
Israel	16	2.2%	82.9%	Netherlands	26	3.7%	80.2%	Netherlands	45	3.7%	79.0%
Poland	16	2.2%	85.1%	Russia	19	2.7%	82.8%	France	40	3.3%	82.3%
Netherlands	15	2.1%	87.1%	India	18	2.5%	85.4%	Belgium	37	3.1%	85.4%
India	14	1.9%	89.1%	France	16	2.3%	87.6%	India	28	2.3%	87.7%
Japan	14	1.9%	91.0%	Belgium	13	1.8%	89.5%	Hungary	25	2.1%	89.8%
Russia (Former USSR)	13	1.8%	92.7%	Israel	11	1.5%	91.0%	Australia	23	1.9%	91.7%

1995–1999				2000–2004				2005–2008			
Country	Num. of papers	Share of papers ($n = 1{,}412$)	Cumulative %	Country	Num. of papers	Share of papers ($n = 1{,}869$)	Cumulative %	Country	Num. of papers	Share of papers ($n = 1{,}556$)	Cumulative %
US	892	63.2%	63.2%	US	935	50.0%	50.0%	US	691	44.4%	44.4%
UK	75	5.3%	68.5%	UK	151	8.1%	58.1%	UK	150	9.6%	54.0%
Canada	71	5.0%	73.5%	Canada	100	5.4%	63.5%	Spain	86	5.5%	59.6%
India	41	2.9%	76.4%	Belgium	77	4.1%	67.6%	Canada	82	5.3%	64.8%
France	39	2.8%	79.2%	Netherlands	75	4.0%	71.6%	Netherlands	77	4.9%	69.8%
Netherlands	37	2.6%	81.8%	Spain	64	3.4%	75.0%	China	66	4.2%	74.0%
Germany	33	2.3%	84.1%	Australia	54	2.9%	77.9%	Belgium	61	3.9%	78.0%
Australia	30	2.1%	86.3%	South Korea	51	2.7%	80.6%	Taiwan	49	3.1%	81.1%
Spain	25	1.8%	88.0%	France	46	2.5%	83.1%	Australia	48	3.1%	84.2%
Belgium	23	1.6%	89.7%	Germany	45	2.4%	85.5%	Singapore	43	2.8%	87.0%

all six periods. The number of times other countries appeared in the top-10 lists varies, ranging from five times (Belgium) to once (China, Japan, Poland, Singapore, South Korea, and Taiwan). Table 3 presents the numbers and shares of papers by region.

Research Question 1: Authorship Trends

For this set of 7,489 papers, single authorship accounted for 2,675 papers (35.7%). There were 4,062 national collaborative papers (54.2%) and 752 international collaborative papers (10%). Figure 1 shows the longitudinal change in authorship for the whole dataset and for individual journals.

In terms of the whole dataset, single authorship used to be the dominant type. In 1980, 55.9% of the papers were in this category. About 42.2% involved national collaboration, and 2% involved international collaboration. In 1995, national collaboration accounted for 53% of all papers published that year. Since then, national collaboration has been the most common authorship type. In 2008 the share of papers involving single authorship, national collaboration, and international collaboration was 23.3%, 59.5%, and 17.3%, respectively.

The drop over the years in the number of single-author papers is notable. This drop has slowed down since approximately 2002. Throughout the years, international coauthorship has remained the least common category. Nevertheless, a rising trend in international collaboration can be seen in Figure 1. To conclude, the increase in national and international coauthorship that has been observed in other disciplines was also found in this set of high-ranking LIS journals.

Table 4 shows the general authorship patterns for each journal. Most shared the same pattern as the one described above for all six journals combined. JAMIA and MISQ stand out in their notably high national collaboration rates. Incidentally, these journals are highly specialized: JAMIA in medical sciences and MISQ in management. ARIST exhibited a slight variation from pattern 1, as single authorship was still the most common category in 2008. ARIST's annual review nature may partly account for the difference. The gap between single authorship and national coauthorship has narrowed, nonetheless. These variations indicate that future studies, in addition to examining all journals as a whole set, should analyze findings by specialization and publication type.

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TABLE 3. Numbers and shares of papers by region, in 5-year intervals.

