

Authorship Patterns and Collaborative Research in Economics

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ABSTRACT

The present study identifies the pattern of authorship and the collaboration in the field of Economics. Discusses the types of collaboration and describes measures of collaboration. The study gives the actual impact of collaboration intensity on the performance of scientific productivity in terms of Collaborative Index (which comes out to be 2.06), Degree of Collaboration (0.58), and Collaboration Co-efficient (0.30). The paper concludes that the results are of significance for the policy makers in Economics research.

Keywords: Research Collaboration, Authorship Pattern in Economics, Scientometrics

1. INTRODUCTION

The productivity of authors in the context of Research and Development (R&D) is normally measured in terms of scientific and technical output. The principle means of author's communication is the publication process, which allows authors to verify the reliability of information, to acquire a sense of relative importance of a contribution, and to obtain critical response to work. Correspondingly, it is through publications that authors receive professional recognition and esteem, as well as promotions, advancements, and funding to future research work. Publication is so central to an author's productivity that the research carried by him becomes a 'work' only when it takes a conventional physical form which can be received, assessed, and acknowledged by the scientific community.

Usually collaboration can be intra-department, inter-departmental, or inter-institutional (multi-institutional) collaboration, i.e., collaboration, between two or more institutions/organizations. International collaboration is the collaboration between two or more organizations or institutions located in more than one country. Guide-Research Scholar collaboration is a very common mode of collaboration in an academic setting. The professor in a university department provides the ideas and guidance, and sometimes also the required funds from a research grant, and the research assistant or student does most of the bench work. The resulting project report, conference paper, or journal article usually carries the names of both the professor and the student. It is not uncommon for a professor to be guiding several students in different research projects at the same time. Collaboration among colleagues is a very common practice in corporate research centers where a number of colleagues will be working on one or more projects, each contributing expertise in a different aspect of the project. In interdisciplinary fields such as environment, energy, or space research, scientists and engineers from a wide variety of specialties often collaborate. In recent days it is common for specialists working together in an interdisciplinary project. In the present paper an attempt has been made to study the research productivity versus scientific collaboration in the field of Economics.

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2. REVIEW OF LITERATURE

Review of literature is a way of summarizing the state of art in a field. It offers insights into aspects of the topic which might be worthy of exploration and future research. It also identifies the conflicting points of view expressed by different authors and discusses relevant research carried out on the same topic. The literature review touches on a few notable studies in the field of scientific collaboration are given below.

Beaver and Rosen (1978) have explored the origins and history of collaboration from seventeenth to twentieth century. There is a well-established trend of using specific measures to foster scientific collaborations at both local and national level (Adams *et al.* 2005). The extent of collaboration in research can apparently be measured with the help of multi authorship of papers; formula given by Subramanyam (1982) for determining the Degree of Collaboration (DC) in a subject. Further the formula to find out Collaborative Co-efficient (CC) is given by Ajiferuke *et al.* (1988) widely used. Lawani (1986) showed that as the number of authors per paper increases, the proportion of high quality papers also increases and the Collaborative Index (CI) can be used to measure the quality in the aggregate. Maheshwarappa *et al.* (1984) studied the authorship pattern in Science and Technology (S&T) in India and found that two-authored papers are more in S&T as a whole. It indicates that the evident of high degree of collaboration in S&T research in India. Bordons *et al.* (1996) analyzed the influence of collaborations on scientific performance for three sectors within the biomedical area: neurosciences, gastroenterology and the area concerning cardiovascular systems.

Kretschmer and Kretschmer (2007) developed simple power function, a new function of co-author-pairs' frequencies. This mathematical model shows well-ordered three-dimensional bodies (3-D graphs), totally rotatable around and their manifold shapes. The process of changing collaboration patterns can be made visible in the space from all possible points of view (Kretschmer and Kretschmer 2013). However, longitudinal studies over time have shown successive variation of collaboration patterns is possible from the maxims "birds of same feather flock together" to "opposites attract" and vice versa. In other words "birds of same feather flock together" diminishes as "opposites attract" emerges and vice versa.

