The Rise in Co-authorship in the Social Sciences (1980-2013)

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Abstract
This paper examines the rise in co-authorship in the Social Sciences over a 33-year period. We investigate the development in co-authorship in different research areas and discuss how the methodological differences in these research areas and changes in academia affect the tendency to co-author articles. The study is based on bibliographic data about 4.5 million peer review articles published in the period 1980-2013 and indexed in the 56 subject categories of the Web of Science's (WoS) Social Science Citation Index (SSCI). Results show that in the majority of the subject categories we can document a rise in the mean number of authors and that there are disciplinary differences in how much the number of authors has increased. The most substantial rise in the mean and median number of authors has happen in subject categories, where the research often is based on the use of experiments, large data set, statistical methods and/or team-production models.

Conference Topic
Citation and Co-citation Analysis

Introduction
This paper explores the rise in co-authorship in the social sciences. The study is based on all the articles registered from 1980-2013 in the Web of Science's (WoS) Social Science Citation Index (SSCI). Several studies have examined the rise in the number of authors in different research fields. The studies vary in design, but the majority of the bibliometric studies can be categorized as studies either based on bibliographic data from a national database (Lariviere, Gingras, & Archambault, 2006; Ossenblok, Verleysen, & Engels, 2014) or a selection of journals (Cronin, Shaw, & La Barre, 2003; Fisher, Cobane, Vander Ven, & Cullen, 1998; Hudson, 1996; Norris, 1993; White, Dalgleish, & Arnold, 1982). The study by Wuchty, Jones, and Uzzi (2007) is one of the few studies, that examined the increase in research collaboration by using bibliographic data about research articles from multiple fields collected from the subject categories in WoS. However, their study is based on a sample of research articles and not an exhaustively data collection of the research articles indexed in WoS. Furthermore, Wuchty et al. (2007) do not clarify how many articles in their study that are indexed in either Science and Engineering, Social Sciences or Arts and Humanities. This paper is the first study of the rise of co-authorship in the social sciences to use a large sample of time series data based on all of the publications in SSCI, thus the study cover multiple fields of the social science. The study is therefore not bias by national publication tendencies or the selection of journals. The disadvantage of a data set restricted to articles from SSCI is that other publication types and a substantial share of journals are excluded (Hicks, 2005; Ossenblok et al., 2014; Piro, Aksnes, & Rørstad, 2013). However, we believe that the larger data sample compensate for these data limitations. Hence, the objective of this

paper is to document the rise in co-authorship in the social sciences and discuss the factors that could have influenced this evolution.

The increasing focus on authorship can partly be attributed to the growing importance of and attention paid to a researcher's publication record, which is influential in the considerations for employment, promotion, funding and increases in salary (Biagioli, 2012; Costa & Gatz, 1992; Weingart, 2005). Thus, there is a tendency to measure and assess researchers' based on their quantitative research output instead for the content of this output. This creates incentives to "game" the system to improve one's resume by co-producing publications. This is especially the case, when the performance-based research funding systems use whole counts instead of fractionalizing (Butler, 2003; Ossenblok et al., 2014), so the reward for producing a publication does not have to be shared. Hence, the instrumental uses of performance-based funding systems affect the researchers' publishing behavior, including their definitions, perceptions and practices of authorship (e.g. Ossenblok, Engels, & Sivertsen, 2012). However, the rises in co-authorship and research collaboration are also affected by other factors that influence the research community. The rise can be a result of the increasing tendency to perform large scale research projects executed as team-production models. These projects require greater human and financial resources, a larger data collection effort and often more advanced technical and statistical analyses, hence leading to more specialization and division of labor in the research process (Beaver, 2001; Birnholtz, 2006; Cronin et al., 2003; Fisher et al., 1998; Hudson, 1996; Moody, 2004; Rennie, Yank, & Emanuel, 1997; White et al., 1982). These types of projects are often associated with natural and medical sciences, where there is a strong tradition for working in the fore mention team-production model. However, the increasing tendency to work with large scale data set, the rise in using quantitative methods and in some cases experiments have generated a similar team-production model in the social sciences (Cronin et al., 2003; Hudson, 1996; Moody, 2004). Furthermore, studies have found that researchers in the more quantitative research areas of social science is more likely to collaborate (Fisher et al., 1998). Others have pointed at the increasing mobility of researchers that has made it possible and desirable to expand inter-institutional collaborations (Melin, 2000; White et al., 1982) while the development of communication and information technology have enabled geographically disperse researchers to collaborate, by making it easier to communicate, analyze and exchange data (Beaver, 2001; Fisher et al., 1998; Melin, 2000). Furthermore, the growing number of people working in academia has created more collaboration opportunities (Fisher et al., 1998; Lee, 2000; Melin, 2000), especially the increase in PhD students have created more opportunities for research advisors to collaborate and co-author with their students (Fisher et al., 1998; Price, Dake, & Oden, 2000). However, this tendency has given rise to issues regarding honorary or gift authorship in academia and some studies suggest that research advisors may be inappropriately demanding co-authorship with their students (Rennie et al., 1997). This is disputed by Costa and Gatz (1992), who found that students willingly are giving their advisors inappropriate authorship credit even though the advisors do not fulfill the journal guidelines and requirements for co-authorship. However, they do suggest that the willingness to offer co-authorship can be affected by a power imbalance between advisors and advisees, especially because of the increase in PhD students being subsidized by grants held by their advisors. In this paper we will document the evolution of co-authorship and research

