Spanish research groups on Economy and Management: a network analysis approach

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Key words

Bibliometrics, Scientometrics, Network analysis, Databases, Scientific collaboration, Co-authorsip, Scientific productivity

Abstract

The aim of this article is to study the evolution of the Spanish research groups on Economy and Management. Due to subject headings lists are considered to be insufficient and inflexible to describe relationship between sciences, the authors develop a method to link journals from the SSCI depending on their subjects on this thematic area. The application of social network analysis to retrieval information in a multidisciplinary database has been demonstrate as very helpful to represent interdisciplinarity in a knowledge area, in particular the Social Science Citation Index. Secondly, a network is created based on co-authorship from the Spanish articles provided on this database and represented for three periods: 1992-1996, 1997-2001 and 2002-2006. The use bibliometric indicators as main attributes of nodes in the network analysis have been helpful to identify equivalent positions, actors who show the same role within each graph.

Introduction

The aim of this work is to describe the process of generation, growth and consolidation of the Spanish research groups on the Economy subjects for the last 15 years combining the two kinds of analysis above mentioned: the bibliometric and the social network analyses.

The bibliometric analyse describes the growth and distribution of the articles and their authors. The co-authorship study based on network analyse shows the way the research groups are organised and structured. The software used, UCINET, provide two benefits. On one hand, it facilitates the comprehension of the explained phenomenon. On the other hand, it supplies the quantification and characterisation of the relationship by the centrality measures: degree, closeness and betweeness.

Co-authorship is the empirical evidence of intellectual collaboration in scientific research. It demonstrates that two or more researchers have been working together in order to produce a scientific output. It is supposed that by this way they pretend to obtain better results than working on their own (Acedo, 2006).

Some reasons that promote the collaboration between authors are the increasing specialization within science; the fact that interdisciplinary research requires the participation of several experts; and the development of telecommunications, specially the Internet, that communicate easily scientists working all around the world.

The academic excellences of researchers, and unfortunately the salaries, are related to the productivity. Hence the authors suspect there is a kind of collaboration due to a supportive strategy between partners. Including an author in his paper guarantee the compensation of appearing in one of the partner's article. This collaboration does not imply equal work intensity by both authors in both papers.

Many bibliometric studies have been applied to the thematic area of Economy and Business (García, 1999; Pons, 2006; Ramos, 2007). Nevertheless the implementation of the network analyse methodology applied to Economy and Business scientific literature is less extended and only recently.

Methods and Materials

Bibliographic data used for this study have been collected from the Social Sciences Citation Index®, henceforth SSCI and the thematic journal classification from the Journal Citation Reports®, Social Sciences Edition, henceforth JCR. Both products are developed by the Philadelphia Scientific Information Institute, founded by Eugene Garfield, nowadays Thompson.

The authors have at their disposal an Access database created ad hoc for a previous research. It contains the whole Spanish scientific production from the SSCI. Relational data has been provided from relevant searches on this database. In order to observe the evolution, three periods have been defined: 1992-1996, 1997-2001 and 2002-2006.

To compile all the scientific Spanish production, all the entries from the SSCI with their field "Address" containing the word "Spain" were collected. Besides, the same subject or subjects ascribed for the journal is assumed for the articles published on that journal.

Software UCINET and Netdraw is used to process the matrix and the graphs of networks.

The fact that a journal is classified as two different matters imply a link between these two subjects: there may be a closeness thematic relation or an interdisciplinary knowledge field.

The metaphor of a Network, widely used among sociologists, make possible to explain the establishment and connections between different subjects. Scientific disciplines which grow involving theoretical bodies and methodologies can be understood on a more sensitive way by this method.

This method to select groups of scientific journals for bibliometric essays is considered an improvement: previous works were based on pre-established sets of authors, or on similar institutions. This article method avoids also the strictness on the choice of pre-established subjects that never explains correctly the overlapping between them. Furthermore, other methods run the risk of mutilate extensions of the subjects or just to produce silence on incipient relationships.