Sangam and Keshava (2005) have presented the collaborative research in six sub-disciplines of social sciences. Sangam and Meera (2009) have examined the collaboration in research that is affected by various socioeconomic and other environmental factors prevailing in the society. Keshava *et al.* (2010) have carried out study to know the characteristics of literature published in JCCC-UGC-INFONET e-journals consortia on a burning issue 'global warming' including authorship pattern and degree of collaboration. Sagar *et al.* (2010) have carried out a scientometric analysis of all Tsunami-related publications as per the Scopus database during 1997-2008 including authorship patterns as one of the parameters for the study. Bartneck and Hu (2010) made a bibliometric analysis of the Computer-Human Interaction conference proceedings to determine if papers having authors from different organizations or countries receive more citations than papers that are authored by members of the same organization. Hui-Zhen Fu *et al.* (2011) overviewed the characteristics of research in China, with the citation impact of internationally collaborative papers differing among fields and international collaborations making positive contributions to academic research in China. Sangam (2012) tried to investigate the pattern of authorship, type of collaborated research and the degree of collaboration in the field of demography. Jaric *et al.* (2012) has applied a bibliometric approach to identify recent patterns and trends in the methods, subjects, and authorship in the literature published in fisheries science during 2000–2009.

Gunasekaran and Balasubramani (2012) have analyzed the artificial intelligence research output during 1973-2011 using different parameters including authorship patterns. Zheng *et al.* (2012) has studied China's international S&T collaboration from the perspective of paper and patent analysis. Manimekalai and Amsaveni (2012) analysed the growth of research publications and the authorship pattern in

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Genetics and other related subjects for the data taken from the articles listed in Web of Science covering the period 1998 to 2011. Gupta (2013) analysed the research output of Bangladesh in S&T during 2001-2010 on several parameters including share of international collaborative publications at the national-level as well as across subjects and characteristics of high productivity institutions and authors. Bajwa *et al.* (2013) analysed the research trends in Pakistan in the field of nanoscience and nanotechnology including authorship patterns. Kato and Ando (2013) examined the robustness of the results presented by *Abramo et al.* and show a positive relationship between the international mobility of researchers and their performances. Rafols *et al.* (2014) explored the pharmaceutical R&D dynamics by examining the publication activities of all R&D laboratories of the major European and US pharmaceutical firms (Big Pharma) during the period 1995-2009. Zyoud and Swelleh (2014) analysed the worldwide research output in the water pipe tobacco smoking field to examine the authorship and collaboration patterns and the citations retrieved from the Scopus database for over a decade (2002-2012).

2.1. Methodology

Data for the study has been collected from Social Science Citation Index of ISI Web of Knowledge published by Thomson Reuters database for the period 2000-2014. The data is used to find the authorship pattern and measures of authorship, CI, DC, and CC in the field of Economics.

3. ANALYSIS OF DATA

4.1. Authorship Pattern

Table 1 shows that the pattern of authorship. It is evident that single authored papers are more, i.e., 1504 (41.67%), followed by papers by two authors (746, 20.66%); three authors (694, 19.23%), and four and above authors (666, 18.44%). The highest number of papers is contributed by single authors. However, when we see total contributed papers it clearly shows that out of 3610 articles 2106 (48.335) are multi-authored articles indicating the collaborative research trend in the field; so, the trend is towards team research.

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Table1: Authorship pattern in Economics