collaboration by presenting evidence for the increase in the number of authors per publication.

Method

The bibliometric data used in this study were collected from the Centre for Science and Technology Studies (CWTS) enhanced version of Thomson Reuters' WoS database in December 2014. We collected bibliographic information for 4,466,134 articles from 99,752 journal issues published in 1980 to 2013 and registered in WoS' SSCI 56 subject categories. These 56 subject categories have in our analysis been grouped into 6 overall subject categories. The grouping of the categories is based on the topics of each subject category described in the SSCI scope notes (SSCI, 2012). Hence, there are differences in how many categories there has been group together, and the similarity of the research areas. The Social Sciences, Interdisciplinary group consist of a variety of subject categories and do not have the similar thematic relationship as the other groups.

- **Management, Planning & Geography** (Geography, Planning & Development, Urban Studies, Environmental Studies, Management, Transportation)
- **Political Sciences, Business and Law** (Criminology & Penology, Business, Business, Finance, Economics, Public administration, International Relations, Law, Political Science
- **Psychology** (Psychology, Mathematical, Psychology, Psychoanalysis, Psychology, Experimental, Psychology, Social, Psychology, Educational, Psychology, Applied, Psychology, Biological, Psychology, Clinical, Psychology, Developmental, Psychology, Multidisciplinary, Psychiatry
- **Social Health Sciences** (Public Environmental & Occupational Health, Substance Abuse, Gerontology, Health Policy & Services, Rehabilitation, Education, Special, Nursing, Ergonomics)
- **Social Sciences, Interdisciplinary** (Social Sciences, Biomedical, Family Studies, Information Science & Library Science, Social Sciences, Interdisciplinary, Hospitality, Leisure, Sport & Tourism, Industrial Relations & Labor, Social Sciences, Mathematical Methods, Communication, Linguistics, Ethics, History & Philosophy of Science, History of Social Sciences, History)
- **Sociology & Anthropology** (Anthropology, Area Studies, Social Work, Education & Educational Research, Women's Studies, Demography, Social Issues, Sociology, Ethnic Studies, Cultural Studies)

Our study limits the relevant types of publications to journal articles, though we know that the publication pattern in the social sciences is more varied (Lariviere et al., 2006; Ossenblok et al., 2014), thus letters, book chapters and books are an essential part of the scholarly communication in some fields of the social sciences. Unfortunately, the Thomson Reuters Book Citation Index (BCI), part of the WoS core collection, do not have as systematic and exhaustively bibliographic information about books compared to the SSCI's information about journal articles. The BCI do only cover the time period from 2006-present, while SSCI have bibliographic data from 1900 to present, so by choosing to only include journal articles we can set a larger time frame for this study.

Results

In the follow subsections we will present the data showing the increase in number of authors per publication. For each group we will present a figure demonstrating the development in the different subject categories[1]. Our data show that the fields of social sciences have experienced a mean 114 percent increase in the number of authors during the last 33 years, hence there have been added 1,2 authors more to each publication. However, there are large differences in how much the number of authors has risen, with the lowest increase being in the History subject category with a minimal change (0.1 authors) to the highest mean increase in Psychiatry (3 authors).