Region	1980–84 ($n = 731$)	1985–1989 ($n = 711$)	1990–1994 ($n = 1,210$)	1995–1999 ($n = 1,412$)	2000–2004 ($n = 1,869$)	2005–2008 ($n = 1,556$)	1980–2008 ($N = 7,489$)
North America	524 (71.7%)	465 (65.4%)	770 (63.6%)	963 (68.2%)	1,035 (55.4%)	773 (49.7%)	4,530 (60.5%)
Europe	156 (21.3%)	216 (30.4%)	387 (32.0%)	359 (25.4%)	680 (36.4%)	654 (42.0%)	2,452 (32.7%)
Asia	50 (6.8%)	46 (6.5%)	89 (7.4%)	135 (9.6%)	338 (18.1%)	369 (23.7%)	1,027 (13.7%)
Oceania	8 (1.1%)	8 (1.1%)	30 (2.5%)	38 (2.7%)	67 (3.6%)	56 (3.6%)	207 (2.8%)
Latin America and the Caribbean	4 (0.5%)	8 (1.1%)	17 (1.4%)	19 (1.3%)	38 (2.0%)	34 (2.2%)	120 (1.6%)
Africa	9 (1.2%)	11 (1.5%)	11 (0.9%)	2 (0.1%)	11 (0.6%)	14 (0.9%)	58 (0.8%)
Total[a]	751	754	1,304	1,516	2,169	1,900	8,394

[a]Under the absolute country counting approach, all contributing countries of a multi-authors paper received one full count instead of a fractional count. The column totals in this table thus exceed 100%.

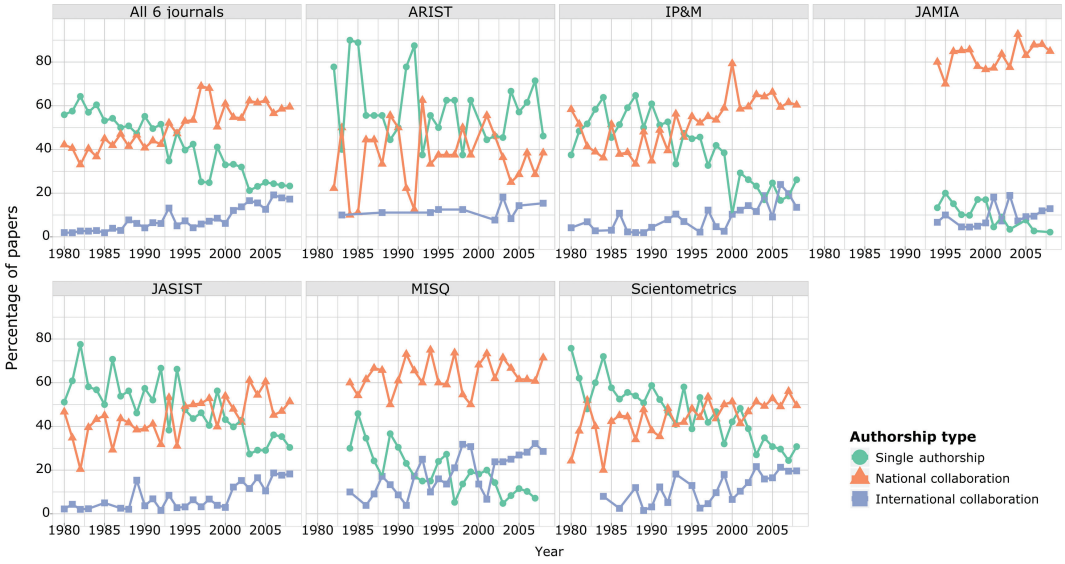

FIG. 1. Trends in authorship types by journal. [Color figure can be viewed in the online issues, which is available at wileyonlinelibrary.com.]
Note. JAMIA was launched in 1994.

TABLE 4. Generalized patterns of changes in authorship types.

