Bibliometrics and research evaluation: an overview

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Outline of the presentation

- Why Evaluating Research?
- What is bibliometrics?
- Data sources and their limits
- Bibliometric indicators
  - Case study

Research Evaluation (1)

- Recent trend that started in the 1980s and accelerated in the 1990s
  - Until then, governments only monitored inputs ($)
    - Imputs are easy to measure....
- Though we may or may not agree that evaluating research is a good thing:
  - It is nonetheless a tendency that is there to stay.
  - Used to define priorities and reorient limited funds
  - We thus need to understand the methods and their limits and make sure that they are use appropriately.

Research Evaluation (2)

Evaluation must take into account the specific missions of the organization

- Government laboratory?
- University department?
- Research laboratory
- Monitoring function?
- Etc....

Missions and objectives must be defined before any evaluation.

Research Evaluation (3)

- Standard form: Peer review
- Peer review: “Process of subjecting an author's scholarly work, research or ideas to the scrutiny of others who are experts in the same field” (wiki).
  - Applied at several levels in the scientific community, such as:
    - Publications
    - Grants
    - Jobs
    - Tenure

Research Evaluation (4)

- Disadvantages of peer review in research evaluation:
  - Expensive
  - Optimal size: individuals, small research groups
    - Less efficient for large organizations and countries
  - Subjective
    - Varies with individuals

- Hence, bibliometrics is more and more often used to supplement or (more rarely) replace peer review.
  - Optimal for large groups(universities, countries)
    - Less subjective since based on reproducible data

- Mixed methods are also often used: quantitative summary reports given to reviewers who also meet with researchers of the lab or research unit.

What is bibliometrics? Definitions

- Term first coined by Alan Pritchard (1969).
- “a field that uses mathematical and statistical techniques, from counting to calculus, to study publishing and communication patters in the distribution of information” (Diodato, 1994).
- In other words, bibliometrics is the “application of various statistical analyses to study patterns of authorship, publication, and literature use.” (Lancaster, 1977).

What is bibliometrics? Definitions (2)

- Though these definitions could apply to the study of any kind of literature — from novels to newspapers —, bibliometrics is generally used for the measurement of **science and technology** (Moed, 2005; van Raan, 1988).
  - And is often called *Scientometrics.*
  - Hence, bibliometrics and scientometrics are often used as synonyms.

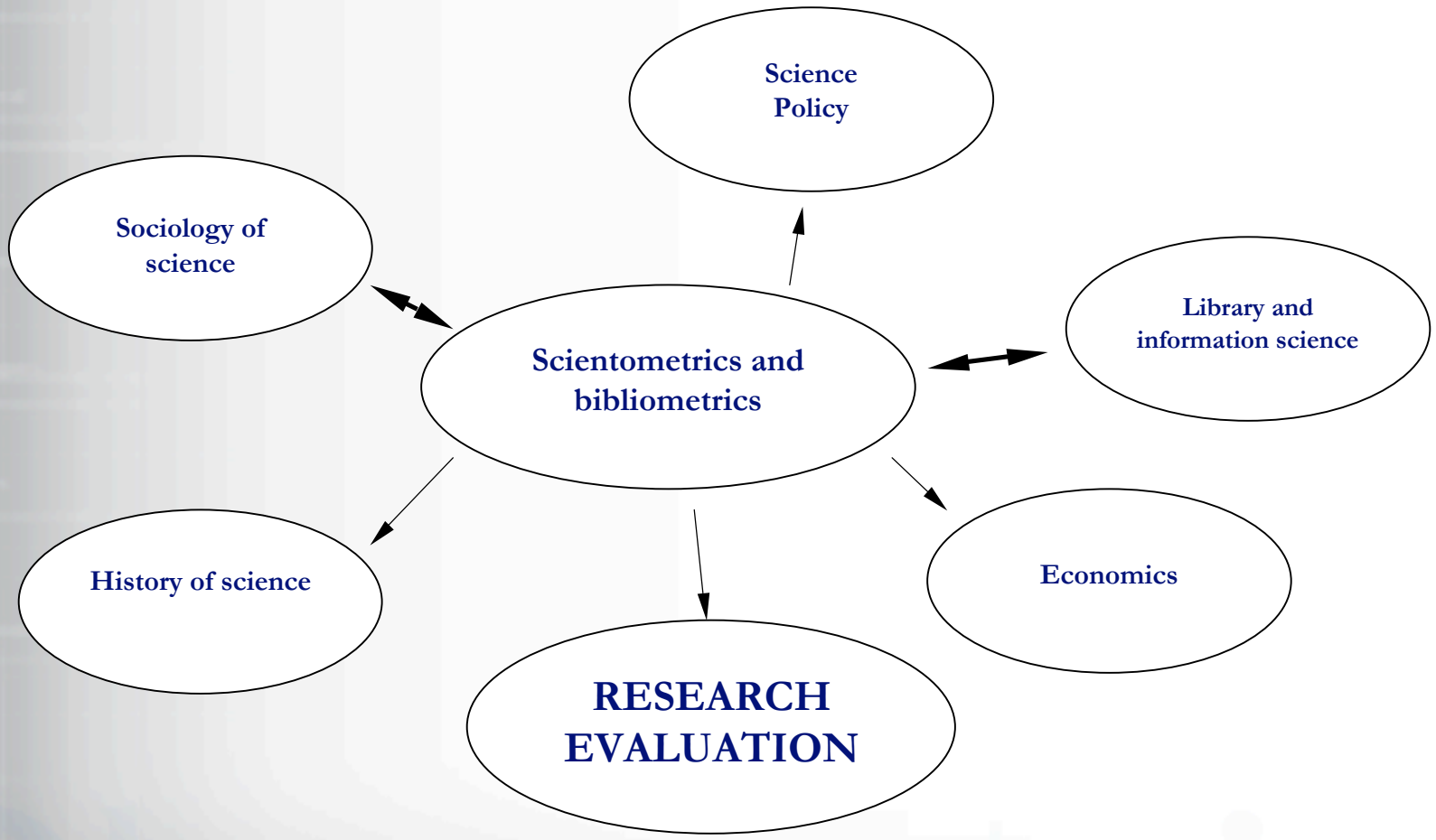
What is bibliometrics? Definitions (3)