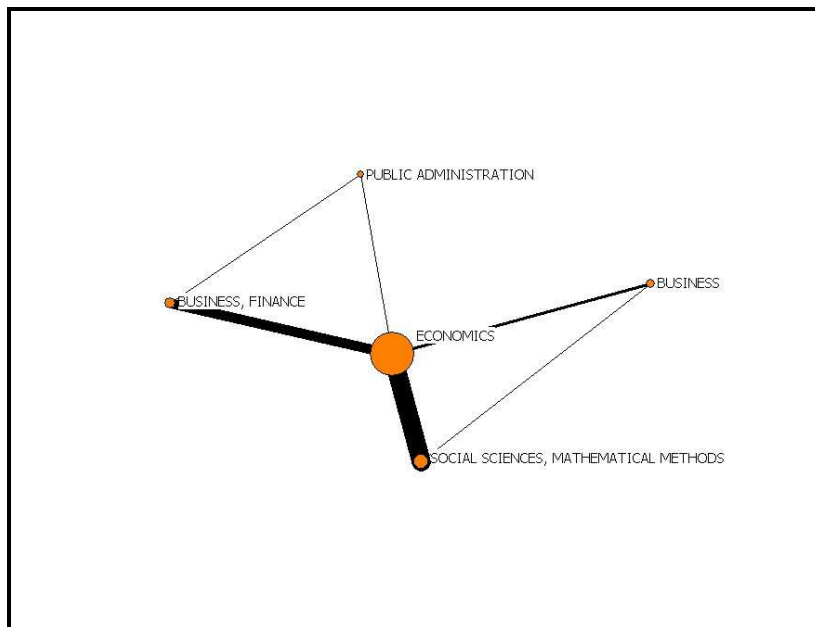With this acceptance Figure 1 represents the network of the subjects related to the thematic area of Economy.

Figure 1. Economy subjects.

The size of the nodes represents the amount of documents published on the journals ascribed to this subject, and the tie wideness represents the number of journal in common.

Table 1 presents the involved journals and allows searching the links between them based on their subjects. These links are generally double, but in some cases, three journals are related through their associated subjects.

Revista	Materia
ACCOUNTING ORGANIZATIONS AND SOCIETY	BUSINESS, FINANCE
AGRICULTURAL ECONOMICS	ECONOMICS
AMERICAN ECONOMIC REVIEW	ECONOMICS
AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS	ECONOMICS
APPLIED ECONOMICS	ECONOMICS
APPLIED ECONOMICS LETTERS	ECONOMICS
APPLIED PSYCHOLOGICAL MEASUREMENT	SOCIAL SCIENCES, MATHEMATICAL METHODS
BUSINESS HISTORY	BUSINESS
DESARROLLO ECONOMICO-REVISTA DE CIENCIAS SOCIALES	ECONOMICS
ECOLOGICAL ECONOMICS	ECONOMICS
ECONOMETRIC THEORY	*ECONOMICS*
ECONOMETRIC THEORY	*SOCIAL SCIENCES, MATHEMATICAL METHODS*
ECONOMETRICA	*ECONOMICS*
ECONOMETRICA	*SOCIAL SCIENCES, MATHEMATICAL METHODS*
ECONOMIC GEOGRAPHY	ECONOMICS

ECONOMIC HISTORY REVIEW	ECONOMICS
ECONOMIC JOURNAL	ECONOMICS
ECONOMIC MODELLING	ECONOMICS
ECONOMIC POLICY	ECONOMICS
ECONOMIC THEORY	ECONOMICS
ECONOMICA	ECONOMICS
ECONOMICS LETTERS	ECONOMICS
ECONOMICS OF EDUCATION REVIEW	ECONOMICS
ENVIRONMENT AND PLANNING C-GOVERNMENT AND POLICY	PUBLIC ADMINISTRATION
ENVIRONMENTAL & RESOURCE ECONOMICS	ECONOMICS
EUROPEAN ECONOMIC REVIEW	ECONOMICS
EUROPEAN REVIEW OF AGRICULTURAL ECONOMICS	ECONOMICS
EUROPE-ASIA STUDIES	ECONOMICS
FUTURES	ECONOMICS
GAMES AND ECONOMIC BEHAVIOR	ECONOMICS
HEALTH ECONOMICS	ECONOMICS
INSURANCE MATHEMATICS & ECONOMICS	***ECONOMICS***
INSURANCE MATHEMATICS & ECONOMICS	***SOCIAL SCIENCES, MATHEMATICAL METHODS***
INTERNATIONAL ECONOMIC REVIEW	ECONOMICS
INTERNATIONAL JOURNAL OF FORECASTING	ECONOMICS
INTERNATIONAL JOURNAL OF GAME THEORY	***ECONOMICS***
INTERNATIONAL JOURNAL OF GAME THEORY	***SOCIAL SCIENCES, MATHEMATICAL METHODS***
INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION	ECONOMICS
INTERNATIONAL REVIEW OF ADMINISTRATIVE SCIENCES	PUBLIC ADMINISTRATION
INTERNATIONAL REVIEW OF LAW AND ECONOMICS	ECONOMICS
INTERNATIONAL TAX AND PUBLIC FINANCE	***BUSINESS, FINANCE***
INTERNATIONAL TAX AND PUBLIC FINANCE	***ECONOMICS***
JOURNAL OF AGRICULTURAL ECONOMICS	ECONOMICS
JOURNAL OF APPLIED ECONOMETRICS	***ECONOMICS***
JOURNAL OF APPLIED ECONOMETRICS	***SOCIAL SCIENCES, MATHEMATICAL METHODS***
JOURNAL OF BANKING & FINANCE	***BUSINESS, FINANCE***
JOURNAL OF BANKING & FINANCE	***ECONOMICS***
JOURNAL OF BUSINESS & ECONOMIC STATISTICS	***ECONOMICS***
JOURNAL OF BUSINESS & ECONOMIC STATISTICS	***SOCIAL SCIENCES, MATHEMATICAL METHODS***
JOURNAL OF BUSINESS ETHICS	BUSINESS
JOURNAL OF ECONOMETRICS	***ECONOMICS***
JOURNAL OF ECONOMETRICS	***SOCIAL SCIENCES, MATHEMATICAL METHODS***
JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION	ECONOMICS
JOURNAL OF ECONOMIC DYNAMICS & CONTROL	ECONOMICS
JOURNAL OF ECONOMIC HISTORY	ECONOMICS
JOURNAL OF ECONOMIC LITERATURE	ECONOMICS
JOURNAL OF ECONOMIC PSYCHOLOGY	ECONOMICS
JOURNAL OF ECONOMIC THEORY	ECONOMICS
JOURNAL OF ECONOMICS & MANAGEMENT STRATEGY	ECONOMICS

