

The Internationalization of Scientific Research

Yves Gingras

Canada Research Chair

In History and Sociology of Science

University of Quebec in Montreal

(UQAM)

Internationality of science

- Science has always been international
- Through exchange of letters
- Through circulation of people between universities since the Middle Ages (ex: Copernicus at Krakow, Bologna and Padua (1496, 1502))
- Through direct scientific collaboration since the 19th century (ex: Liebig and Gay-Lussac, 1822-24)
- Through sharing of scientific instruments like CERN SNO, etc

Geographic distribution of Mersenne's correspondents (1588-1648)

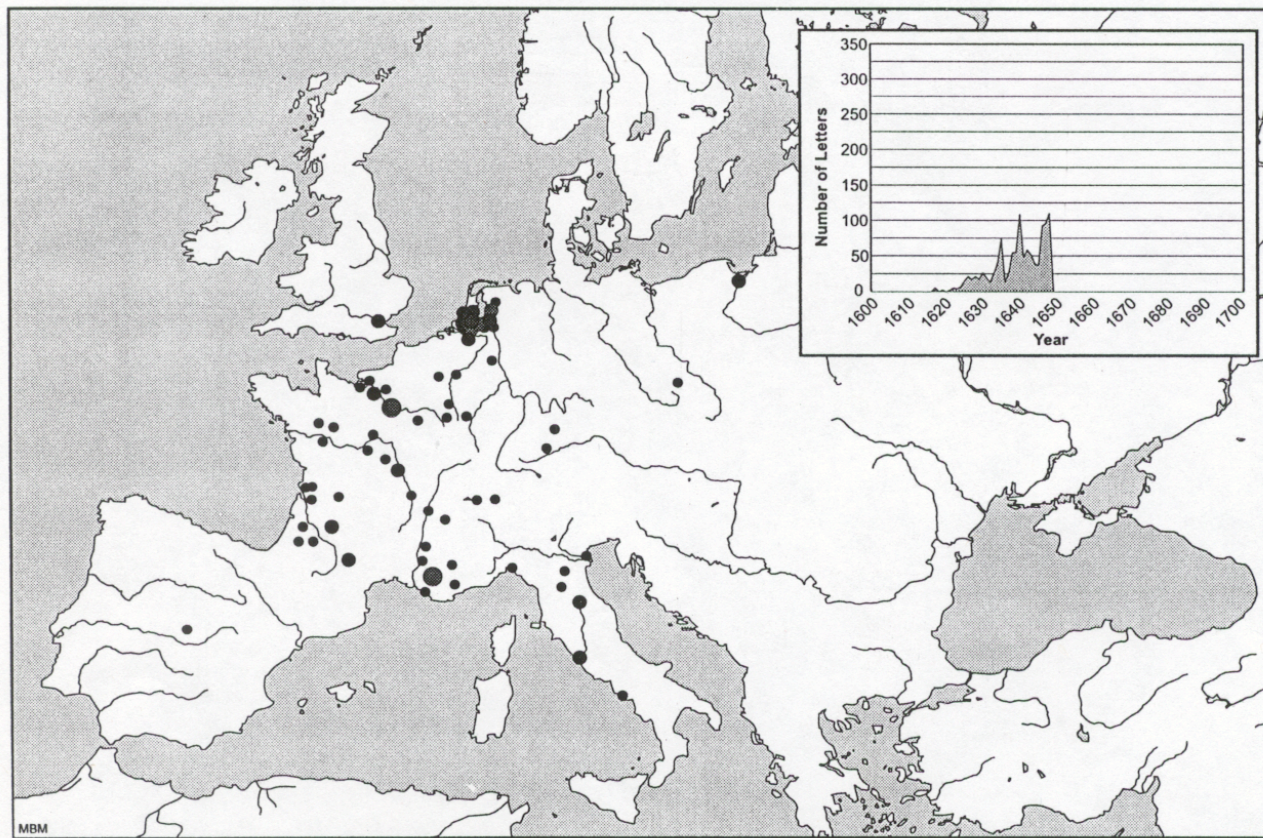
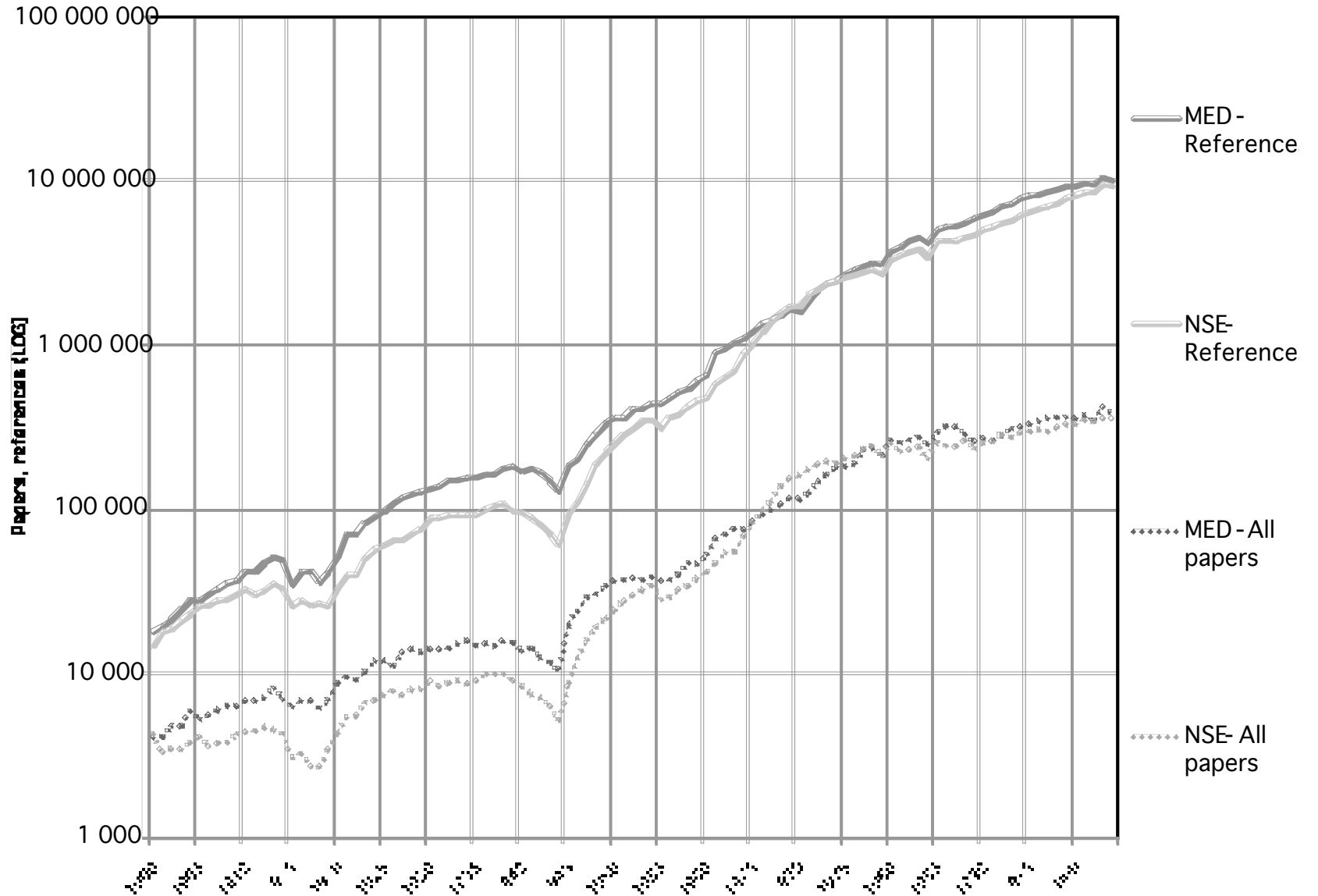
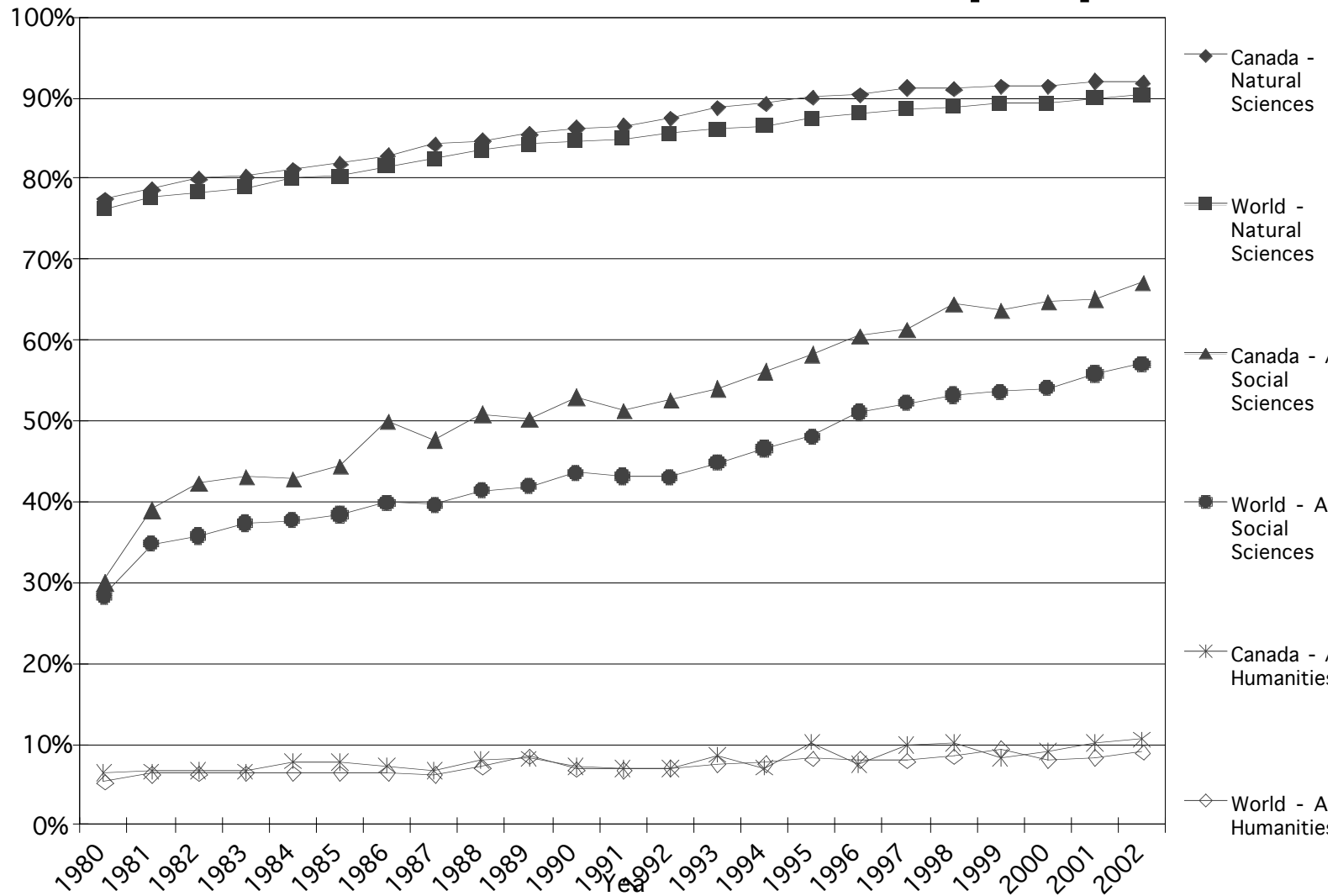