- It uses published scientific literature (articles, books, conference proceedings, 'gray literature' etc.) as a way of measuring scientific activity.
- One of the basic ideas of bibliometrics is that new knowledge created by scientists is embedded in the scientific literature, and that by measuring scientific literature, we measure knowledge.

The field of bibliometrics / scientometrics

- Bibliometrics is now a research field in itself, located at the “crossroads” of information sciences and sociology of science
- It has its own international journal (*Scientometrics*) since 1978
  - and several other international journals publish bibliometric research: *JASIST*, *Social Studies of Science*, *Research Policy* (among others).
- Its scientific society: the International Society for Scientometrics and Informetrics (ISSI)

What is bibliometrics? Some applications



Main use of bibliometrics : science policy & research evaluation

- Positioning and benchmarking of countries, cities, research groups
- Sector studies e.g. genomics, stem cells, nanotechnologies
- Citation analysis, scientific impact and excellence assessment
- Network and collaboration mapping (e.g. international, inter-provincial and inter-institutional)
- Program-related question, e.g. measuring the impact of funding on scientific production

Typical scientific paper

Journal and title of the paper →

PHYSICAL REVIEW C **76**, 044312 (2007)

In-beam γ-ray and α-decay spectroscopy of ^{170}Ir

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Abstract →

Excited states in the highly neutron deficient odd-odd nucleus ^{170}Ir have been investigated. The experiment was performed using the ^{112}Sn(^{60}Ni, pn)^{170}Ir reaction and employing the recoil-decay tagging technique. Gamma rays were detected using the JUROGAM γ-ray spectrometer and those belonging to ^{170}Ir were selected based on recoil identification provided by the RITU gas-filled recoil separator and the GREAT spectrometer at the RITU focal plane. A partial level scheme of ^{170}Ir is presented for the first time. New α-decay branches are assigned to ^{170}Ir and a tentative level structure for ^{166}Re is deduced from a study of the α-decay fine structure and the associated α-γ correlations.

DOI: 10.1103/PhysRevC.76.044312 PACS number(s): 23.20.Lv, 27.70.+q, 23.60.+e, 29.30.Kv

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Data sources

- The main data sources for bibliometrics are ***bibliographic* databases**.

- Data sources are the biggest *barrier to entry* in the field of bibliometrics.
  - Access is very (generally) expensive !!!
  - Information is not organized (or optimized) for bibliometric data production, but for bibliographic research

Data sources
Web of Science (2)

- Thomson-Reuters databases are the staple databases for bibliometric analysis.
- SCOPUS: launched in 2004 by the editor Elsevier; new competitor to Thomson-Reuters

Limits of these databases

- There are several limits to the applications of bibliometrics, the main being that Biblio(graphic)metric databases do not index all of the scientific literature.
- Especially true for the social sciences and humanitiies
- Databases have an English-language biais
  - No books are indexed

Journal coverage rates by country of editor
(Archambault et al. 2006)