JOURNAL OF ECONOMICS-ZEITSCHRIFT FUR NATIONALOKONOMIE	ECONOMICS
JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	*BUSINESS*
JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	*ECONOMICS*
JOURNAL OF INDUSTRIAL ECONOMICS	*BUSINESS, FINANCE*
JOURNAL OF INDUSTRIAL ECONOMICS	*ECONOMICS*
JOURNAL OF INTERNATIONAL ECONOMICS	ECONOMICS
JOURNAL OF INTERNATIONAL MONEY AND FINANCE	BUSINESS, FINANCE
JOURNAL OF MACROECONOMICS	ECONOMICS
JOURNAL OF MATHEMATICAL ECONOMICS	*ECONOMICS*
JOURNAL OF MATHEMATICAL ECONOMICS	*SOCIAL SCIENCES, MATHEMATICAL METHODS*
JOURNAL OF MATHEMATICAL PSYCHOLOGY	SOCIAL SCIENCES, MATHEMATICAL METHODS
JOURNAL OF MONETARY ECONOMICS	*BUSINESS, FINANCE*
JOURNAL OF MONETARY ECONOMICS	*ECONOMICS*
JOURNAL OF POLICY MODELING	ECONOMICS
JOURNAL OF POLITICAL ECONOMY	ECONOMICS
JOURNAL OF POPULATION ECONOMICS	ECONOMICS
JOURNAL OF POST KEYNESIAN ECONOMICS	ECONOMICS
JOURNAL OF PRODUCTIVITY ANALYSIS	*BUSINESS*
JOURNAL OF PRODUCTIVITY ANALYSIS	*ECONOMICS*
JOURNAL OF PRODUCTIVITY ANALYSIS	*SOCIAL SCIENCES, MATHEMATICAL METHODS*
JOURNAL OF PUBLIC ECONOMICS	ECONOMICS
JOURNAL OF RISK AND UNCERTAINTY	*BUSINESS, FINANCE*
JOURNAL OF RISK AND UNCERTAINTY	*ECONOMICS*
KYKLOS	ECONOMICS
LABOUR ECONOMICS	ECONOMICS
LECTURE NOTES IN ECONOMICS AND MATHEMATICAL SYSTEMS	ECONOMICS
MACROECONOMIC DYNAMICS	ECONOMICS
MATHEMATICAL SOCIAL SCIENCES	SOCIAL SCIENCES, MATHEMATICAL METHODS
MULTIVARIATE BEHAVIORAL RESEARCH	SOCIAL SCIENCES, MATHEMATICAL METHODS
OPEN ECONOMIES REVIEW	ECONOMICS
OXFORD BULLETIN OF ECONOMICS AND STATISTICS	*ECONOMICS*
OXFORD BULLETIN OF ECONOMICS AND STATISTICS	*SOCIAL SCIENCES, MATHEMATICAL METHODS*
OXFORD ECONOMIC PAPERS-NEW SERIES	ECONOMICS
POLITICKA EKONOMIE	ECONOMICS
PUBLIC CHOICE	ECONOMICS
PUBLIC FINANCE-FINANCES PUBLIQUES	*BUSINESS, FINANCE*
PUBLIC FINANCE-FINANCES PUBLIQUES	*ECONOMICS*
PUBLIC FINANCE-FINANCES PUBLIQUES	*PUBLIC ADMINISTRATION*
R & D MANAGEMENT	BUSINESS
RAND JOURNAL OF ECONOMICS	ECONOMICS
REGIONAL SCIENCE AND URBAN ECONOMICS	ECONOMICS
REVIEW OF ECONOMIC STUDIES	ECONOMICS
REVIEW OF ECONOMICS AND STATISTICS	*ECONOMICS*
REVIEW OF ECONOMICS AND STATISTICS	*SOCIAL SCIENCES, MATHEMATICAL METHODS*