Figure 2. *The Published Correspondence of Mersenne: The Correspondance du P. Marin Mersenne* (17 vols.) contains 1,871 entries; slightly over half involve letters to or from Marin Mersenne (1588–1648). The present map and chart represent 1,099 published letters of Mersenne for the years 1617–48.

Growth of publications and references, 1900-2004

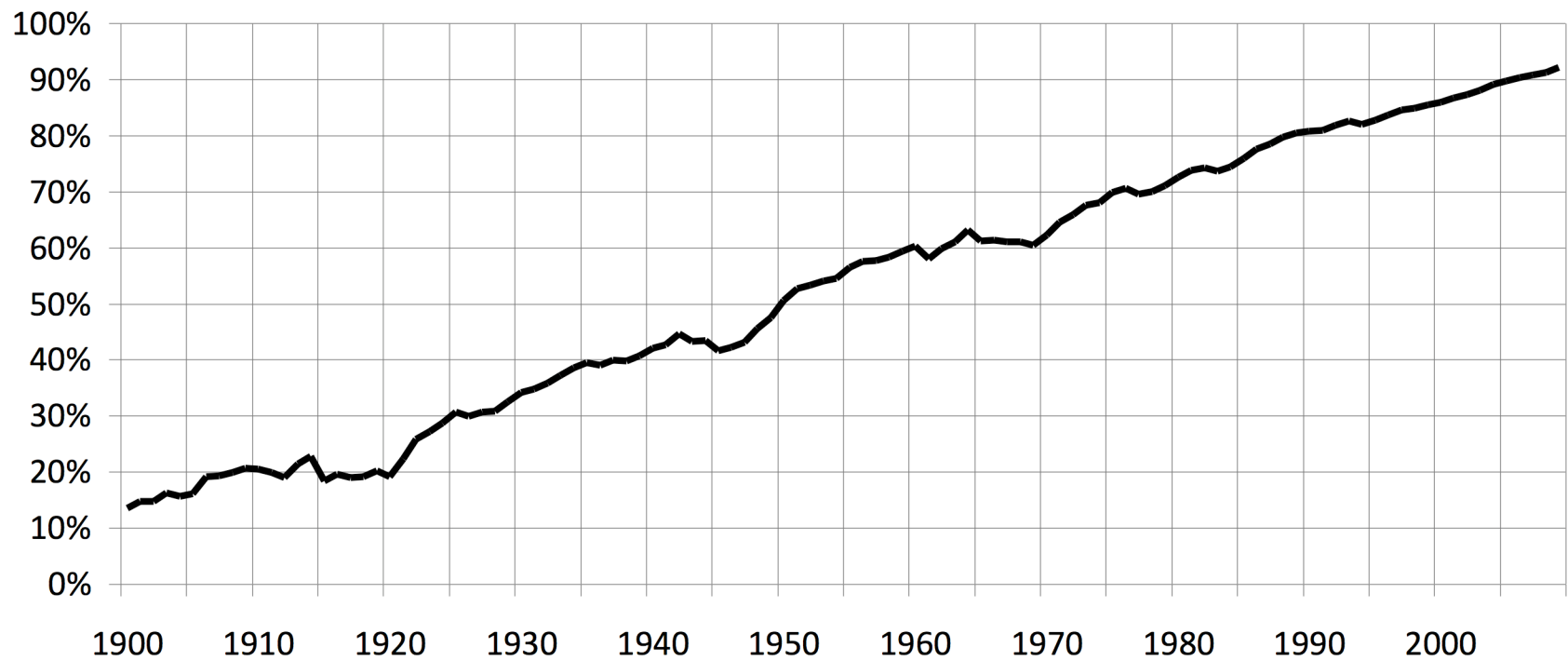


Collectivisation of Science: Growth of multi-author papers

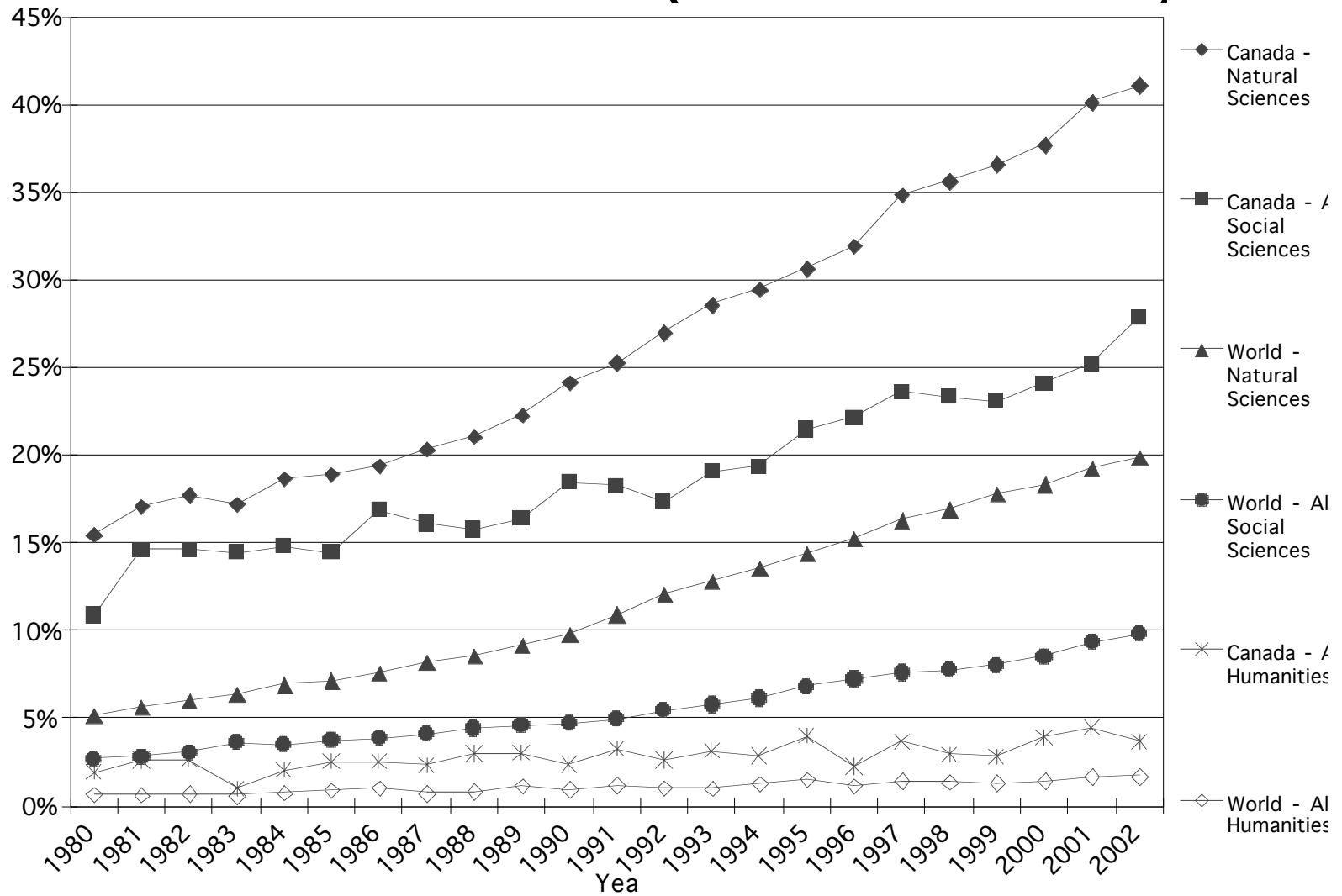


Collectivisation of research

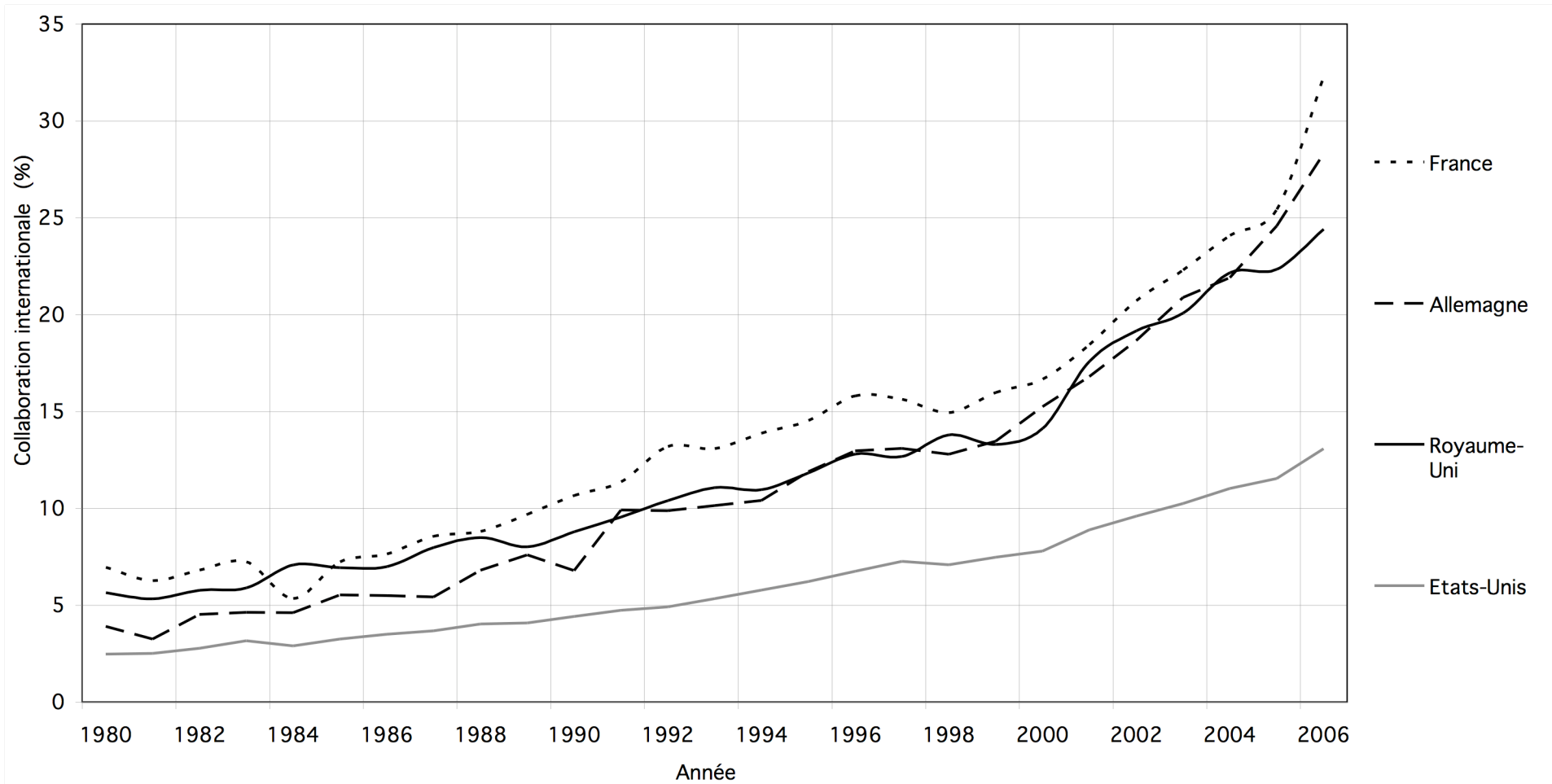
% of multi-author scientific papers since 1900



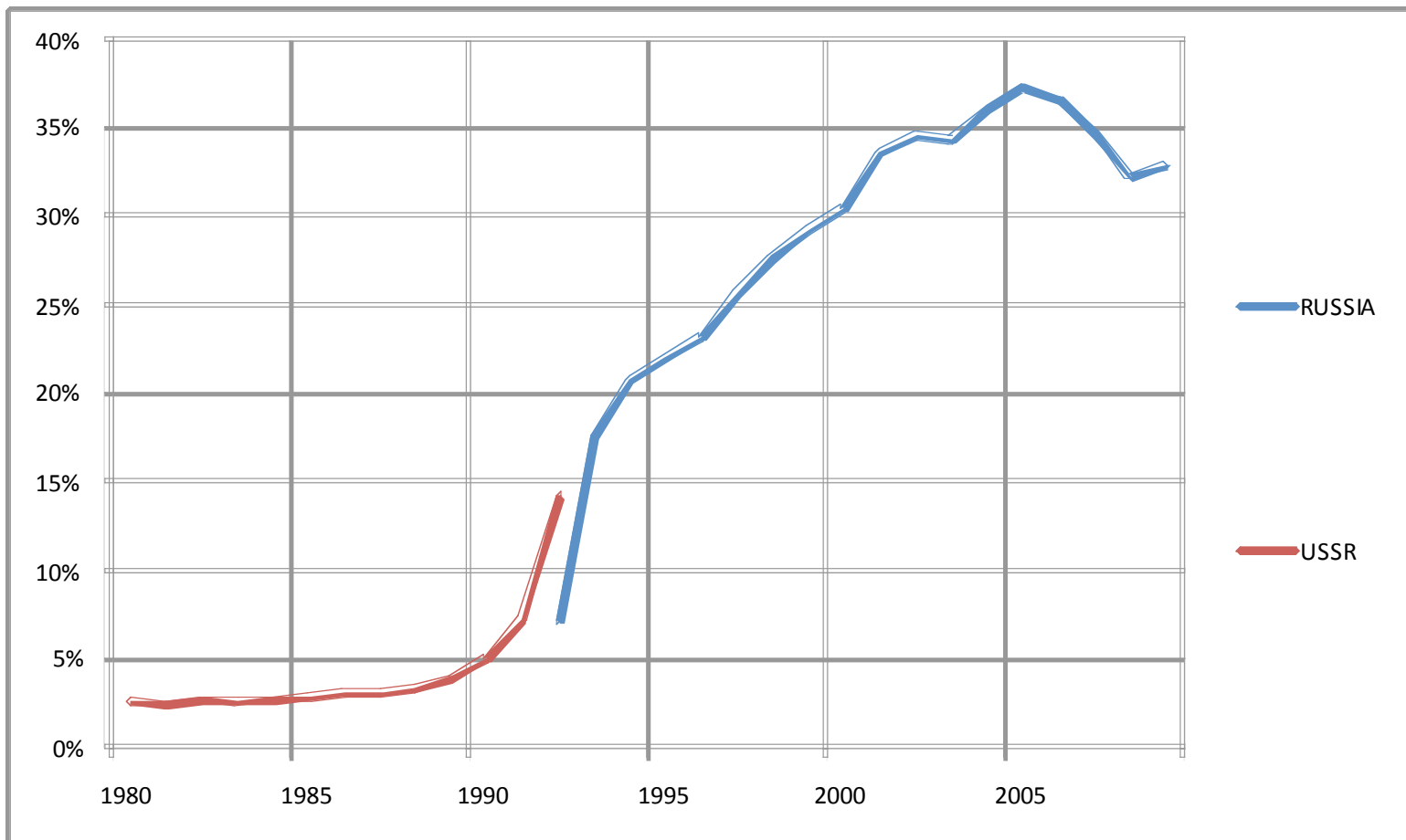
Growth of International collaborations (1980-2002)