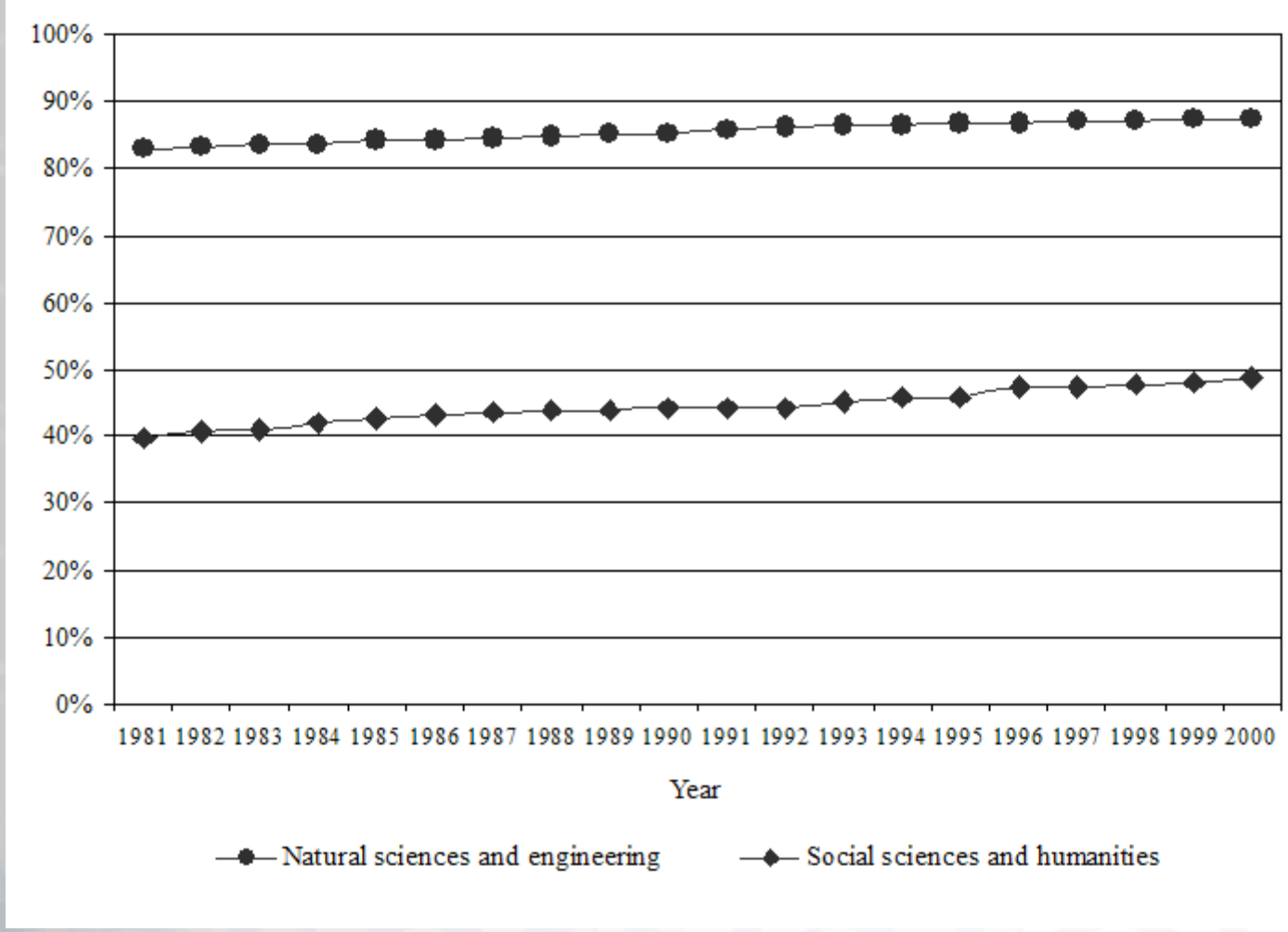
Country	NSE			SSH		
	Thomson ISI	Ulrich	Difference	Thomson ISI	Ulrich	Differenc
United Kingdom	23%	17%	36%	27%	18%	55%
Russian Federation	1.6%	1.4%	12%	0.3%	0.3%	36%
United States	36%	31%	19%	50%	37%	35%
Switzerland	2.7%	2.1%	26%	0.6%	0.5%	8%
Netherlands	9.4%	8.3%	14%	7.7%	7.4%	5%
Canada	1.3%	1.3%	1%	2.5%	3.2%	-21%
France	2.4%	2.6%	-6%	1.0%	1.4%	-24%
Germany	7.7%	6.2%	25%	3.9%	5.9%	-34%
Japan	2.3%	3.7%	-39%	0.5%	1.0%	-55%
Australia	1.2%	2.1%	-42%	1.1%	3.6%	-71%
Spain	0.4%	1.3%	-72%	0.3%	1.0%	-75%
Belgium	0.2%	0.4%	-52%	0.5%	2.1%	-75%
India	0.9%	2.2%	-61%	0.2%	1.6%	-86%
Poland	0.7%	1.6%	-58%	0.2%	1.3%	-87%
Italy	1.1%	1.7%	-38%	0.1%	1.2%	-89%
China	0.9%	2.9%	-69%	0.1%	0.9%	-91%
Brazil	0.3%	1.1%	-72%	0.04%	1.0%	-96%
Other	7.5%	14%	-45%	3.5%	13%	-73%

Journal coverage rates by language of journals

(Archambault et al. 2006)

Language	NSE			SSH		
	Thomson ISI	Ulrich	Difference	Thomson ISI	Ulrich	Differenc
English	89%	78%	13%	90%	75%	20%
Czech	0.04%	0.3%	-85%	0.2%	0.2%	8%
Russian	0.5%	0.9%	-48%	0.3%	0.4%	-24%
French	3.3%	3.4%	-3%	3.2%	4.4%	-26%
Multiple languages	0.2%	0.2%	-14%	0.3%	0.5%	-45%
Dutch	2.2%	2.2%	0%	1.3%	2.6%	-48%
German	3.2%	3.9%	-18%	3.0%	5.8%	-50%
Japanese	0.4%	1.7%	-74%	0.2%	0.6%	-64%
Swedish	-	0.1%	-100%	0.1%	0.4%	-69%
Spanish	0.6%	2.6%	-75%	0.9%	3.0%	-69%
Italian	0.1%	0.8%	-83%	0.2%	1.1%	-80%
Danish	0.04%	0.1%	-50%	0.1%	0.3%	-83%
Portuguese	0.1%	0.7%	-85%	0.1%	1.0%	-86%
Chinese	0.3%	2.4%	-88%	0.04%	1.2%	-96%
Polish	0.05%	0.7%	-92%	-	0.9%	-100%
Arabic	-	0.1%	-100%	-	0.3%	-100%
Turkish	0.01%	0.2%	-95%	-	0.1%	-100%
Other	0.3%	1.6%	-80%	0.3%	2.4%	-87%

Share of citations made to serials in natural sciences and engineering and in social sciences and humanities, 1980-2000
(Lariviere et al. 2006)



Bibliometric indicators (1)

- Number of papers published by an individual/organization
  - What do scientific publications measure?
  - Can publication counts be compared across fields?