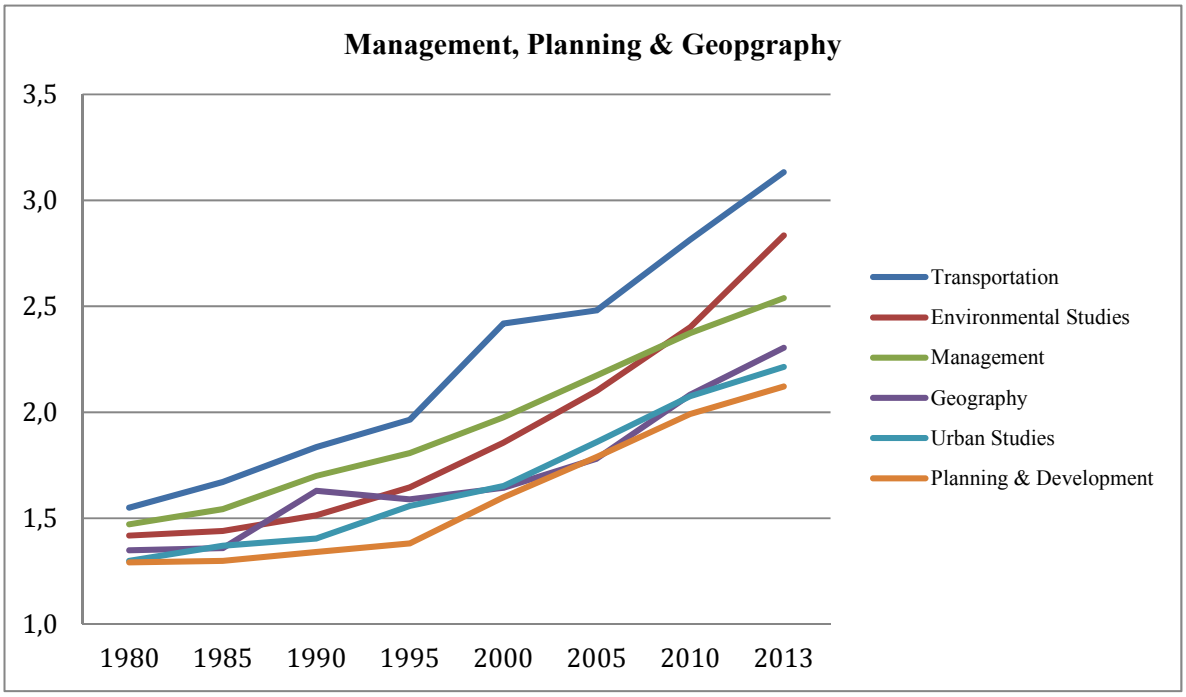

Figure 1. The mean number of authors per publication from 1980-2013 of the group Management, Planning & Geography.

The six categories group as Management, Planning & Geography consist of 373,372 publications. Figure 1 shows the evolution in numbers of authors. The mean numbers of author have increase 71% to 102% or 0.8 – 1.6 authors during the 33 year time period. The mean numbers of authors in 1980 are in the range of 1.3-1.6 authors and have increased in 2013 to 2.1-3.1 authors. The median number of authors is 1 in all categories in 1980. In 2013 the median number of authors has risen to 3 in the category Transportation, while the remaining categories have a median of 2. Even though the category Transportation does not cover civil engineering per se, the close relation with the above mentioned research field can explain some of the increase in co-authorship in this category. The subject categories in this group have all similarities to research fields

[1] We have in this article, because of the space limit, decided to present the development of co-authorship in six figures. The data behind the study will be presented in more details at the conference and are also available if requested.

in science and technology, and are probably influenced by collaboration and publication tendencies dominating these fields.