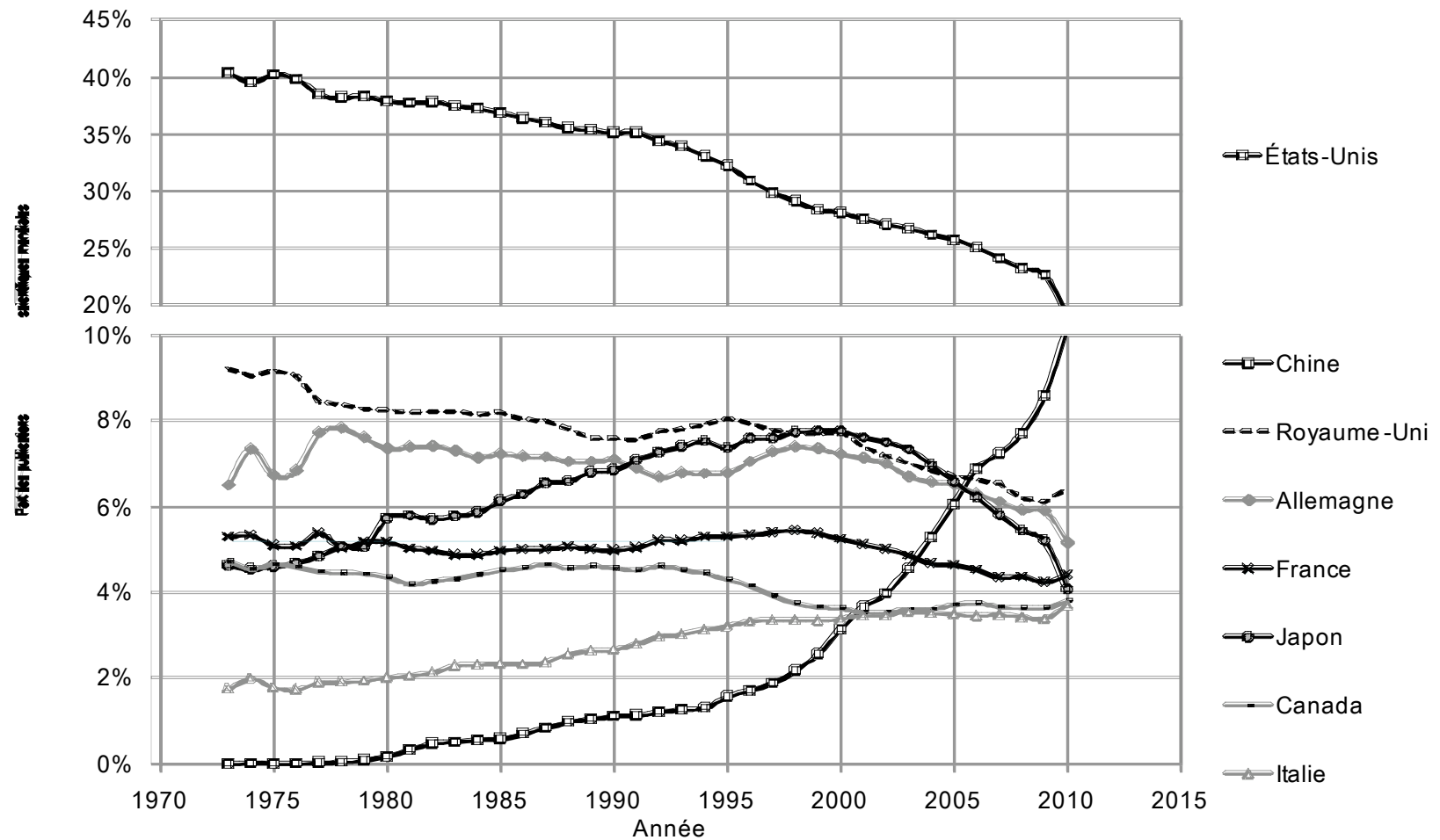
International collaborations in Social sciences and humanities



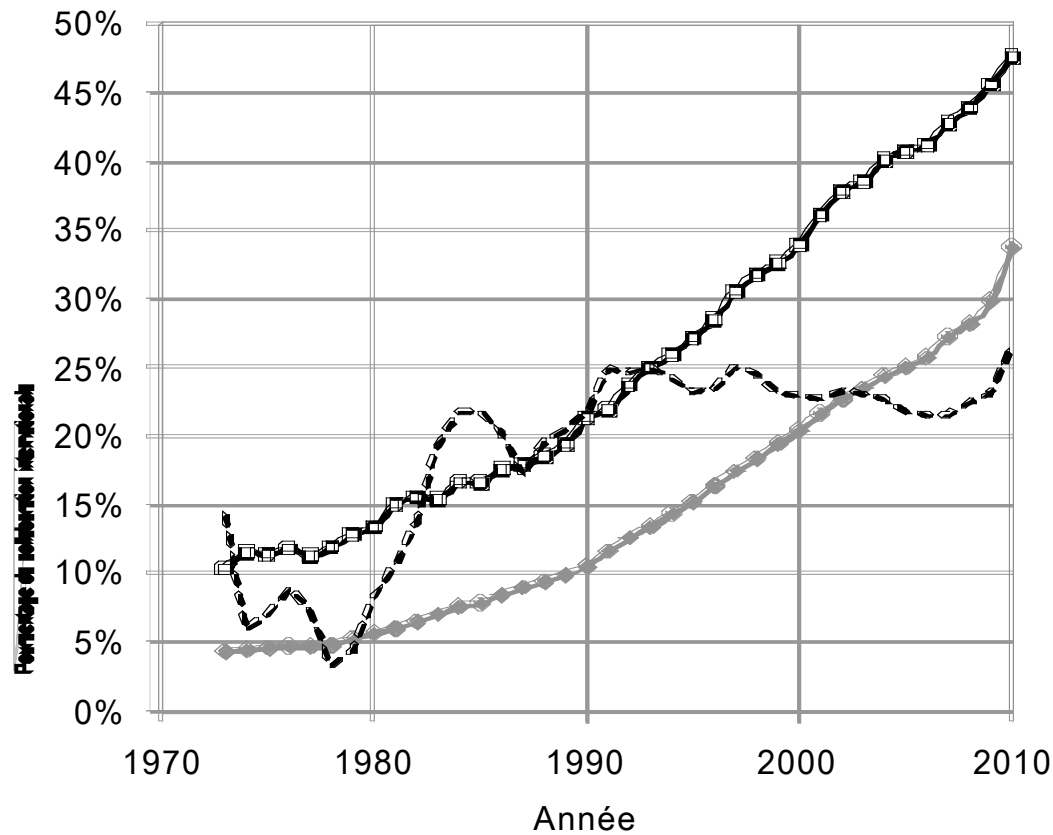
Growth of International Collaboration of Russia



Diversification of world research



Growth of international collaboration : diversification and multilateral relations