Pattern	Early pattern (1980s)	Recent pattern (late 2000s)	Journal
1	Single authorship > National coauthorship > International coauthorship	National coauthorship > Single authorship > International coauthorship	All 6 journals combined; IP&M; JASIST; Scientometrics
2	Single authorship > National coauthorship > International coauthorship	Single authorship > National coauthorship > International coauthorship	ARIST
3	High national coauthorship > Single authorship > International coauthorship	High national coauthorship > International coauthorship > Single authorship	JAMIA; MISQ

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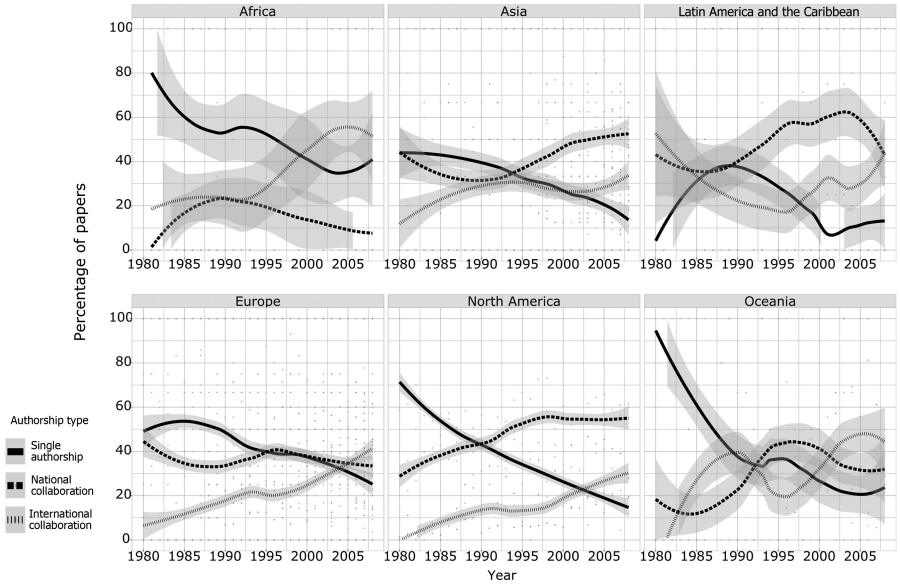

FIG. 2. Trends in collaboration types by region.

This section explores authorship types based on author regions. Figure 2 presents the percentage of papers that involved single authorship, national collaboration, and international collaboration for each country in six regions. Local regression (loess) fit lines were plotted for each region (gray lines). The shaded area shows the 95% confidence intervals.

In the 1980s, five of the six regions (Africa, Asia, Europe, North America, and Oceania) had single authorship as the main category. Latin America and the Caribbean stood out, as international collaboration was the most common type. In the early 1980s the share of single-author papers was particularly high for Oceania, but the rate dropped markedly afterward. Europe experienced an increase in single authorship in the early 1980s. Single authorship in Latin America and the Caribbean also rose during the 1980s. This share dropped in the 1990s. For most regions, the share of single-author papers is generally decreasing. This suggests that collaboration is in favor, not only in particular regions; collaboration has become quite common for authors across continents. Since 2000, the downward trend for single authorship has leveled out a bit for Africa, Latin America and the Caribbean, and Oceania. Whether the average share of single-author papers will stop decreasing in North America, Asia, and Europe remains to be seen.

Regions' authorship types in recent years were also examined. On average, authors in North American and Asian countries have had the highest share of national collaborative papers (i.e., those that involve coauthorship with researchers in the same country), followed by international collaborative and then single-author papers. In 2008, Latin America and the Caribbean shared the same pattern as North America and Asia. Nevertheless, the trend suggests that it may change into a pattern similar to that of Europe and Oceania. For the latter two regions, a larger share of papers involved international collaboration, followed by national collaboration, and then single authorship. Africa exhibited a different pattern. Internationally coauthored papers overtook single-author papers as the main category around 2000. National coauthorship was the least common category. National coauthorship has also shown a downward trend since the 1990s. In 2008, on average, less than 10% of papers from Africa involved national collaboration. This trend is different from those of the other five regions, where, on average, at least 30% of the papers involved national collaboration in 2008.