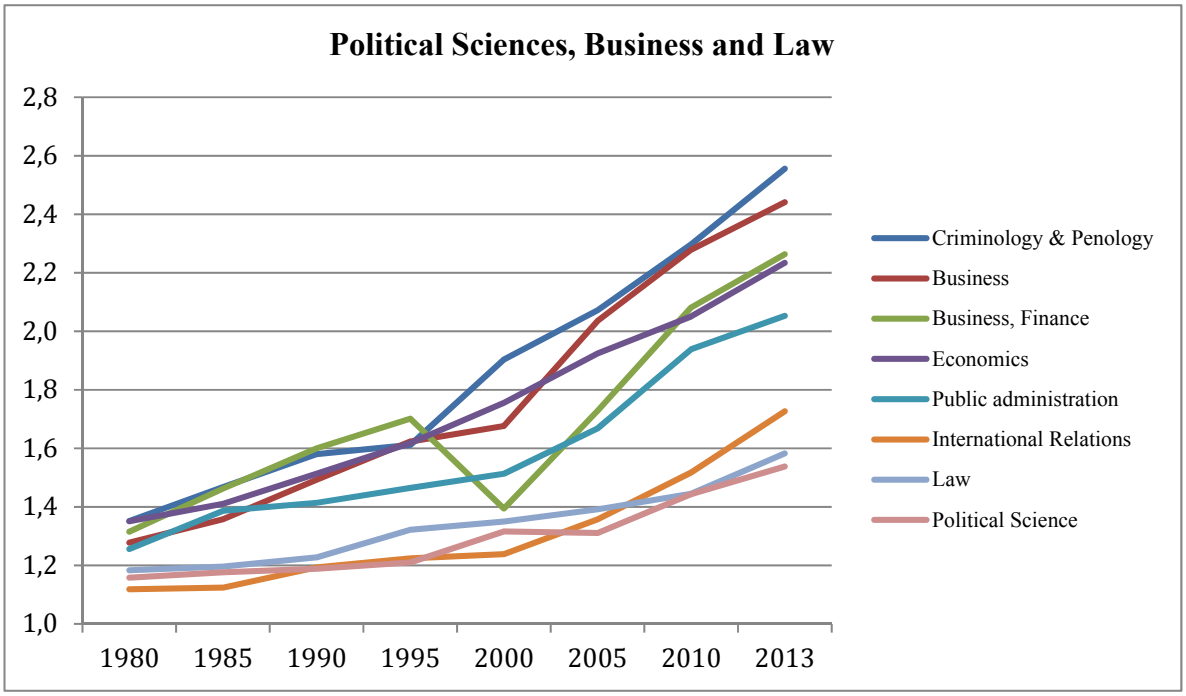

Figure 2. The mean number of authors per publication from 1980-2013 of the group Political Sciences, Business and Law.

The 1,011,725 publications belonging to the Political Sciences, Business and Law show a rise between 38% to 89% in the mean numbers of authors. The mean numbers of authors are between 1.1 - 1.4 in 1980 to 1.5 - 2.6 in 2013 (see figure 2). In Business, Business, Finance, Economics, Criminology & Penology and Public Administration have the median number of authors increase from 1 to 2 authors during the 33 years, while in the remaining categories the median number of authors is 1 during the time period. The greater rise in mean number of authors in the categories Criminology & Penology, Business, Business, Finance, Economics, and Public Administration could be because of the greater use of statistics and register/survey data (Fisher et al., 1998; Hudson, 1996). Political Science is the category in this group with the highest amount of publications (n = 172,625) and covers a broad range of research, thus the lower increase and mean number of authors is probably because areas of Political Science have similarities with research fields in the humanities. The same is the case for the category Law that draws on methods often associated with humanities, such as text analysis.