REVIEW OF FINANCIAL STUDIES	BUSINESS, FINANCE
REVIEW OF INCOME AND WEALTH	ECONOMICS
SCANDINAVIAN JOURNAL OF ECONOMICS	ECONOMICS
SMALL BUSINESS ECONOMICS	ECONOMICS
SOCIAL CHOICE AND WELFARE	*ECONOMICS*
SOCIAL CHOICE AND WELFARE	*SOCIAL SCIENCES, MATHEMATICAL METHODS*
SYSTEM DYNAMICS REVIEW	SOCIAL SCIENCES, MATHEMATICAL METHODS
THEORY AND DECISION	*ECONOMICS*
THEORY AND DECISION	*SOCIAL SCIENCES, MATHEMATICAL METHODS*
TIJDSCHRIFT VOOR ECONOMISCHE EN SOCIALE GEOGRAFIE	ECONOMICS
TRIMESTRE ECONOMICO	ECONOMICS
WORLD ECONOMY	*BUSINESS, FINANCE*
WORLD ECONOMY	*ECONOMICS*

Table 1. Journals and Subject Categories from Economy at JCR.

Results and Discussion

Figure 2 contains data about productivity and number of authors for each period.

Through the studied period, the Spanish scientific production from the Economy area compiled on the SSCI, grows above the double each five years. Specifically, from the first to the second five-year period, the number of articles grows from 389 to 920, that mean an increase of 137%. On the third period, from 2002 to 2006, the number of articles corresponds to 1892, which means an increase of 106% from the articles of the second period.
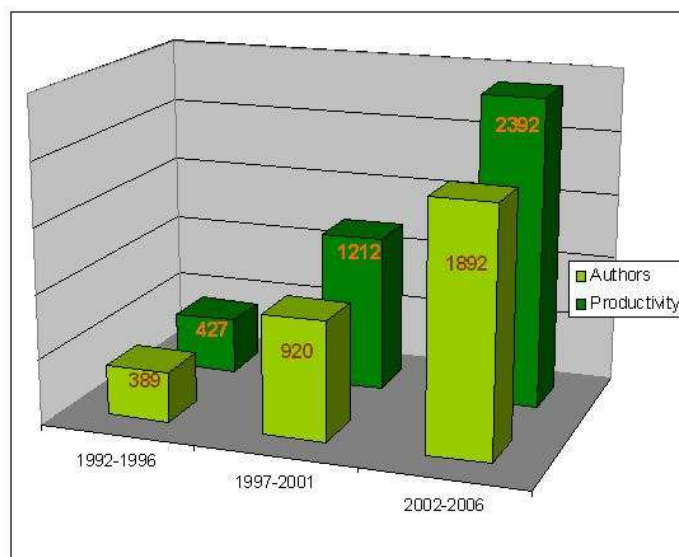

Figure 2 Productivity and Authors

The growth rate of the number of active authors on the studied subjects is even higher: a 184% from the first to the second five-year period, and a 97% from the second to the third.

Table 2 displays Lotka distribution of the scientific production for each of the three periods. Belonging to this theory (Lotka, 1926), not all the researchers are equally creative, but they are stratified on different productivity levels. In general in all the subjects, three groups can be detected: a select group of maximum producers, another one of medium producers and finally a big mass of authors that contribute with a single work. In the current study, big producers have signed 4 or more articles in each period and the medium ones have written 2 or 3 papers.