Research Question 2: Citation Impact

Logistic regression was used to test the relationships of the seven explanatory variables with the odds of an article being more cited. Before the analysis, a multicollinearity test was performed using the SPSS Collinearity Diagnostics function. Multicollinearity occurs when two or more independent variables are highly correlated. A rule of thumb is that a tolerance value of less than 0.20 may indicate multicollinearity (Menard, 2002). The diagnostic results showed that all seven variables in this study have tolerance values above the recommended level. Thus, all seven variables were included in the analysis with the SPSS Binary Logistic function. The findings were significant ($\chi = 1494.54$, $df = 56$, $p < 0.00$). For this analysis, the Nagelkerke R^2 was 0.218. That is, the seven variables explained 21.8% of the variations in the outcome variable (i.e., an article being less cited or more cited).

This study focused less on the overall model and more on the relationships of individual variables with citations received. The seven variables were all found to be significant (Table 5). The odds ratio (OR) was used to evaluate how each variable, and each level within the variable, affected the direction and magnitude of changes in the outcome variable. An OR higher than 1 suggests that a paper with that characteristic has a higher likelihood of being cited more than that of the reference group.

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TABLE 5. Results of logistic regression: Odds of a paper being more-cited.

	B	SE	Wald	df	Sig.	Odds ratio
Authorship type			21.39	2	0.000**	
• International collaboration	0.34	0.09	16.41	1	0.000**	1.41
• National collaboration	0.04	0.07	0.41	1	0.523	1.04
• Single authorship (Reference category)						
Subregion			94.17	16	0.000**	
• Southern Africa	0.85	0.46	3.47	1	0.062	2.34
• Northern Europe	0.18	0.08	4.77	1	0.029*	1.20
• Australia and New Zealand	0.13	0.16	0.68	1	0.408	1.14
• Western Africa	0.07	1.3	0	1	0.956	1.07
• Western Europe	0.06	0.08	0.48	1	0.488	1.06
• South America	0.01	0.28	0	1	0.961	1.01
• Eastern Europe	−0.02	0.15	0.02	1	0.882	0.98
• Western Asia	−0.1	0.17	0.33	1	0.566	0.91
• Southern Asia	−0.19	0.23	0.65	1	0.419	0.83
• South-Eastern Asia	−0.58	0.24	5.81	1	0.016*	0.56
• Central America	−0.62	0.56	1.24	1	0.265	0.54
• Southern Europe	−0.65	0.13	23.57	1	0.000**	0.52
• Eastern Africa	−0.7	1.47	0.23	1	0.635	0.50
• Northern Africa	−0.75	0.78	0.92	1	0.338	0.47
• Eastern Asia	−0.76	0.12	43.34	1	0.000**	0.47
• Caribbean	−1.29	1.1	1.37	1	0.241	0.27
• Northern America (Reference category)						
Country income level			17.67	2	0.000**	
• Lower income	−0.43	1.18	0.13	1	0.716	0.65
• Middle income	−0.62	0.15	17.64	1	0.000**	0.54
• High income (Reference category)						
Publication year			580.87	28	0.000**	
Number of authors	0.08	0.02	16.76	1	0.000**	1.08
Document type			40.67	2	0.000**	
• Review	0.84	0.13	40.67	1	0.000**	2.32
• Bibliography	−21.65	7387.02	0.00	1	0.998	0.00
• Article (Reference category)						
Journal			308.33	5	0.000**	
• MISQ	2.29	0.19	140.15	1	0.000**	9.85
• JASIST	0.50	0.17	8.73	1	0.003**	1.65
• Scientometrics	0.36	0.18	4.25	1	0.039*	1.44
• IP&M	0.35	0.17	3.96	1	0.047*	1.42
• JAMIA	0.35	0.18	3.68	1	0.055	1.41
• ARIST (Reference category)						
Constant	−2.54	0.21	150.05	1	0.000	0.08

*$p < 0.05$; **$p < 0.01$.

The logistic analysis showed that authorship type was significant. International collaborative papers had statistically different citation counts. These papers were 1.41 times more likely than single-author papers to be cited more. The difference in citations between national collaborative papers and single-author papers, however, was not statistically significant.

All other factors being constant, articles from middle-income countries (OR = 0.54) were less likely than those from the high-income group to be cited more. In terms of authors' geographic subregions, ceteris paribus, papers authored by scholars in East Asia (OR = 0.47), Southeast Asia (OR = 0.56), or Southern Europe (OR = 0.52) were less likely to be in the more-cited category, compared to the reference group (i.e., papers from North America). However, papers from Northern Europe were more likely than those from North America to be in the more-cited category (OR = 1.2).