- Number of citations received by an individual/organization
  - What do citations measure?
  - Can citation counts be compared across fields?
  - Citation window and uncitedness.

- Percentage of papers written in collaboration:
  - International
  - Interinstitutional
  - Intersectorial (university, industry, governements, hospitals)

Bibliometric indicators (2)

The Impact Factor

- Average number of citations received by articles published in a journal two years after their publication

- For example, the impact factor of a given journal in 2000 would be calculated as follows:

$$\frac{\text{N citations in 2000 by articles published in the journal in 1998-1999}}{\text{N articles published in the journal in 1998-1999}}$$

Bibliometric indicators (3)

The Impact Factor

Pros

- Rapidly available (faster than waiting for citation counts)
- Highly correlated with peer judgements

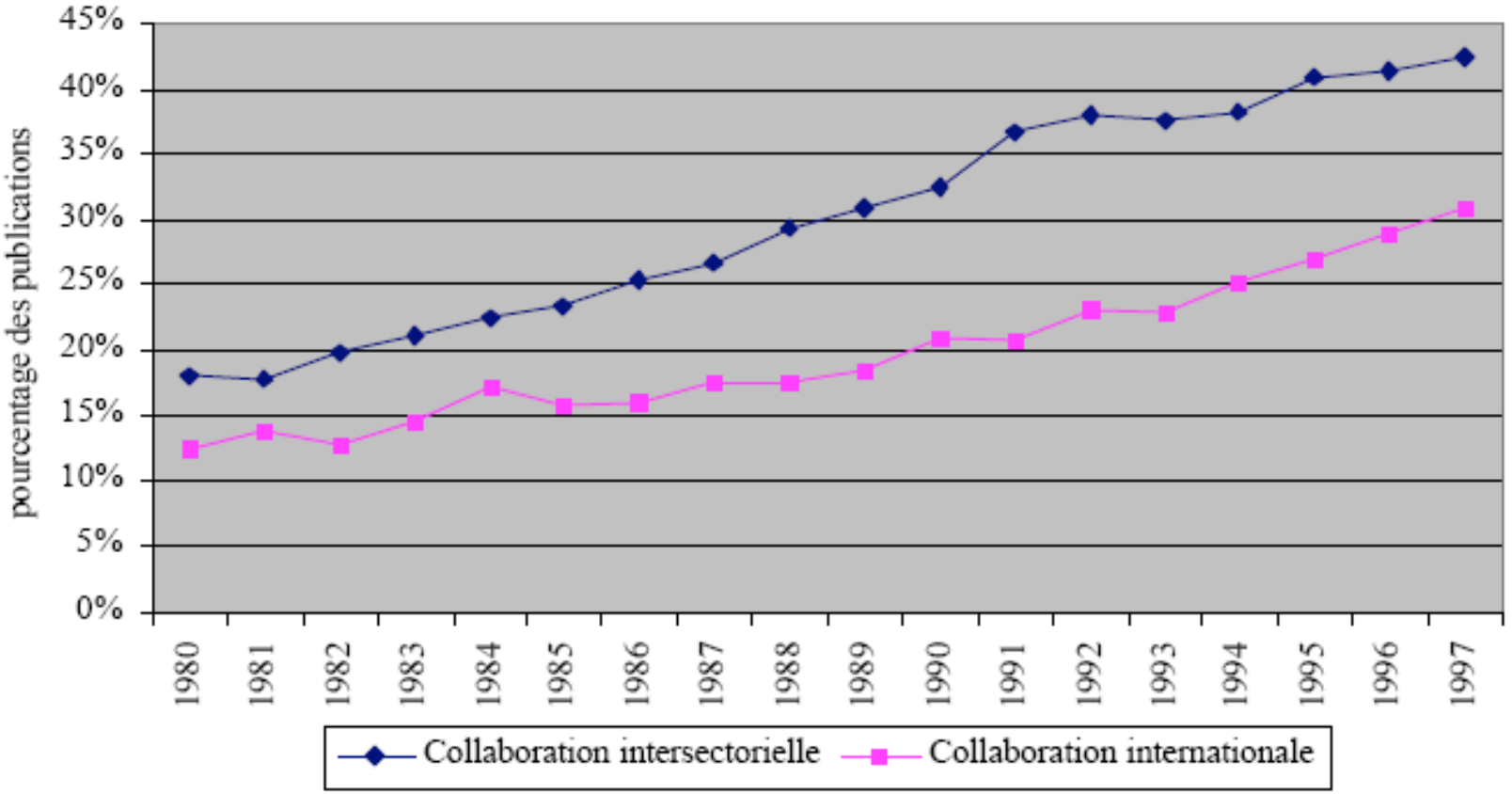
Cons

- Includes journal self-citations
- Cannot be used for inter-field evaluation
- Asymmetry between numerator and denominator
- Two-year citation window (Short term impact)
- Skewness of citation distributions