This distribution is common in all the scientific subjects, and it keeps stable in this study for the three periods. The group of maximum producers, only approximately the 7% of all the authors, represents practically the 25 % of the whole production. The medium producers group, corresponding to the 20% of the authors, contributes in a 30 % to the global production. Finally, single article authors represent between the 70-75% of all the authors, even so their global contribution never reaches the 50% of all the papers.

	1992-1996			1997-2001			2002-2006		
	Articles %	Authors %	núm.	Articles %	Authors %	núm.	Articles %	Authors %	núm.
Main producers (4 or more articles)	24%	7%	**30**	21%	6%	**69**	26%	8%	**188**
Medium producers (2 or 3 articles)	30%	20%	87	31%	20%	248	32%	23%	560
Lower producers (1 article)	46%	73%	310	49%	74%	895	41%	69%	1644
			427			1212			2392

Table 2 Lotka distribution

Nevertheless the little variations are meaningful. The trend is that maximum and medium producers accumulate more and more percentage of the total scientific production; despite the incorporation rate of new authors is as explosive as seen on figure 2. This trend is clearly that

the stricter the scientific excellence criteria are the higher of articles must be published preferentially compiled on the ISI databases.

The average of co-authorship rate in the Economic area corresponds to 1.9 authors per article. Through the studied fifteen-year period it has increased from 1.7 on the first period 1992-1996, to 2.1 on the third one.

The most important increase on the co-authorship rate can be observed between the first and the second period, from from 1.7 on the first period 1992-1996, to 2.0 on the second, and it is related with the higher increase rate of active authors in the area: a 184% of the previous one.

Figure 3, 4 and 5, and the measures from the tables 3, 4 and 5 have been developed with the maximum producers data, which means the 30 main authors for the period 1992-1996; 69 authors for the second period 1997-2001; and 188 authors for 2002-2006.

Each node represents an author and its size is based on his productivity. The same colour represents the same research group or component. This means that several nodes on a close position with the same colour are connected in at least one of the studied periods by a co-authorship in a scientific research article1. The ties joining nodes point out a co-authorship, and their width is also based on the number of co-signed articles.

There are three centrality measures: the degree, the closeness and the betweeness. The degree is the number of links of a node. In this case, as it is a valued network, the degree not only corresponds to the number of connections with the others, but also with the width of these links. The betweeness represents the way a node is necessary to link other nodes. It is calculated by summing the ties that correspond to the shortest path between two nodes. A high number means that a node has the ability of connecting, or, on the contrary, of isolating other nodes. Closeness is a measure of the ability of a node to access to all the nodes of its component being or not directly connected to it. It is calculated by summing the relations of the path from that node to the rest of all the nodes of its component. A low betweeness means that the node has a high capacity to interact with its environment.

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1 The high number of components forces to repeat some colours.

1992-1996 period

Figure 3 describes the co-authorship networks for the 1992-1996 period.

The most productive author in this five-year period is Vives-X who collaborates occasionally with Mascolell-A and Caminal-R. The latter makes possible the component to enlarge to 5 authors, the biggest of the period.

In terms of work teams, the main group is the one composed by Indurain-E and Candeal-JC. The component consists of just two members, but its degree is the highest and it indicates that they work together regularly.

The association of Sosvillarivero-S, Modesto-L and Bradley- J is also a balanced and durable group in which all members are connected to everyone else as a cluster.

Dolado-JJ is the only one of its component who remains along the three analyzed periods.

Eventually, several isolated nodes appear, its colours indicates its membership to a team work in other periods. They are, like Neme-S and Barbera-S or Motta-M, the most trained researchers who lead his groups during many five-year periods.