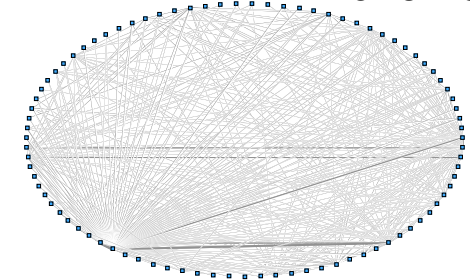


Canada

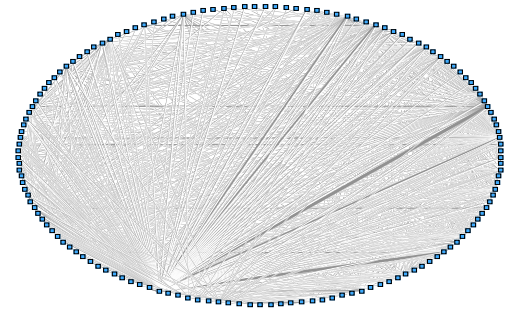
États-Unis

Chine

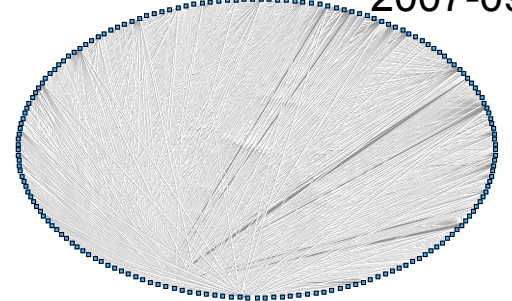
1973-75



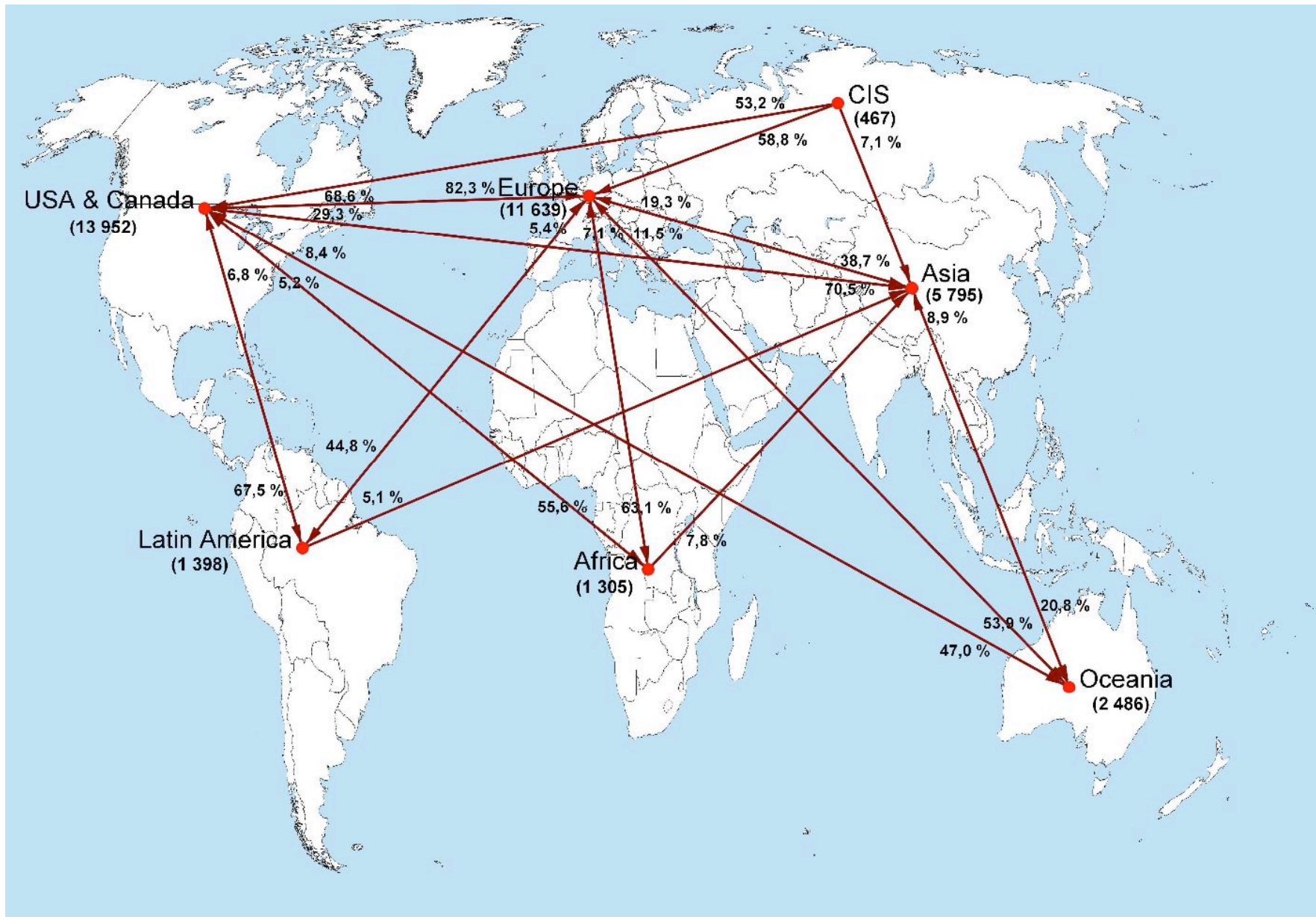
1990-92



2007-09