Trends in Intersectorial and International collaborations

Figure 6

Proportion des publications du Gouvernement du Canada produites en collaboration intersectorielle et internationale 1980-1997



Source : Observatoire des sciences et des technologies

Figure 1: % of multi-author articles in NSE, social sciences and humanities, Canada and the world, 1980-2002

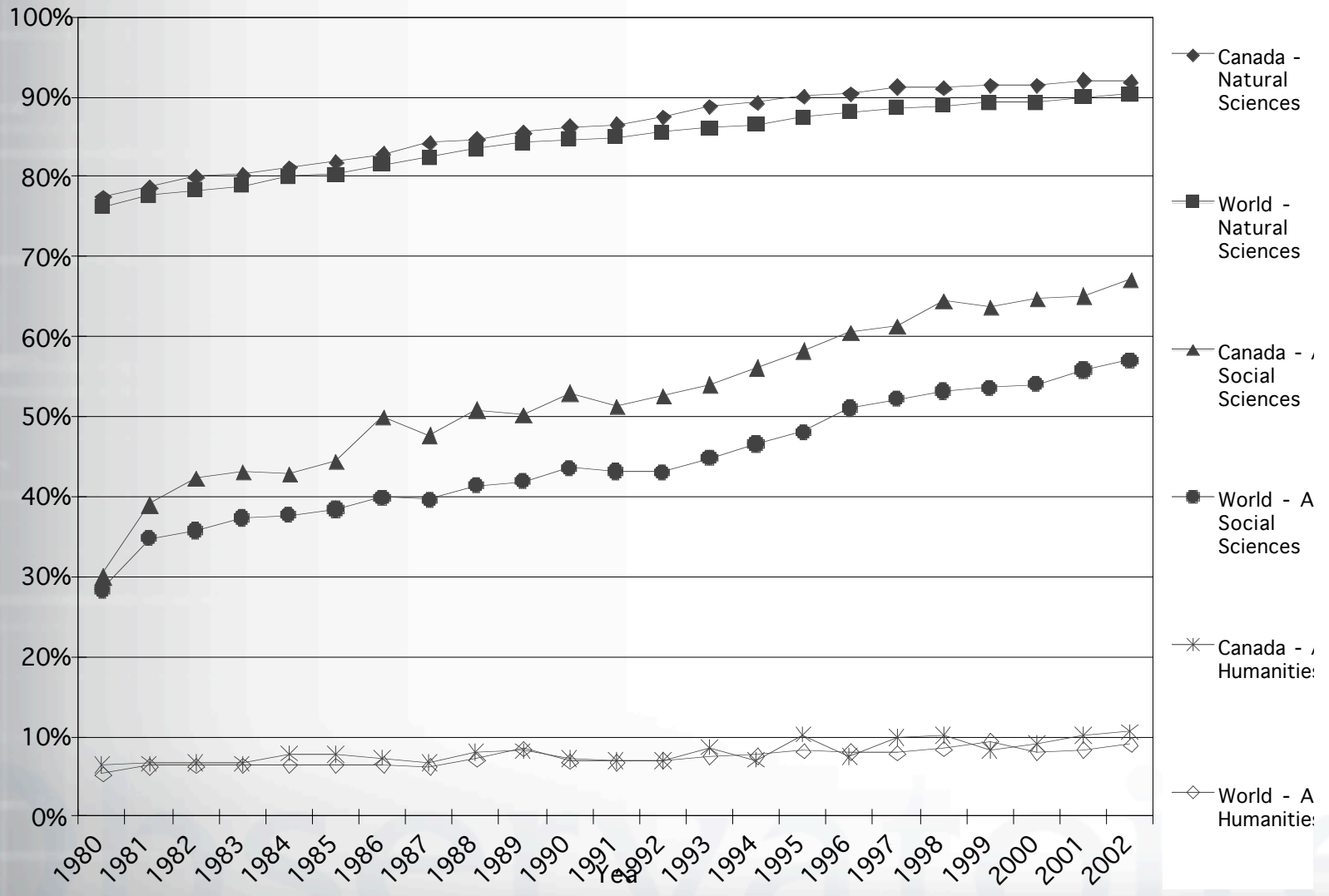


Figure 3: International collaboration trends in NSE, social sciences and humanities, Canada and the world, 1980-2002