As noted, publication year, the number of authors, document type, and journal title were included to control for variance. All four were found to be significant in this study. Papers had an increased likelihood of being more cited if they had a greater number of authors (OR = 1.08). In general, papers published recently were less likely than earlier papers to be more cited. Because publication year served mainly as a statistical control and was not the focus of this study, the OR for each of the 29 years is neither listed in Table 5 nor further discussed here. In terms of document type, papers in the Review category tended to be more cited than those in the Article category (OR = 2.32). The citation counts of Bibliography, however, were not statistically different from those of the Article category. The findings suggest notable difference

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between annual review publications such as ARIST and other journal titles. Future investigators, especially those not controlling for journal title and document type variance, may consider focusing only on regular journals.

Discussion

The analysis shows that the shares of national and internationally coauthored papers published in the leading LIS journals have increased. This finding indicates a trend similar to those found in other disciplines (Glänzel & Schubert, 2004). National collaboration, rather than single authorship, is now the dominant authorship type. While international coauthorship is still the least common category in four of the publications, it nevertheless exhibits a rising trend.

Analysis at the authors' subregion level indicates that although the rate differs, collaboration is now common for most countries around the world. Based on the sample data, international coauthorship is hypothesized to continue to rise. However, it may not overtake national coauthorship as the dominant category for some time to come. This is in part due to the presence of large nations with high research output. Scholars based in large countries with many research institutes, such as the U.S., will have ample opportunities for national collaboration (Schubert & Braun, 1990). These countries may continue to have a higher share of national collaborative papers than international collaborative ones.

International collaboration is now more convenient with the advances in ICT and transportation systems. Nevertheless, such collaboration can still incur extra monetary and time costs when compared to national collaborations (Davis & Wilson, 2001). The cost may be particularly high for countries where ICT and transportation infrastructure are being developed. There are notable disparities in the deployment of ICT worldwide (International Telecommunication Union, 2008). This disparity may be an additional disadvantage for researchers from developing nations vis-à-vis those from developed countries.

In addition, recent advancements in ICT might actually widen the communication gap. Social informatics scholars have underscored the need to critique the differential impacts of ICT on various groups (Kling, 2000; Sawyer & Eschenfelder, 2002). Downey (2007) demonstrated how the critical approach of human geography can contribute to LIS research. He discussed the "geographies of infrastructure" and their role in reproducing social power (p. 697). The uneven deployment of ICT infrastructure, such as fiber optics and cables, can influence "the production, distribution and consumption of . . . knowledge-bearing artifacts" (Downey, 2007, p. 691). Drawing from the above perspectives, in addition to analyzing the benefits of collaboration, we also need to study the costs of national and international collaboration (monetary and otherwise) for researchers in different locations. Sociostructural factors can reinforce the uneven access to communication systems; these factors need to be examined. Cross-cultural studies of scholars and policymakers may shed light on the facilitators and barriers of international scholarly communication, as well as the perceived cost and value of ICT and collaboration types on research productivity and impact.

Coauthorship type was found to be a significant factor for citation count. From a practical angle, the findings suggest that international coauthorship can be a good publication strategy. In this analysis, international coauthorship contributed to an increased likelihood of being cited more (1.41 times greater) than single-author papers, after holding other factors constant. This finding, in general, agrees with findings concerning other disciplines.

In contrast to findings for journal publications in other disciplines, in the current study national collaboration did not statistically increase the odds of a paper being cited more. Further analysis on a larger set of LIS data is encouraged to test this aspect. One reason for this difference may be the inclusion of the number of authors in the multivariate analysis. This author ran another logistic regression without the number of authors variable. The result for national collaboration is statistically significant; national collaborative papers were likely to be cited more than single-author papers ($OR = 1.19$, $p = .003$). Under this alternative model, international coauthorship was, again, statistically significant. The OR was 1.65, which is higher than the 1.41 odds found when the number of authors variable was included. These findings suggest that the relationship of authorship to citations received can partly be attributed to the higher number of authors involved. Self-citation can contribute to this relationship (Glänzel, Debackere, Thijs, & Schubert, 2006). Another reason may be social networks. A study can be formally and informally shared through each author's personal network. For papers with a greater number of authors, sharing through personal networks may contribute to a higher chance of the papers being visible and, hence, cited.