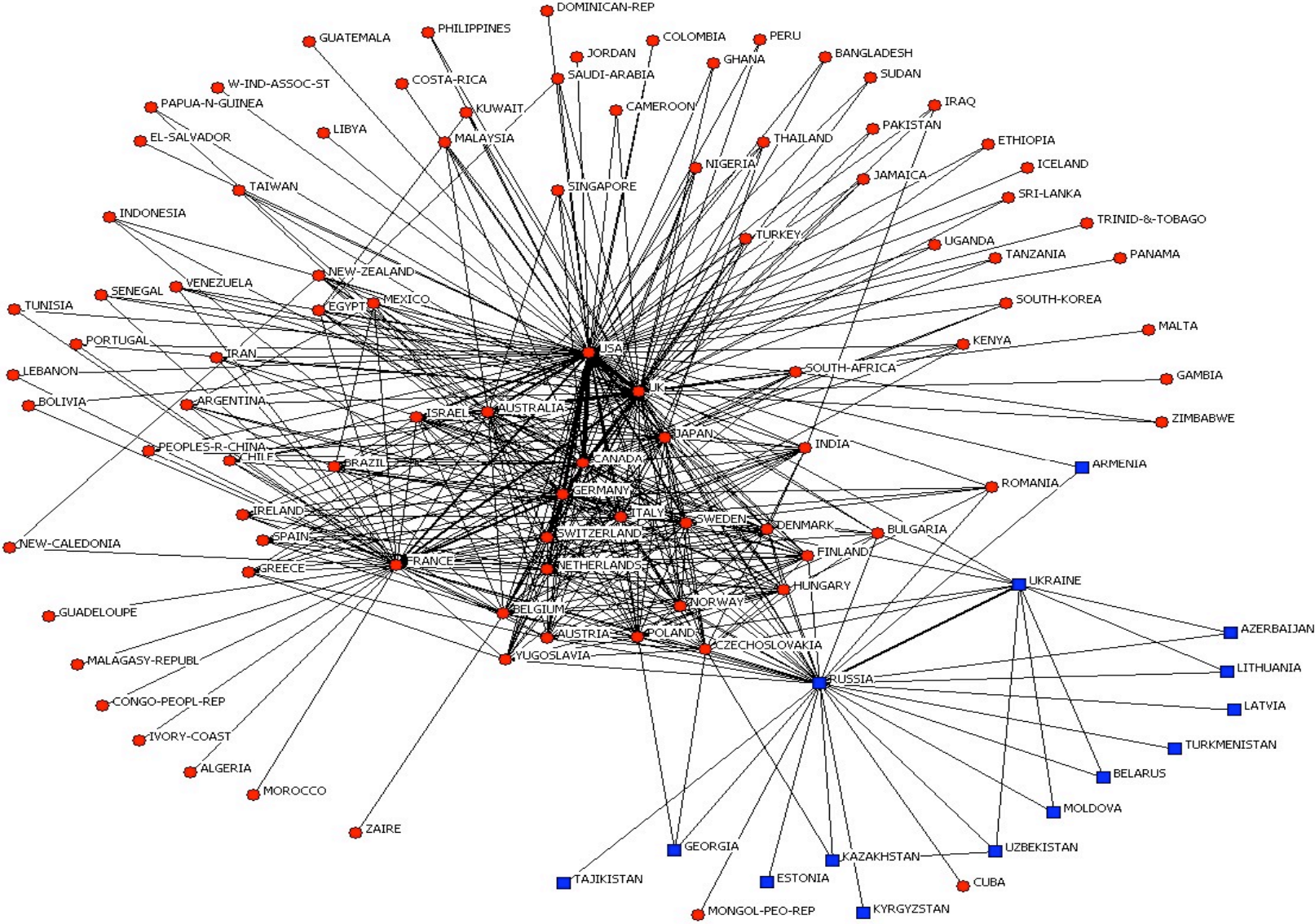


World distribution of interregional collaborations between social scientists (1998-2007)

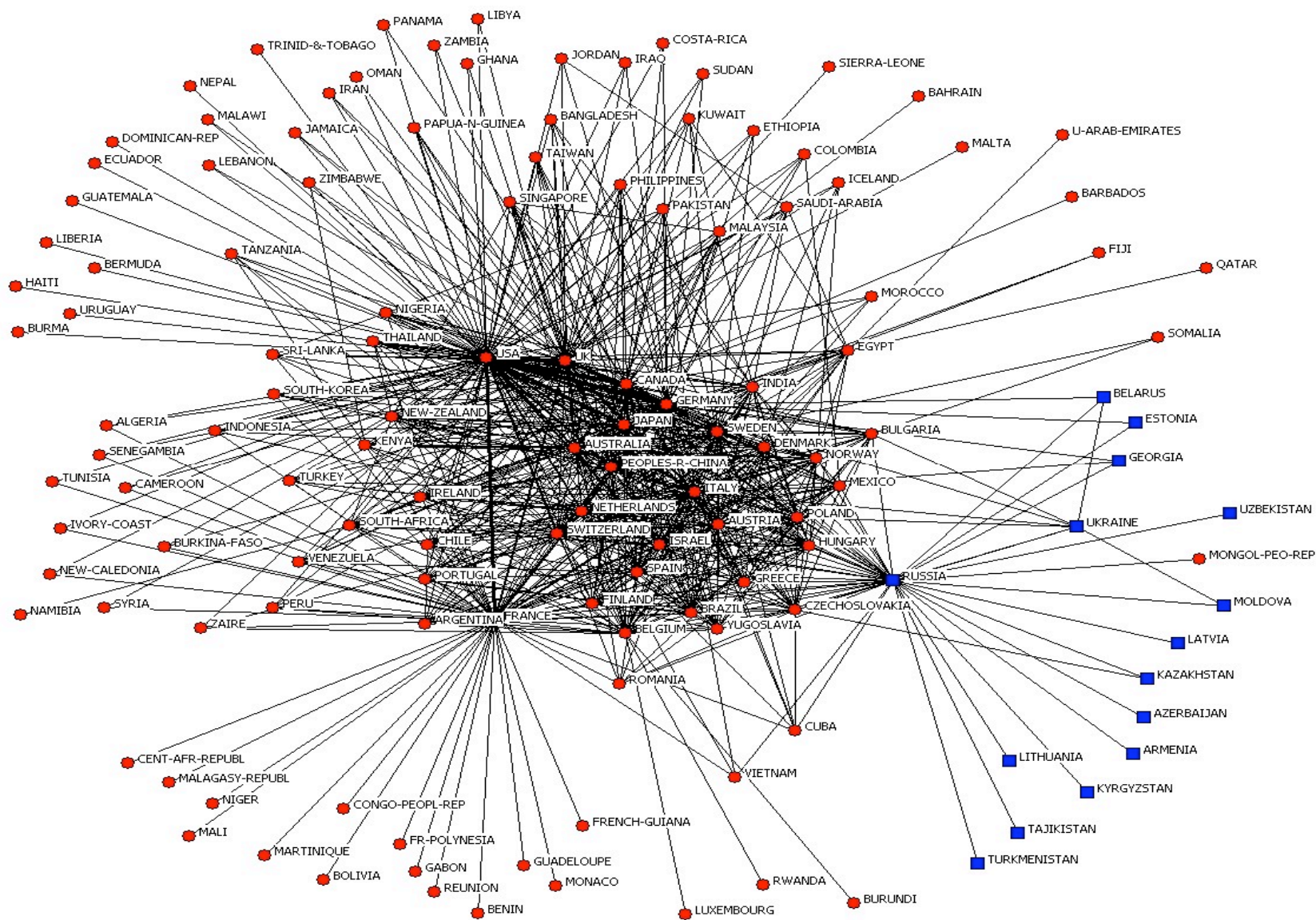


International networks (1977-79)

(N>10)