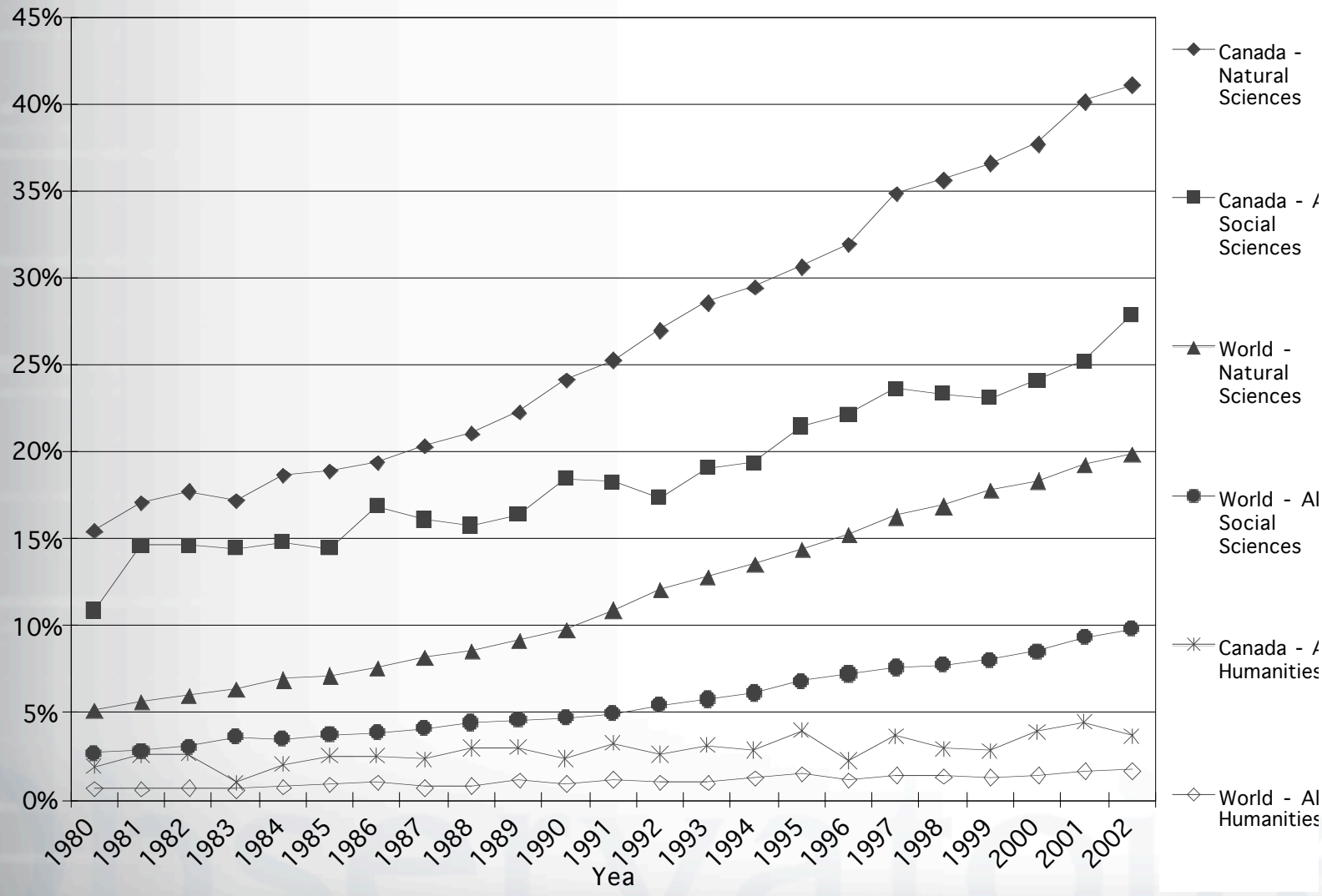


Figure 4: Trends in interinstitutional collaborative activities of Canadian scholars in NSE, social sciences and humanities, 1980-2002