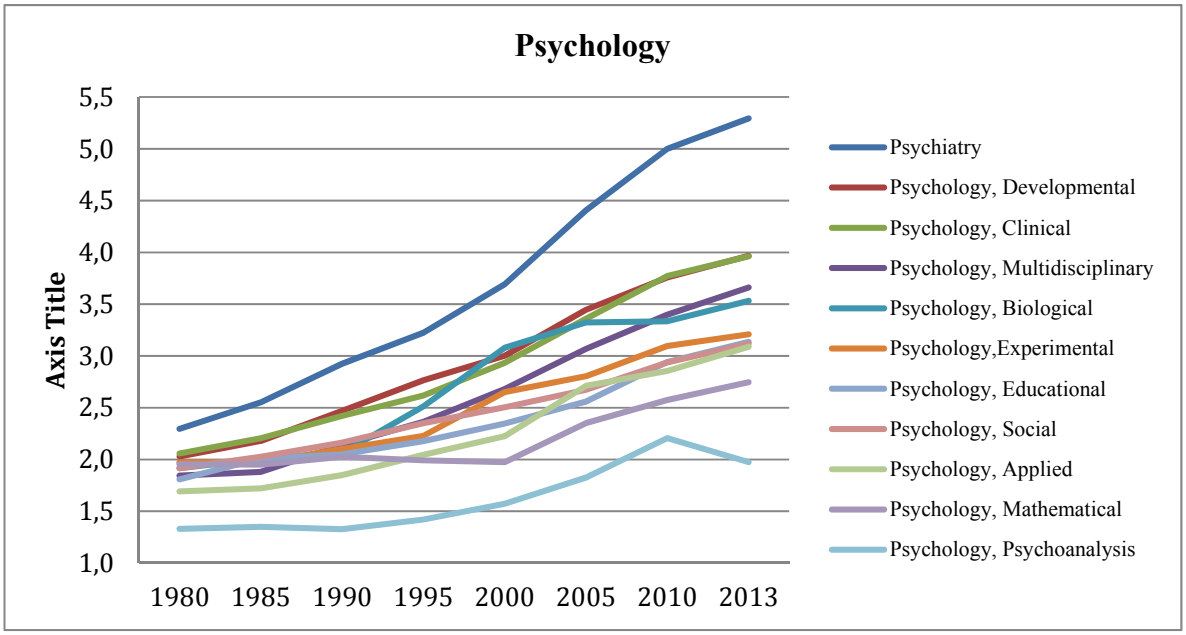

Figure 3. The mean number of authors per publication from 1980-2013 of the group Psychology.

We have collected 1,101,234 publications categorized as Psychology. During the 33 years the mean increase in number of authors is in the range from 0.6 to 3 authors or from 40 % to131%. The mean numbers of authors in 1980 are between 1.4-2.3 authors, this have in 2013 increased to between 2-5.3 authors. The categories of Psychology have all increased the number of authors in the byline during the 33 years, though it is not a constant increase as can been seen in figure 3. The category with the lowest increase is Psychoanalysis, the subject category with a publication and collaboration behavior closest to the humanities, and a mean number of authors in 2013 at 2 authors. Psychoanalysis is the only subject category in the Psychology group where the median have remain constant at 1. In the other end of the scale we have Psychiatry, a subject category with close relations to the medical research fields and therefore a similar collaboration and publication pattern. The mean number of authors in this category is 5.3 authors and the median is 5. Psychology, Mathematical have constantly had a median at 2, while Psychology, Applied have had an increase in the median number of authors from 1 to 3 and Psychology, Clinical have had an increase in median authors from 2 to 4. Psychology, Experimental, Psychology, Social, Psychology, Educational, Psychology, Development, Psychology, Biological and Psychology, Multidisciplinary have had an increase in the median number authors from 2 to 3 authors.