| Year | Single author | Two authors | Three authors | ≥ Four authors | Total articles | Total authors |
|--------------|---------------------|--------------------|--------------------|--------------------|----------------|---------------|
| 2000 | 58(53.21) | 15 (13.76) | 7 (6.43) | 29 (26.60) | 109 | 386 |
| 2001 | 62 (49.20) | 34 (26.98) | 14 (11.11) | 16 (12.71) | 126 | 453 |
| 2002 | 50 (42.01) | 15 (12.60) | 30 (25.23) | 24 (20.16) | 119 | 396 |
| 2003 | 73 (52.89) | 37 (26.81) | 10 (7.26) | 18 (13.04) | 138 | 488 |
| 2004 | 81 (55.47) | 20 (13.69) | 12 (8.24) | 33 (22.60) | 146 | 520 |
| 2005 | 38 (32.47) | 52 (44.44) | 19 (16.23) | 8 (6.86) | 117 | 452 |
| 2006 | 59 (32.41) | 36 (19.78) | 40 (21.97) | 47 (25.84) | 182 | 563 |
| 2007 | 102 (43.40) | 20 (8.510) | 59 925.12) | 54 (22.97) | 235 | 602 |
| 2008 | 113 (39.23) | 68 (23.61) | 75 (26.05) | 32 (11.11) | 288 | 752 |
| 2009 | 123 (38.55) | 49 (15.36) | 73 (22.89) | 74 (23.20) | 319 | 831 |
| 2010 | 146 (39.67) | 91 (24.72) | 49 (13.33) | 82 (22.28) | 368 | 647 |
| 2011 | 152 (40.10) | 89 (23.48) | 71 (18.73) | 67 (17.69) | 379 | 858 |
| 2012 | 163 (46.57) | 58 (16.57) | 95 (27.15) | 34 (9.71) | 350 | 518 |
| 2013 | 149 (41.16) | 78 (21.54) | 79 (21.84) | 56 (15.46) | 362 | 735 |
| 2014 | 135 (36.29) | 84 (22.58) | 61 (16.39) | 92 (24.74) | 372 | 738 |
| Total | 1504 (41.67) | 746 (20.66) | 694 (19.23) | 666 (18.44) | 3610 | 8939 |

4.2 Measures of Authorship

The study of authorship is an important aspect and plays a vital role in information dissemination and communication activities. The latest research trends show that it is more data intensive than earlier research due to the proliferation of digital technologies and the demand for solutions in today's era of fast paced innovation. Similarly the movement towards collaborative innovation is affecting scientific research, bringing scientists from different disciplines together in their pursuit of solutions to today's challenges. This is also found true in the case of social science research, because of the interdisciplinary growth of the subjects. At the same time, it is obligatory on the part of social scientists to come together and complement one another to overcome the challenges. The collaboration is not limited to individual scientists; it is extended even up to institutions, communities, and nations and so on. The concept of team work is in vogue because of various funding agencies.

The Iollaborative Index, degree of collaboration and collaboration coefficient were determined based on year-wise output of publications.

4.2.1 Collaborative Index

This is one of the early measures of degree of collaboration derived by Lawani (1980).

$$CI = \frac{\sum^A_j = I_j f_i}{N}$$

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It is a measure of mean number of authors. Although it is easily computable, it is not easily interpretable as a degree, for it has no upper limit. Moreover; it gives a non-zero weight to single-authored papers, which involve no collaboration.

$$CI = [(f1) 1 + (f2) 2 + (f3) 3 + \dots (fk) k] / N$$

Using data in the Table1, during 2000-2014,

$$CI = (58 + 15 \times 2 + 7 \times 3 + 29 \times 4) / 109 = 58 + 30 + 21 + 116 = 225 \\ = 225 / 109 = 2.06$$

Table 2 shows the variation in the CI. It varies from 1.80 in 2003 and highest Collaboration we can notices in 2014 i.e. 2.29. This may be due to the geographical or environmental factors of the organization.

Table2: Collaborative index in Economics

| Year | Single author | Two authors | Three authors | ≥ Four authors | Total articles | CI |
|--------------|----------------------|--------------------|----------------------|-----------------------|-----------------------|-------------|
| 2000 | 58 | 15 | 7 | 29 | 109 | 2.06 |
| 2001 | 62 | 34 | 14 | 16 | 126 | 1.87 |
| 2002 | 50 | 15 | 30 | 24 | 119 | 2.23 |
| 2003 | 73 | 37 | 10 | 18 | 138 | 1.80 |
| 2004 | 81 | 20 | 12 | 33 | 146 | 1.97 |
| 2005 | 38 | 52 | 19 | 8 | 117 | 1.97 |
| 2006 | 59 | 36 | 40 | 47 | 182 | 2.41 |
| 2007 | 102 | 20 | 59 | 54 | 235 | 2.27 |
| 2008 | 113 | 68 | 75 | 32 | 288 | 2.09 |
| 2009 | 123 | 49 | 73 | 74 | 319 | 2.30 |
| 2010 | 146 | 91 | 49 | 82 | 368 | 2.18 |
| 2011 | 152 | 89 | 71 | 67 | 379 | 2.13 |
| 2012 | 163 | 58 | 95 | 34 | 350 | 2.00 |
| 2013 | 149 | 78 | 79 | 56 | 362 | 2.11 |
| 2014 | 135 | 84 | 61 | 92 | 372 | 2.29 |
| Total | 1504 (41.67) | 746 (20.66) | 694 (19.23) | 666 (18.44) | 3610 | 2.14 |