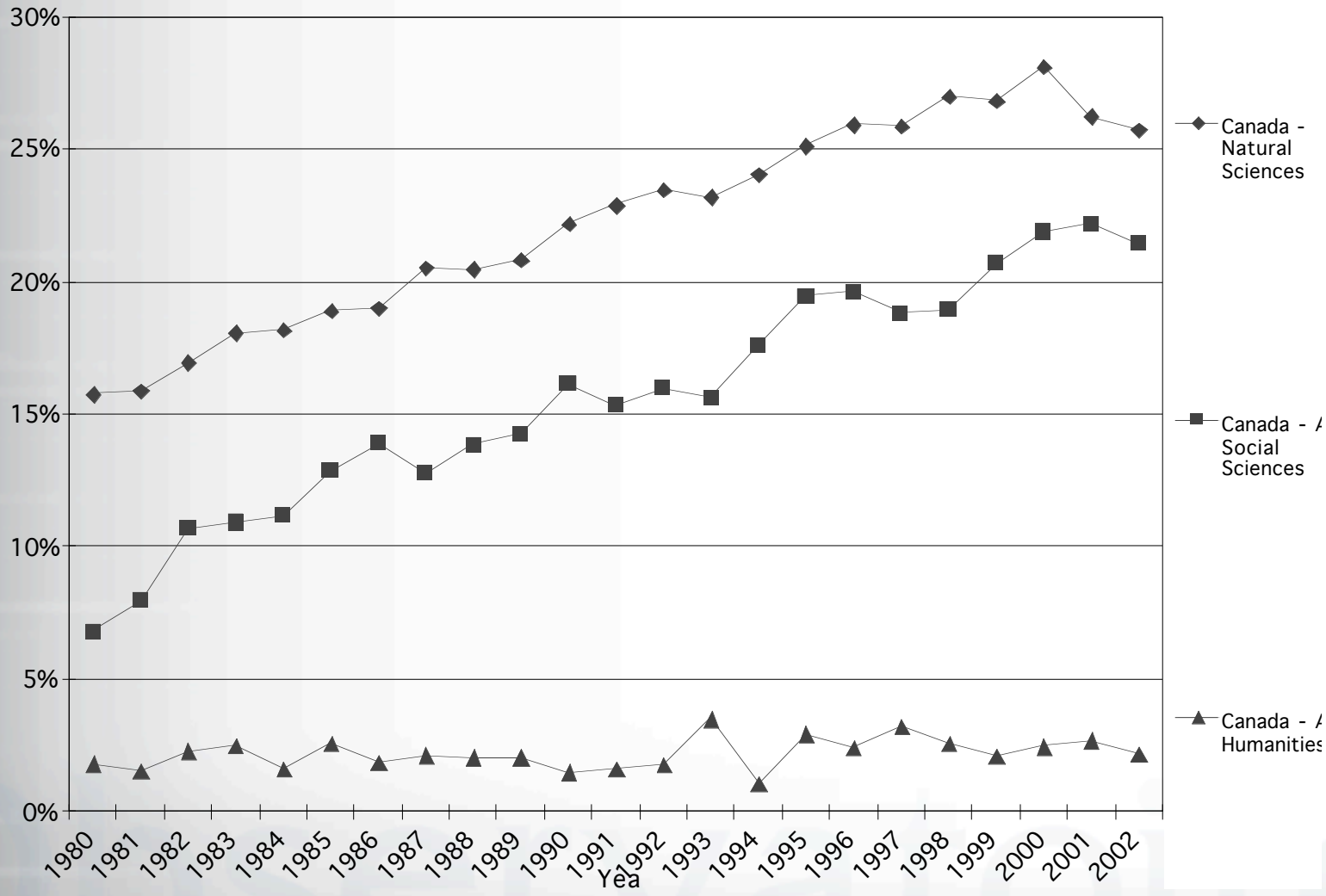


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Figure 5: Interinstitutional collaborative activities of Canadian scholars in the NSE, 1980-2002 (250 or more joint publications). Black nodes represent English-speaking universities; grey nodes represent French-speaking universities.