The finding that citation counts varied with author geographic affiliation is worth examining. Cronin and Shaw's study (1999) showed that papers with first authors outside the North Atlantic nations were more likely to be uncited than those within these nations. The results in the current study were similar. The income level category of the author's country was found to be significant. Authors from middle-income countries were more likely to be less cited than those from high-income nations. This finding is in line with the findings of Sin (2005), which included a set of 20 high-ranking LIS journals. The present study found that lower-income nations also have a lower OR than their high-income counterparts; the difference was not statistically significant, however. This may be explained, in part, by the lower number of cases for this level. Only 26 papers (0.4%) involved authors from lower-income nations. A larger dataset may find significant results for this income group.

An author's subregion also made a difference, even after factors including the country's income level were taken into account. The question then arises why the citation count differs. The selected publications are all prestigious, and thus, we can assume there are no systematic variations in paper quality based on the author's country income level or

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subregion. Factors beyond the quality of the paper are in play. Further empirical studies and exploration of the theory of citing will shed light on the factors salient to citations. These studies will involve research at different levels—macro-level studies of aggregated data that explore structure and norms, as well as meso- and micro-level analyses that uncover the peculiarities in citing behaviors (Moed, 2005). Teasing out all factors influencing citations received is beyond the scope of this paper. The following discussion will focus on proposing plausible factors that contribute to country income level and subregion differences.

Variations in citation counts by the authors' subregions may be interpreted from the perspective of the Matthew Effect and cumulative advantage. Merton developed the concept of the Matthew Effect in Science. It suggests that, for comparable achievement, famous scientists are often disproportionally bestowed more credit, visibility in publication, and funding resources than less widely recognized scientists (Merton, 1968). Cole and Cole (1973) discussed that researchers comparing works of similar quality could be influenced by factors beyond the substantive content of the work itself. Authors employed in prestigious institutes are more likely to have their publications respected. This contributes to the accumulation of advantages, which leads to a scenario of the rich get richer, and the poor, poorer (Merton, 1968).

Scholars have also found this skewed rewards system for scientific institutions (Merton, 1988). Extending Merton's and Cole and Cole's insights, one can infer that this effect can be found at the country and regional levels. Countries and regions with a long history of scholarly publishing are likely to have more eminent scholars and research resources than emerging nations. From a sociometric angle, eminent scholars are also sociometric stars with extensive networks. These networks can contribute to higher research visibility, and subsequently, more citation of their research. The higher concentration of eminent authors can draw higher-than-expected citations to the established countries. As discussed earlier, Downey explored the geographies of ICT infrastructures. The current author proposes furthering our examination of geospatial aspects, including the geographies of invisible colleges. That is, future research may include the geographic attributes of collaborating or cociting authors when studying their collaboration types, frequency, productivity, and citation impact.

Bonitz, Bruckner, and Scharnhorst (1997) proposed a Matthew index to measure the Matthew Effect of countries (MEC). The Matthew index is calculated using the following formula: (Observed citation rate − expected citation rate) / expected citation rate. The expected citation rate of a country is based on the citation impact of the journals where the country's authors contributed. The finding is of interest to us, as it suggests that the differential effect of geographic affiliation on citation impact is also found in other disciplines. Based on the 1990–1994 SCI data, Bonitz et al. (1997) found that the following countries received high-than-expected citation rates (i.e., Matthew index >1), in descending order: Switzerland, Denmark, the Netherlands, Sweden, the UK, West Germany, Finland, the U.S., and Ireland. The 20 countries with the lowest Matthew index included three East Asian and three Southern European countries.

Several Northern European countries had higher MEC than the U.S. This finding is similar to the present study's findings, where papers with Northern European authors have higher odds of being more cited than those with North American authors. Bonitz et al. found several Western European countries with a higher MEC than the U.S. However, this effect was not found in the current study. (Western European papers had a higher OR of 1.06, but it is not statistically significant.) The difference in findings may in part be attributed to disciplinary differences and study time frame, and because the current study used subregion-level analysis. Bonitz et al.'s study is based on early 1990s data. It would be interesting to examine whether this pattern is still found in SCI or in a large set of LIS journals.