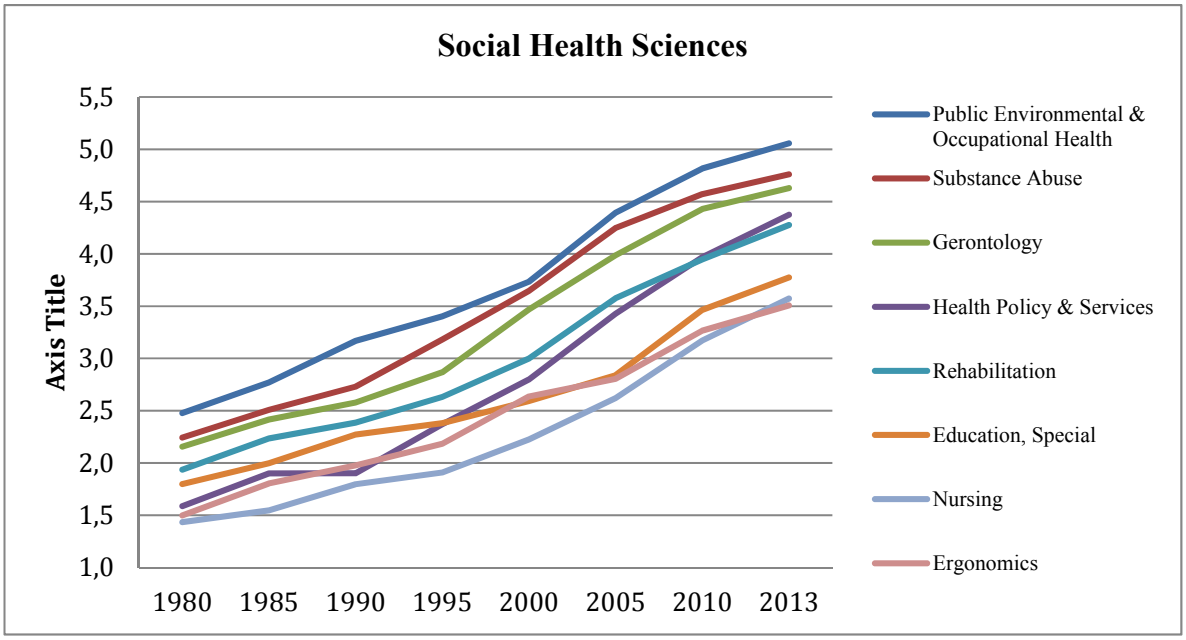

Figure 4. The mean number of authors per publication from 1980-2013 of the group Social Health Sciences.

The data of the categories Social Health Sciences is based on 824,125 publications. The mean number of authors per publication in the Social Health Sciences categories has risen between 104% to 176% or 2-2.6 authors. Figure 4 shows how there have been a substantial increase in all seven subject categories during the 33 years. The median number of authors in 1980 is 1 in the categories Ergonomics, Health Policy & Services and Nursing and 2 in the categories Rehabilitation, Public Environmental & Occupational Health, Substance Abuse, Gerontology and Educational, Special. In 2013 the median numbers of authors have risen to 3 authors in Ergonomics, Nursing and Education, Special and to 4 in the remaining categories. The mean numbers of authors in the Social Health Sciences are between 1.4-2.5 authors in 1980 and have risen to 3.5-5.1 authors in 2013. The average numbers of authors are general quite high in Social Health Sciences compared to other subject categories in the Social Sciences and the subject categories have a publication and collaboration pattern similar to the health and life sciences.

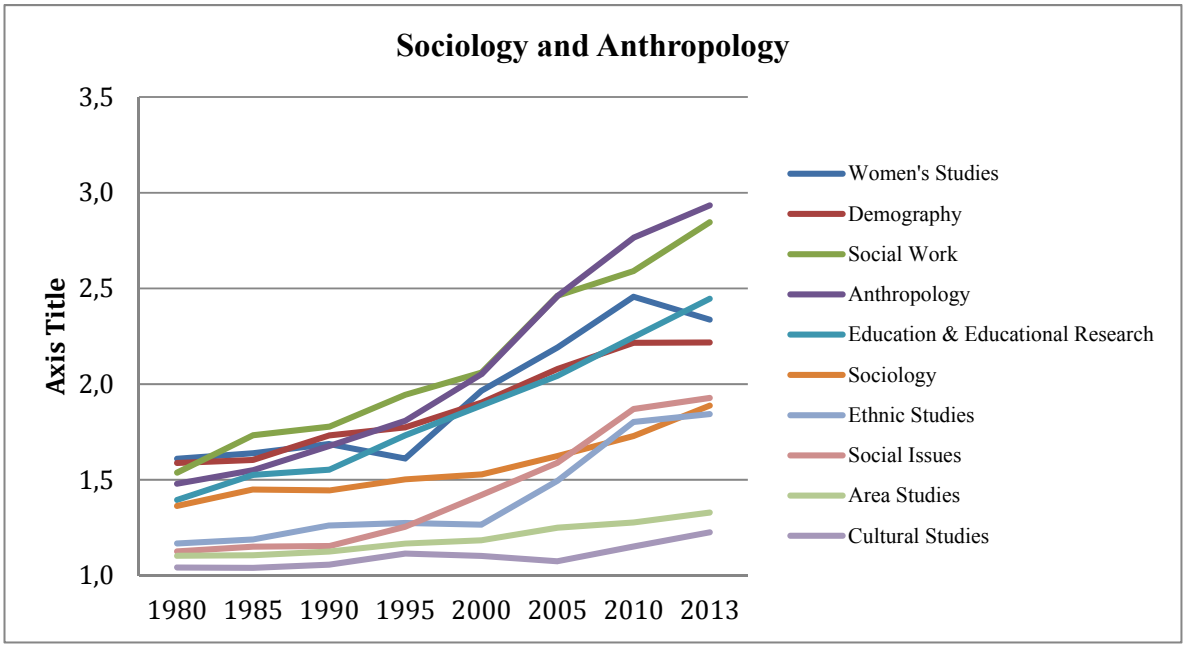

Figure 5. The mean number of authors per publication from 1980-2013 of the group Sociology and Anthropology.