Even though some authors, as Canova-F, are very relevant concerning to his productivity, they remain isolated during the whole defined interval.
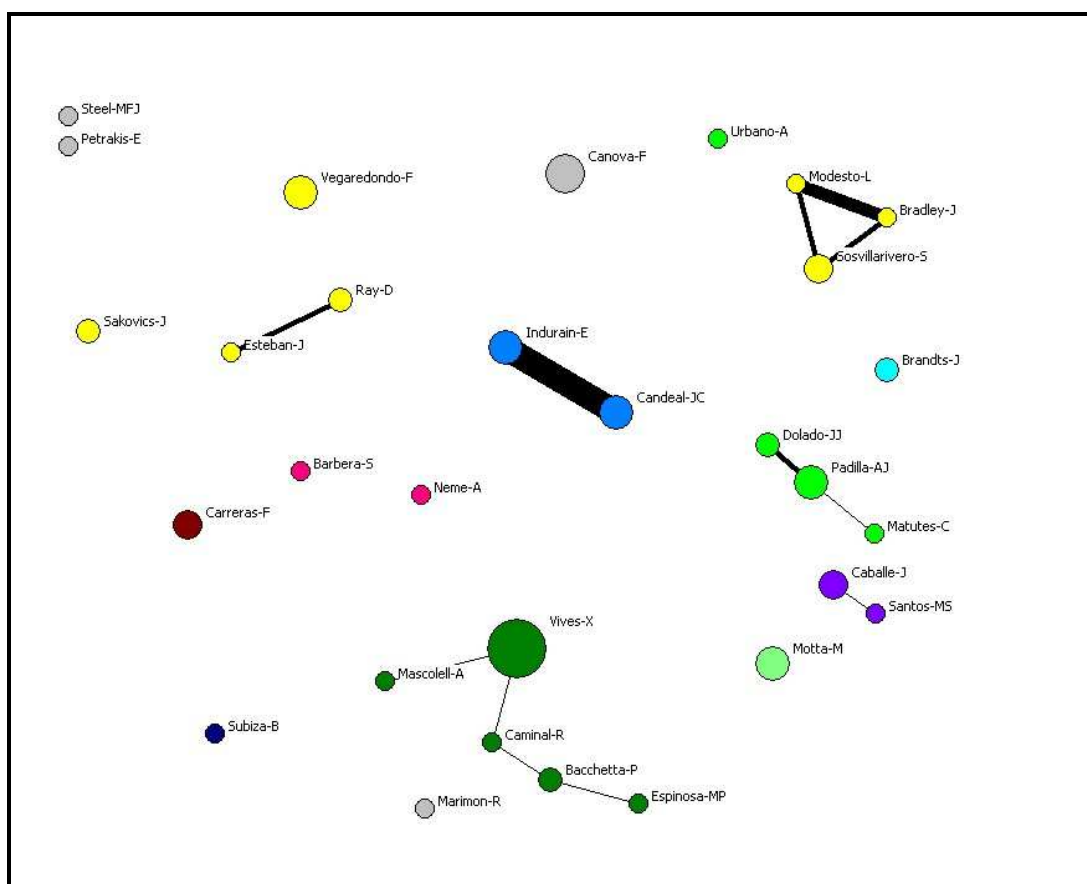

Figure 3. Co-authorship network for the period 1992-1996

	Productivity	Degree	Betweness	Closseness
Vives-X	12	2	3	3,831
Candeal-JC	7	7	0	3,448
Indurain-E	7	7	0	3,448
Sosvillarivero-S	6	4	0	3,571
Dolado-JJ	5	2	0	3,567

Table 3 Centrality measures for the period 1992-1996

1997-2001 period

Figure 4 describes the co-authorship networks for the 1997-2001 period.

Consolidation of existing team works, like Sosvillarivero-S or Barbera-S and Neme-A, is observed in this period. But also the arising of new groups as the fuchsia component leaded by Calvo-E, the violet one leaded by Moreno-D, or the blue one composed by two different subgroups leaded by Herrero-C and Peris-JE

Candeal-JC and Indurain-E; Vegaredondo-F; and, finally, Dolado-JJ groups keep on this period.

The most productive author in the previous five-year period, Vives-X, who led the biggest component in terms of number of nodes, has been much reduced in the present five-year period and he vanishes the last period, probably due to a change in his place of work.

	Productivity	Degree	Betweness	Closseness
Sosvillarivero-S	11	8	1	1,493
Calvo-E	10	7	0	1,493
Herrero-C	9	4	3	1,538
Moreno-D	9	13	0	1,493
Peris-JE	8	9	0	1,537
Barbera-S	8	6	0	1,493
Candeal-JC	8	8	0	1,471
Indurain-E	8	8	0	1,471
Vegaredondo-F	7	1	0	1,514
Dolado-JJ	7	5	0	1,471
Masso-J	6	7	0	1,493
Neme-A	5	7	0	1,493