4.2.2 Degree of Collaboration

In recent years, most of the countries have realized the importance of scientific research for its socio-economic development, and have initiated programmes that encourage and support collaboration among scientists and researchers, both at the national and the international levels. In order to measure the collaborative research pattern, an indicator, known as the Degree of Collaboration, proposed by Subramanyam (1983), has been computed as under:

$$DC = Nm / (Nm + Ns)$$

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where N_m is the number of multi-author publications, N_s is the number of single author publications in a discipline during a given period of time in a discipline.

Table 3 shows the Degree of Collaboration. It may be noted that the value of the highest degree of collaboration (DC) was 0.58 during the period 2000-2014. The DC among two authors was 0.33 and the minimum was 0.30 among the four and above authors.

Table-3: Degree of collaboration in Economics

| Authorship pattern | | |
|--|------------------------|-------------|
| | Number of publications | DC |
| Total number of single/multi-authored publications | 3610 | |
| Number of co-authored publication (N_m) | 2106 | 0.58 |
| Number of single-authored publication (N_s) | 1504 | |
| Number of two-authored publication | 746 | 0.33 |
| Number of three-authored publication | 694 | 0.31 |
| Number of four above authored publication | 666 | 0.30 |

Based on the data in the Table 3, using the values for $N_m = 2106$ and $N_s = 1504$, DC for multi-authored publications is

$$DC = 2106 / (2106 + 1504) = 0.58$$

4.2.3. Collaborative Coefficient

According to Ajiferuke *et al.* (1988) who have shown the mean number of authors per paper, the proportion of multiple authorship as a measure of degree of collaboration in a discipline, is inadequate. Therefore, they have proposed a measure combining some of the merits of both measures into what is known as Collaborative Coefficient.

Suppose, if a paper has a single author, the author receives one credit; if two, each receives $\frac{1}{2}$ credits. In general, if we have 'n' authors each receive $1/n$ credits. Hence, the average credit awarded to each author of a random paper is $E [1/n]$, a value which lies between 0 and 1. If '0' is to correspond to single authorship, then the CC is defined as:

$$CC = E [1/n]$$

$$= \sum (1/j) p(N=j)$$

$$\text{And its sum } \sum \text{rate} = \frac{1 \cdot f_1 + (1/2) f_2 + (1/3) f_3 + \dots + (1/k) f_k}{N}$$

where: F_j is the number of j -authors research papers published in a discipline during a certain period of time, N is the total number of research papers published in a discipline during a certain period of time (excluding anonymous authors) and K is the greatest number of authors per paper in a discipline. Ajiferuke *et al.* were of the opinion that the CC incorporates the sum of the merits of both CI and DC. It lies between 0 and 1 ($0 <= cc < 1$). It tends to zero as single authored papers dominate and differentiates among levels of multiple authorship.

Table 4 shows that CC has increased from 0.31 in 2000 to 0.41 in 2014 indicating that research among scientists is fairly collaborative with an average CC of 0.38.