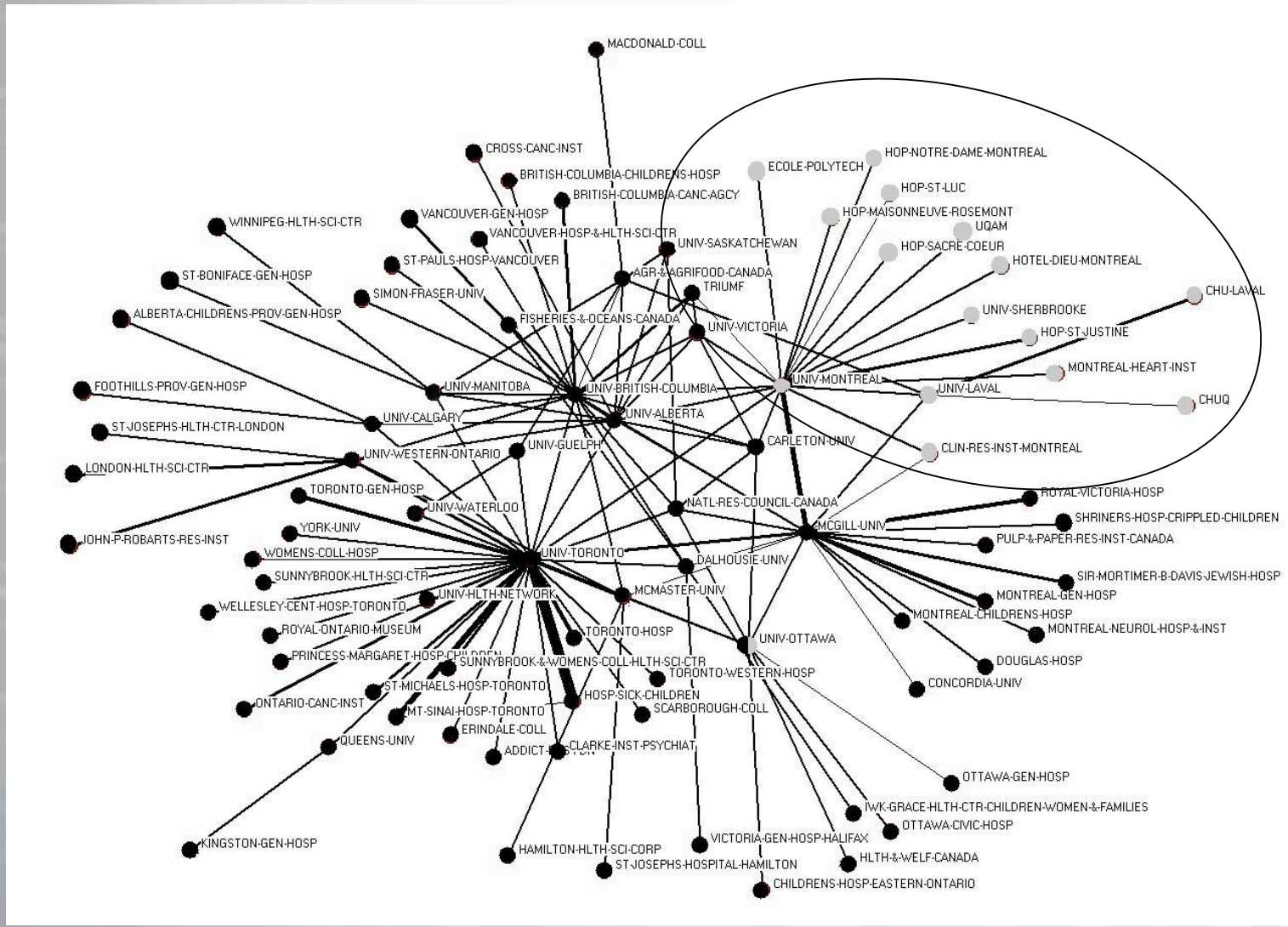

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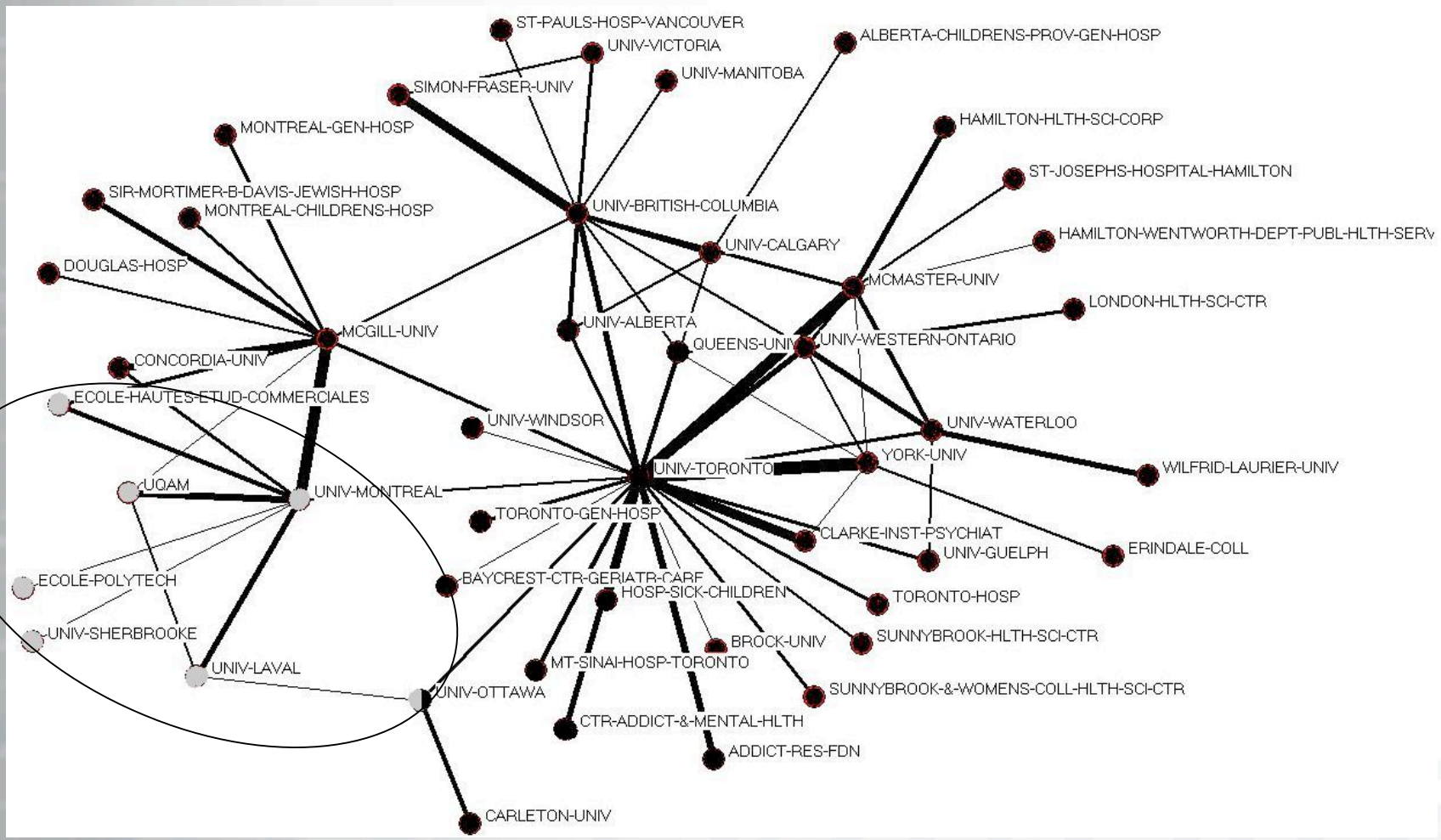
Figure 6: Interinstitutional collaborative activities of Canadian scholars in social sciences, 1980-2002 (30 or more joint publications). Black nodes represent English-speaking universities; grey nodes represent French-speaking universities.



Conclusion

- Bibliometrics should be used carefully for research evaluations, NOT best suited at the level of individuals.
  - As for any indicators, the significance of bibliometric indicators is highly dependant on the level of aggregation.
- Excellent tool to assess the research strength of large research organization such as universities.
- Very useful for mapping trends in different fields over time

Further reading

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