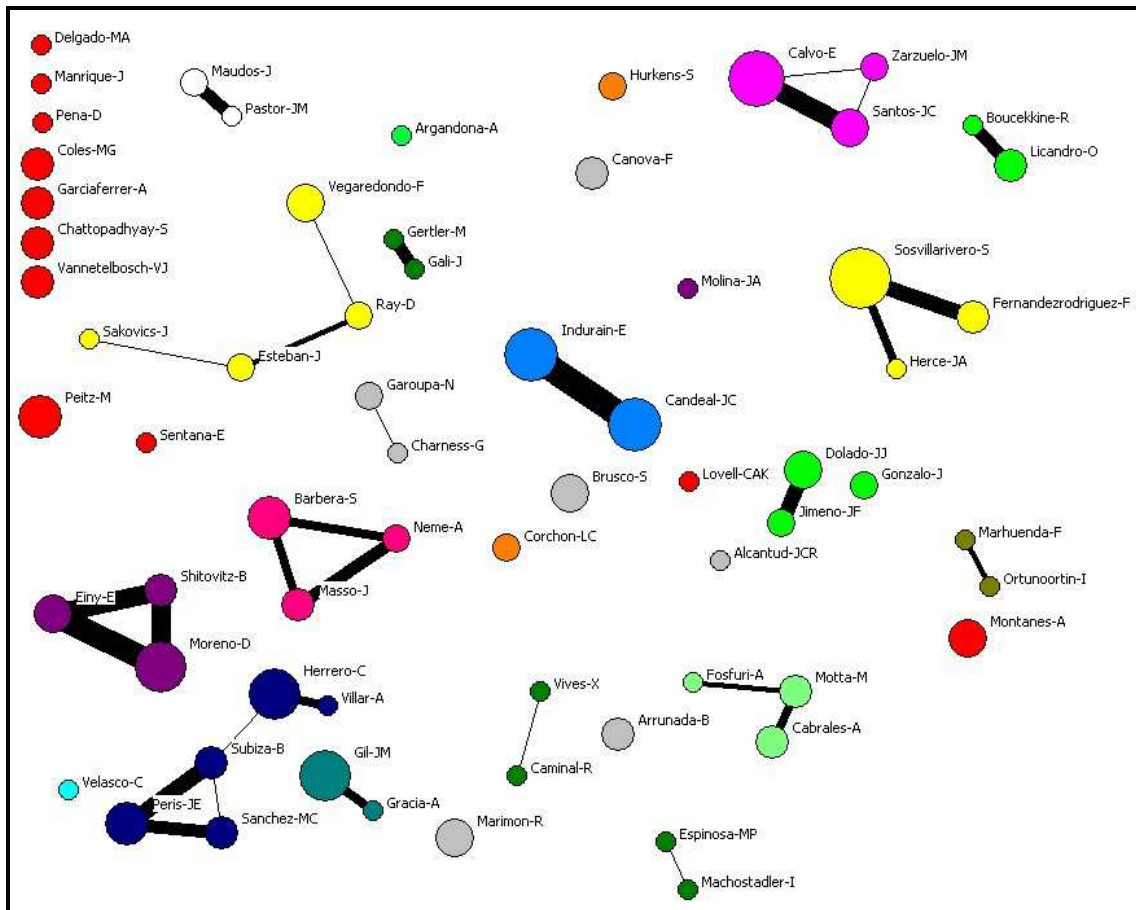**Table 4** Centrality measures for the period 1997-2001

Figure 4. Co-authorship network for the period 1997-2001

2002-2006 period

Figure 5 describes the co-authorship networks for the 2002-2006 period. The authors find remarkable the large amount of nodes comparing previous figures. Of course, this is a consequence of the growth rate observed.

The most productive author in this period is Gil-Alana-LA[2] who has the double of papers than the second author in the productivity ranking, and three times the productivity of Barbera-S, who is the first author in the ranking in previous periods.