In our data set we have 514,504 publications categorized in the 10 subject categories of Sociology and Anthropology, and the mean percentage increases in numbers of authors are between 17% to 98%. In Figure 5 is the increase in number of authors demonstrated. There have been minimal changes in the mean number of authors in the subject category Cultural Studies and Area Studies, while the categories Social Issues and Ethnic Studies have increased with 0.6-0.8 authors. All of these fore mention categories have a median at 1 in the whole time period. The median has risen to 2 authors for Education & Educational Research, Anthropology, Social Work, Sociology, Women's Studies and Demography. These categories, except Sociology, have a mean number of authors between 1.4-1.6 authors in 1980, which has increased to 2.2-2.9 in 2013. The mean number of authors has only increased with 0.5 for Sociology.

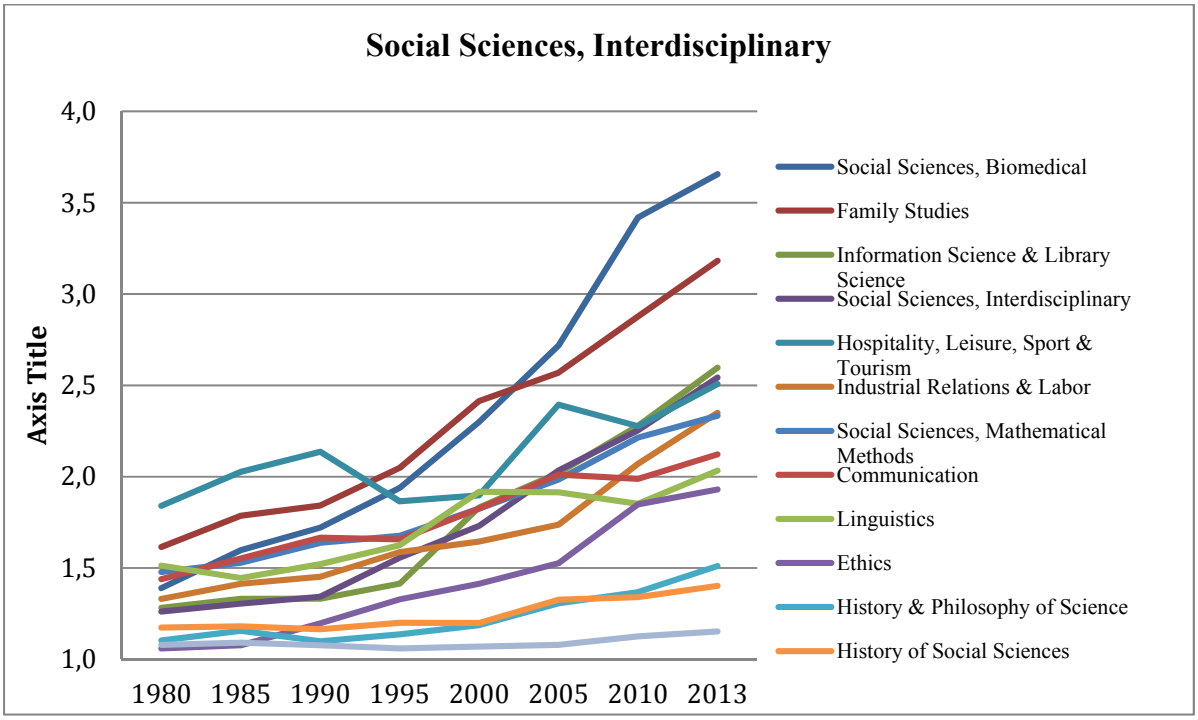

Figure 6. The mean number of authors per publication from 1980-2013 of the group Social Sciences, Interdisciplinary.