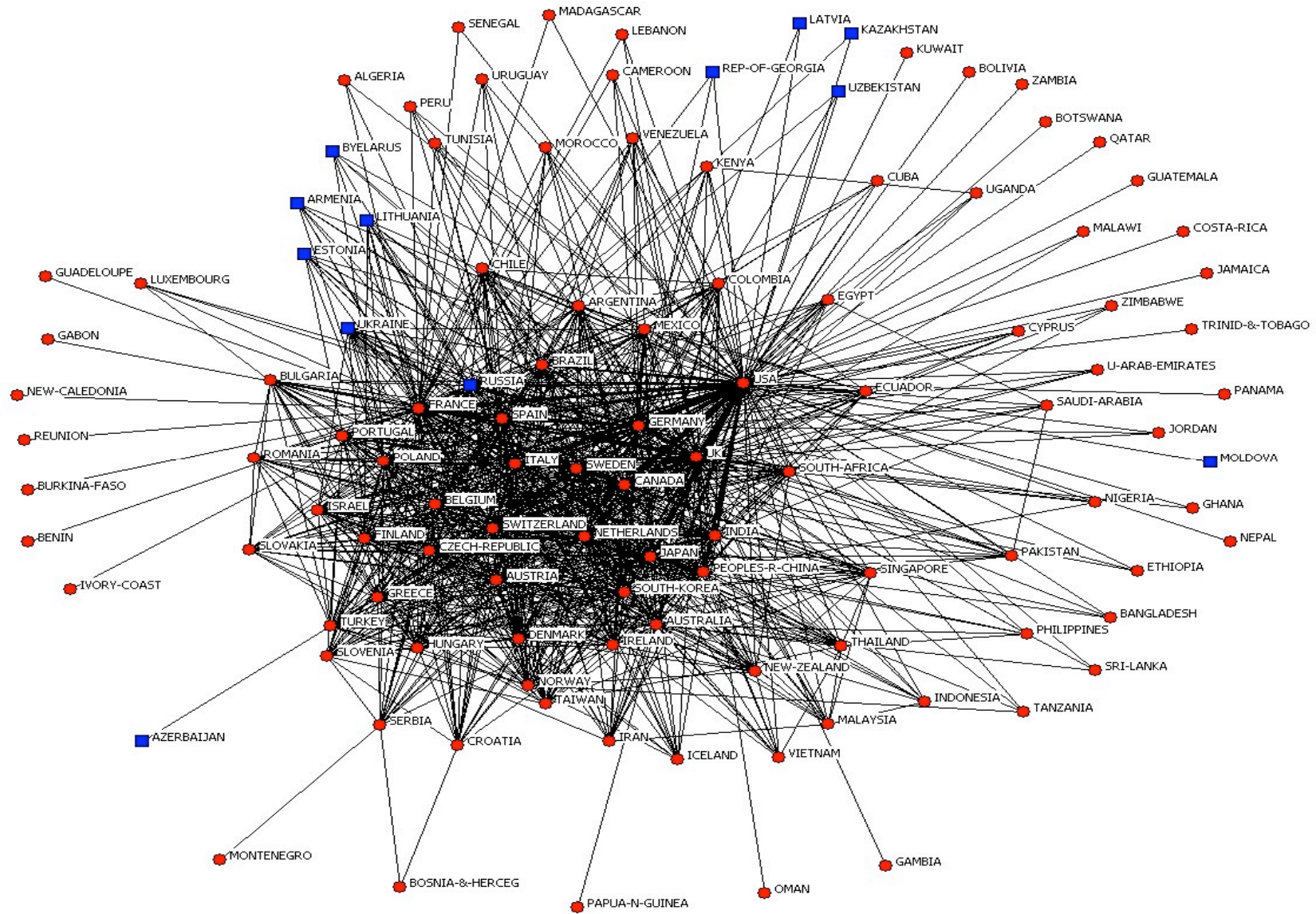


International networks (1987-89) ($N > 10$)



International networks (2007-09)

(N>100)



Measures of Centrality

Centralité (1977-79)

pays	Nb tot coll.	Rang
USA	26603	1
UK	12055	2
FED-REP-GER	9171	3
FRANCE	8016	4
CANADA	7665	5
SWITZERLAND	4537	6
RUSSIA	3737	7
ITALY	3472	8
SWEDEN	3284	9
AUSTRALIA	3056	10
NETHERLANDS	2957	11
JAPAN	2804	12
ISRAEL	2433	13
DENMARK	2290	14
BELGIUM	2241	15

Centralité (1997-99)

pays	Nb coll.	Rang
USA	187155	1
GERMANY	97272	2
UK	89705	3
FRANCE	76481	4
ITALY	52145	5
CANADA	43742	6
JAPAN	43689	7
NETHERLANDS	37056	8
RUSSIA	35686	9
SWITZERLAND	35150	10
SPAIN	32037	11
SWEDEN	29603	12
AUSTRALIA	24666	13
BELGIUM	23117	14
PEOPLES-R-CHIN	19510	15

Centrality (2)

Centralité (2007-09)

pays	Nb coll	Rang
USA	386968	1
UK	206309	2
GERMANY	201256	3
FRANCE	155374	4
ITALY	114249	5
CANADA	105626	6
PEOPLES-R-CHINA	95352	7
SPAIN	89512	8
JAPAN	84136	9
NETHERLANDS	83422	10
SWITZERLAND	73298	11
AUSTRALIA	71556	12
SWEDEN	60358	13
BELGIUM	53085	14
RUSSIA	51354	15

20 Main collaborating countries of Russia

Country	1980-1989	Country	1990-1999	Country	2000-2009
GER-DEM-REP	2210	GERMANY	12706	GERMANY	23675
CZECHOSLOVAKIA	1644	USA	12368	USA	22372
USA	1276	FRANCE	6307	FRANCE	12029
FED-REP-GER	889	ITALY	4060	ENGLAND	8250
FRANCE	861	ENGLAND	3984	ITALY	7724
BULGARIA	839	JAPAN	2658	JAPAN	7004
HUNGARY	754	POLAND	2527	POLAND	4862
POLAND	715	SWEDEN	2475	SWEDEN	4438
ITALY	525	UKRAINE	2448	SWITZERLAND	4369
YUGOSLAVIA	349	SWITZERLAND	2261	NETHERLANDS	4368
SWITZERLAND	342	NETHERLANDS	2254	SPAIN	4080
RUSSIA	320	CANADA	1882	CANADA	3917
SWEDEN	318	FINLAND	1717	UKRAINE	3329
FINLAND	300	SPAIN	1672	FINLAND	3133
ENGLAND	294	BELGIUM	1246	PEOPLES-R-CHINA	3133
NETHERLANDS	231	DENMARK	1223	SOUTH-KOREA	3020
BELGIUM	218	ISRAEL	1087	BELGIUM	2706
ROMANIA	185	CZECH-REPUBLIC	940	CZECH-REPUBLIC	2452
DENMARK	183	BULGARIA	879	SCOTLAND	2045
AUSTRIA	178	AUSTRIA	855	AUSTRIA	2019

Conclusion

- Science has radically transformed over the 20th Century
- It moved from individual to collective
- From national to International
- This trend first emerged through the internal dynamics of science and is now (since the 1990s) taken up at the institutional and state level through the rhetoric of « internationalization »
- New countries emerged:
 - Rapid Rise of China since the end of the 1990s
 - Relative decline of Centrality of Russia
 - Most countries diversity their network of collaboration

Conclusion (2)

- Only large bibliometric database used in conjunction with geometrical methods of data representation (like MDS and Network analysis) can reveal such global trends