Other than the Matthew Effect and cumulative advantage, this author proposes testing the influence of a study's geographic focus, termed here a geographic scope effect. This author hypothesized that a study's geographic scope can contribute to explaining the variances in citations received with regard to authors' geographic affiliations. Several factors, such as social ties and intellectual ties, have been proposed in examining the variations in citation. White, Wellman, and Nazer (2004) conducted a unique analysis that measured sociometric and bibliometric data. The study demonstrated the importance of intellectual ties, which refer to the "commonality of discipline, subject matter, research methods, and perspective" (p. 112). White et al. tested the effect of social ties, intellectual ties, and mixed ties on the frequency of intercitation among 16 prominent scholars. The authors found that stronger social ties, such as collegial ties and friendship, correlated with more frequent intercitation. When multivariate analysis was conducted via regression, the significant factor was intellectual ties/affinity (as reflected in cocitation by third parties) rather than social ties.

A study's geographic scope can be examined as a facet of intellectual ties. Studies with the same geographic scope may share similar sample populations, sociocultural contexts, and possibly similar perspectives. In certain disciplinary areas such as agriculture, history, and some LIS subfields (e.g., information behavior), geospatial and contextual factors are recognized as influential. This is not to say that national studies are of no import to overseas scholars. The contrary is recognized (Nederhof, 2006). Nevertheless, when studies are available, scholars may prefer to consult papers with a scope and sample population that parallel the scholars' own study, before they use studies of different geographic, economic, and social environments.

Authors from North Atlantic nations make up a large percentage of scholars publishing in top LIS journals indexed in SSCI (Sin, 2005). Assuming that the majority of papers analyzed cases and data from the authors' own nations, a large collection of LIS papers will be on the North Atlantic context.

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Most researchers may not need to seek out extra papers with a scope outside the North Atlantic nations. This may contribute to lower citation counts of papers from other regions. Previous studies have found that authors tend to cite scholars from the same region (Wormell, 1998), language (Yitzhaki, 1998), or nation (Bookstein, Moed, & Yitzahki, 2006; Moed, 2005). The geographic scope of a study may be a factor contributing to these preferences.

Geographical scope may also partly explain the higher impact of international collaborative papers when compared to national collaborative papers. International research involves participants from different countries, and may include cross-cultural perspectives. This may help increase a study's perceived relevance to a large number of scholars. Additional analysis is needed to test this hypothesis of a geographic scope effect. Content analysis can be used to code papers' geographic scopes; further hypothesis testing can then be conducted. Another avenue of research involves testing whether countries with lower citation impacts have a higher concentration of papers in LIS subfields where geographic scope is particularly salient. This could contribute to a higher chance of differential citation counts, when compared to countries that specialized in subfields where sociospatial context is less of a concern.

Conclusion

Collaboration among scholars on journal publications, nationally and internationally, increased in the six LIS publications during the 1980–2008 period. Such worldwide sharing of ideas and resources will be favorable to the continuous growth of the LIS field. Similar to the findings for other disciplines, international coauthorship is related to higher citation counts. Although national collaboration in itself is not statistically significant in this analysis, papers with a larger number of authors have higher odds of being more cited. This suggests that collaboration, no matter the type, is positively related with citation impact. These findings may encourage more research collaboration and coauthorship in LIS, a practice increasingly recommended by government agencies and research institutions (European Commission, 2009).

Apart from science policy and publication strategy implications, more research on the cost of collaboration and on the relationships between authors' geographic affiliations and their research impact is needed. The reasons that citations received vary with authors' subregions and countries' income levels warrant further examination. In addition to the geographies of infrastructure discussed by Downey (2007), this author proposes exploring the geographies of invisible colleges and testing a possible geographic scope effect. Continuous research in bibliometrics and scholarly communication, together with the critical perspectives offered by social informatics and human geography, will shed further light on the trends, facilitators, and barriers in communication for researchers in different areas of the world. Such knowledge will speed up our progress toward full-fledged globalization of science and scholarship.

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