694,752 publications are indexed in the categories in the group Social Sciences, Interdisciplinary. The mean increases in numbers of authors are between 6.8%-163% or between 0.1-2.3 authors. Figure 6 demonstrates how much the increase in the numbers of authors varies from 1980 to 2013. The category History hardly had any changes in the mean number of authors and the median remain constantly at 1 during the time period. The median also remains at 1 author in the categories History of Social Science, History & Philosophy of Science and Ethics, while the mean rises from 1.1-1.2 authors in 1980 to 1.4-1.9 authors in 2013. The median increases from 1 to 2 authors in the categories Communication, Information Science & Library Science, Industrial Relations & Labor, Linguistics, Social Sciences, Interdisciplinary and Social Sciences, Mathematical Methods and the mean numbers of authors increases from 1.3-1.5 authors to 2-2.5 authors. The median is constant at 2 authors in Hospitality, Leisure, Sport & Tourism, where mean number of authors rise from 1.8 authors to 2.5 authors. The median increases from 1 author in 1980 to 3 authors in 2013 in the categories Family Studies and Social Sciences, Biomedical and the mean numbers of authors rises from 1.4-1.6 authors to 3.2-3.7 authors. In this very mixed group we can see how the categories with research closest to the humanities such as History, History of Social Science, History & Philosophy of Science and Ethics have a lower rise in the number of mean authors, while the categories Family Studies and Social Sciences, Biomedical, that both are methodological close to the life and medical sciences have had a substantial high rise in number of authors.

Discussion

In this study we document the evolution of co-authorship in the social sciences and find that the majority of research fields have had substantial increases in the numbers of authors per publication. During the 33 years the increase is equal to one author or more in

31 out of 56 subject categories, and in further five subject categories, the increase is nearly 1 author (0.9). We detect a similar increase when we include the median increase in the number authors, where the median number of authors has increased by one or more authors in 42 out the 56 subject categories. The increases in the number of authors have not happened in the same degree in all areas of the social sciences and illustrate how heterogeneous the research fields of social sciences are. The articles indexed in the four subject categories History, Cultural Studies, Area Studies and History of Social Sciences have only had a mean increase in the number of authorship between 0.1-0.2, and could be categorized as status quo during the 33 years. The percentage increases in the mean number of authors in the subject categories varies from 6.8% (History) to 175.6% (Health Policy & Services).

The results of this study confirm that there is an increasing tendency to co-author and collaborate and is in line with the tendency detected in previous studies of co-authorship and collaboration (e.g. Bebeau & Monson, 2011; Fisher et al., 1998; Ossenblok et al., 2014). Namely that the number of authors per publication has increased in the social sciences and that the largest increases have occurred in the fields with use of experiments, large data set, statistical methods and/or team-production models, such as the Social Health Sciences and parts of Psychology. A good example in our study of how the methodological differences affect the collaboration patterns is the subject categories group as Psychology. The subject categories Psychology, Psychoanalysis and Mathematical are both examples of research domains dominated by theory building and abstract concepts and with methodological relationships to research fields often defined as belonging to the humanities. The opposite are Psychiatry and Developmental Psychology, where the research are more experimental and empirical, and often sampled in collaboration with other researchers. Hence, the greatest rises in number of authors have occurred in subject categories containing research fields using quantitative methods and with a close relationship to the medical and life sciences or the natural sciences. An additional explanation for the rise in co-authorship in the majority of the subject categories is the increasing tendency for supervisors to co-author with students (Costa & Gatz, 1992; Fisher et al., 1998; Price et al., 2000).

Conclusion

As mentioned in the introduction, most of the bibliometric studies about co-authorship and research collaboration in the social sciences have been focusing on the trends and patterns in particular research fields or countries and have been based on data collected from a selection of journals in one or few research fields or national databases. In this study we use a larger sample of articles to confirm there is a rise in co-authorship in the majority of the research fields in the social sciences, and that in more than half of the subject categories the mean number of authors has increased by one or more authors.

Few of these studies undertake a deeper investigation of the rise of co-authorship and research collaboration (Costa & Gatz, 1992; Fisher et al., 1998), and the explanations offered for the rise is often speculative and anecdotal or borrowed from the “hard” sciences. We have discussed some of the factors that influence the researchers’ collaboration behavior and the rise in co-authorship. However, our explanations are based on the fore mention studies, and we therefore suggest that the next step is a thoroughly

investigation of the effects of these factors in the fields we have documented a rise in co-authorship.

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