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2 The singular case of Gil-Alana-LA caught the attention of the authors, who have checked this researcher had developed an extended career abroad previously
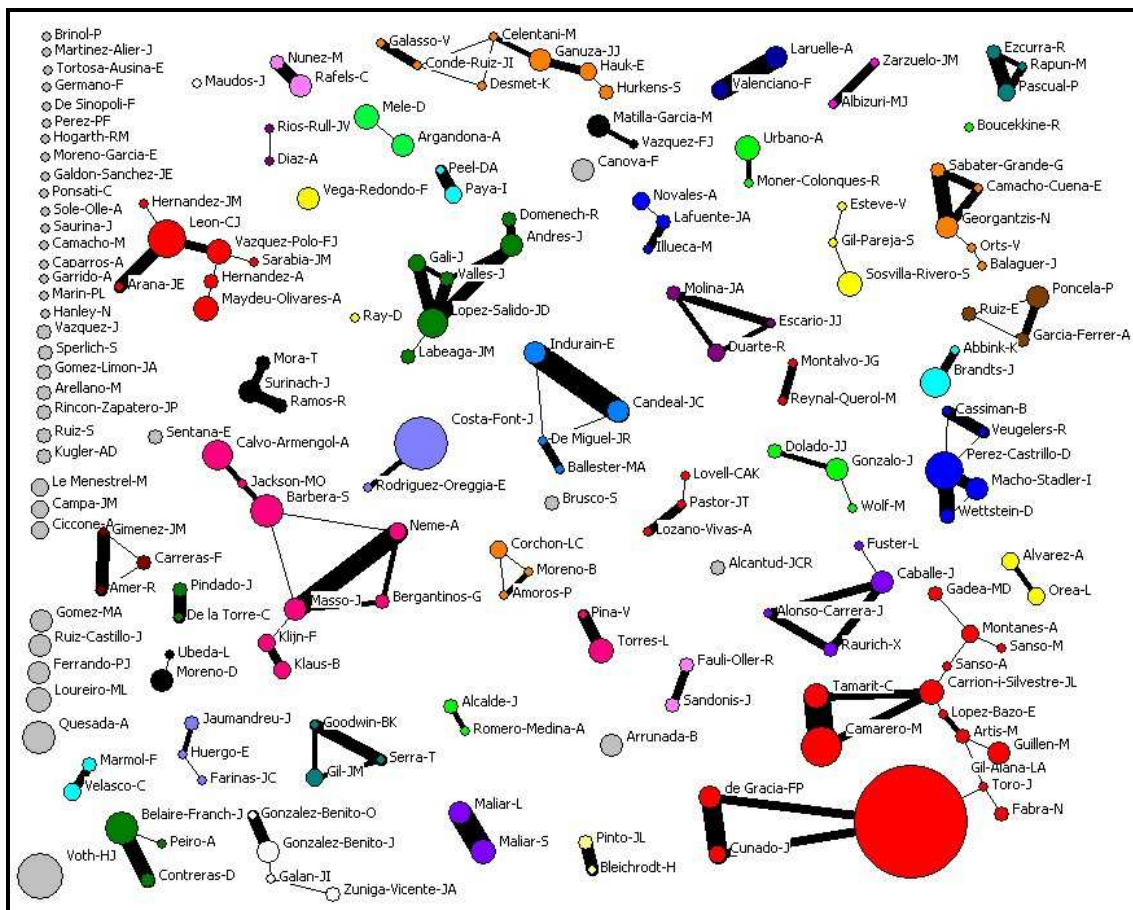
Figure 5. Co-authorship network for the period 2002-2006

	Productivity	Degree	Betweness	Closseness
Gil-Alana-LA	30	7	24	0,574
Barbera-S	10	4	10	0,552
Lopez-Salido-JD	9	13	5	0,546
Masso-J	7	10	11,5	0,552
Candeal-JC	7	8	0	0,541
Indurain-E	7	8	0	0,541
Neme-A	6	9	1,5	0,552
Gali-J	6	6	0	0,546

Table 5 Centrality measures for the period 2002-2006

The work teams which have persisted during the whole studied interval are the pair composed by Indurain-E and Candeal-JC; the green component led by Dolado-JJ; and, finally, the fuchsia component led by Barbera-S and Neme-A. The inclusion during 1997-2001 period and consolidation during 2002-2006 of Masso-J in this last component is also remarkable

A component which should be emphasized is the one composed by Lopez-Salido-JD, the highest degree on figure 5, not only due to the number of its members but also to the extraordinary cohesion between them. Even though it is another member of the component, Gali-J, the only one who has persist during the fifteen years in the selected group of most productive authors.

Other authors have remained during the fifteen-year period. They are Vegaredondo-F, Ray-D and Sosvillarivero, however his partners have changed along the five-year periods.

There is a great amount of isolated researchers. The pattern of a pair of authors as basic set of collaboration in Economy is remarkable and fits in with the average co-authorship rate calculated (1.9).

Conclusions

The increase of the Spanish research, collected on the SSCI in the Economics area is accelerated, as showed by the growth rates on the number of articles and on the number of involved authors on this research area.

Become part of the maximum producers implies to sign more and more number of articles.

Productivity can not be a single bibliometric indicator for researchers evaluation because, as seen on this work, the researchers with higher relevance at long term are not the ones with the first positions for a fixed period.

The co-authorship rate corresponds to 1.9, which proves, as well as seen on the figures, that the pair or group of two is a common work structure on the Economy area (Acedo, 2006).

The high number of isolate authors could be due to the high scope of the strategy search, as all the researchers from the Economy area have been included regardless of their research subjects.

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