Table 4: Collaborative co-efficient in Economics

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| Year | Single author | Two authors | Three authors | Four & above authors | Number of publications | CC |
|--------------|---------------------|--------------------|--------------------|----------------------|------------------------|-------------|
| 2000 | 58 | 15 | 7 | 29 | 109 | 0.31 |
| 2001 | 62 | 34 | 14 | 16 | 126 | 0.30 |
| 2002 | 50 | 15 | 30 | 24 | 119 | 0.38 |
| 2003 | 73 | 37 | 10 | 18 | 138 | 0.28 |
| 2004 | 81 | 20 | 12 | 33 | 146 | 0.29 |
| 2005 | 38 | 52 | 19 | 8 | 117 | 0.38 |
| 2006 | 59 | 36 | 40 | 47 | 182 | 0.44 |
| 2007 | 102 | 20 | 59 | 54 | 235 | 0.38 |
| 2008 | 113 | 68 | 75 | 32 | 288 | 0.38 |
| 2009 | 123 | 49 | 73 | 74 | 319 | 0.40 |
| 2010 | 146 | 91 | 49 | 82 | 368 | 0.38 |
| 2011 | 152 | 89 | 71 | 67 | 379 | 0.37 |
| 2012 | 163 | 58 | 95 | 34 | 350 | 0.34 |
| 2013 | 149 | 78 | 79 | 56 | 362 | 0.37 |
| 2014 | 135 | 84 | 61 | 92 | 372 | 0.41 |
| Total | 1504 (41.67) | 746 (20.66) | 694 (19.23) | 666 (18.44) | 3610 | 0.37 |

$$CC = 1 - [f1 + (1/2)f2 + (1/3)f3 + \dots + (1/k)fk] / N$$

Based on the data in the Table 4, using the values for $f1$, $f2$, and $f3$, CC for the year 2001

$$\begin{aligned}
 CC &= 1 - \{ [62 + (1/2) 34 + (1/3) 14 + (1/4) 16] / 126 / N \} \\
 &= 1 - \{ [62 + 17 + 4.66 + 4] / 126 \} \\
 &= 1 - [87.66 / 126] = 1 - 0.695 = 0.305
 \end{aligned}$$

5. FINDINGS

The main findings of the present study are summarized as under:

- Majority of the papers are single authored, i.e., 1504 (41.67%), followed by 746 (20.66%) by two authors; 694 (19.23%) by three authors with four and above authors papers are 666 (18.44%).
- The Collaborative Index varies from 1.80 in 2003 with highest collaboration of 2.29 in 2014.
- The Collaborative Coefficient increased from 0.31 in 2000 to 0.41 in 2014 indicating that research among scientists is fairly collaborative with an average CC of 0.38.
- The highest Degree of Collaboration was 0.58 during the period 2000-2014. The DC among two authors was 0.33 and the minimum was 0.30 among the four and above authors.
- There is a collaborative trend in Economics.

6. CONCLUSION

Among the various studies in scientometrics, author productivity studies are the most common. The present era is witnessing the practice of collaboration which is spreading very fast owing to the globalization of research. The days of individual research are gone. The present situation compels on the researchers to go for collaboration in research, thus resulting in the shift from solo research to team research. Communication and collaboration between researchers are of great importance in the development of subject areas and in the dissemination of research results. Thus, collaboration is an intense form of interaction that allows for effective communication as well as the sharing of competence and other resources. In view of this, it is suggested that essential studies should be conducted in other sub-fields of Economics in order to identify the intensity of collaboration.

REFERENCES

1. Adams, S. J. D., Black, G. C., Clemmons, J. R., Paula, E., and Stephan, P. E. (2005). Scientific teams and institutional Collaboration: Evidence from Universities, 1981-1999. *Research Policy*, 34(3), 259-285.
2. Ajiferuke, I, Burell, Q and Tague, J. (1988). Collaborative coefficient: A single measure of the collaboration in research. *Scientometrics*, 14, 421-433.
3. Bartneck, C. and Hu, J. (2010). The fruits of collaboration in multidisciplinary field. *Scientometrics*, 85 (1), 41–52.
4. Bajwa, R. S., Yaldram, K. and Rafique, S. (2013). A Scientometric assessment of research output in nanoscience and nanotechnology: Pakistan perspective. *Scientometrics*, 94, 333-338.
5. Beaver, D. and Rosen, R. (1978). Studies in scientific collaboration part 1: The professional origins of scientific co authorship. *Scientometrics*. 1, 72.
6. Bordons, M., Gomez I., Fernandez, M. T., Zulueta, M. A., and Mendez, A. (1996). Local, domestic and international scientific collaboration in biomedical research. *Scientometrics*, 37(2), 279-295.
7. Gunasekaran, M. and Balasubramani, R. (2012). Scientometric Analysis of Artificial Intelligence Research output: An Indian Perspective. *European Journal of Scientific Research*, 70 (2), 317-322.
8. Fu, H., Chuang, K., Wang, M., and Ho, Y. (2011). Characteristics of research in China assessed with ESI. *Scientometrics*, 88, 841-862.
9. Gupta, B. M. (2013). Bangladesh: A Scientometric Analysis of National Publications Output in S&T, 2001-10. *DESIDOC Journal of Library and Information Technology*, 33 (1).
10. Jaric, I., Cvijanovic, G., Knezevic-Jaric, J., and Lenhardt, M. (2012). Trends in Fisheries Science from 2000 to 2009: A Bibliometric Study. *Reviews in Fisheries Science*, 20 (2), 70-79. 10.1080/10641262.2012.659775.
11. Kato, M. and Ando, A. (2013). The relationship between research performance and international collaboration in chemistry. *Scientometrics*, 97 (3), 535-553.
12. Keshava, Prakash, Y. and Gowda, M. P. (2010, December). Global warming: A bibliometric analysis. In eds Sangam. *Paper presented at Webometrics, Informetrics and Scientometrics National seminar, Dharwad*, (27-36).
13. Kretschmer, H. and Kretschmer, T. (2007). Lotka's distribution of co-author pairs frequencies. *Journal of Informetrics*, 1, 308-337.
14. Kretschmer, H. and Kretschmer, T. (2013). Who is collaborating with whom in science? Explanation of a fundamental principle. *Social Networking*, 2, 99-137, doi:10.4236/sn2013.23011Publishedonline July 2013 (<http://www.scirp.org/journal/sn>).
15. Lawani, S. M. (1986) Some bibliometric correlates of quality in scientometric research. *Scientometrics*, 9(1&2), 13-25.
16. Manimekalai, A. and Amsaveni, N. (2012). Collaborative Research Publications of Genetics in India. *Journal of Advances in Library and Information Science*, 1 (2), 88-93. www.jails.in/. [Retrieved on 21/6/2013].
17. Maheshwarappa, B. S, Nagappa, B and Mathias (1984). S. A. Collaborative research in science and technology in India: A Bibliometric study. *Journal of Library and Information science*. 9 (2)154-159.

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18. Rafols, I., Hopkins, M. M., Hoekman, J., Siepel, J., Hare, A., Perianes-Rodriguez, A. and Nightingale, P. (2014). Big Pharma, little science? : A bibliometric perspective on Big Pharma's R & D decline. *Technological forecasting and social change*, 81, 22-38. doi:10.1016/j.techfore. 2012.06.007.
19. Sagar, A., Kademani, B. S., Garg, R. G. and Vijaykumar (2010). Scientometric mapping of Tsunami publications: a citation based study. *Malaysian journal of Library and Information Science*, 15 (1), 23-40.
20. Sangam, S. L. and Keshava. (2005). Colloboration in Social Science Research in India. *Journal of Information Management and Scientometrics*, 2 (1), 34-39.
21. Sangam, S. L. and Meera. (2009). Research Collaboration Pattern in Indian Contribution to Chemical sciences. *Colleenet Journal of Scientometrics and Information Management*, 3 (1), 39-45.
22. Sangam, S. L. (2012). Scientific productivity and collaborative research patterns in the field of demography. In eds Kumbar, et al. *Paper presented at Statistical methods for communication science national Workshop, Dharwad* (pp. 109-117). UGC/SAP/DRS-1: Dharwad.
23. Subramanyam, K (1982). Research collaboration and funding in biochemistry and chemical engineering. *Int. forum Inf.Doc.* 7(4), 26-29.
24. Zheng, J. Zhao, Z., Zhang, X., Chen, D., Huang, M., Lei, X., Zhao, Y. (2012). International scientific and technological collaboration of China from 2004 to 2008: A perspective from paper and patent analysis. *Scientometrics*, 91(1), 65-80.