Intellectual structure of the entrepreneurship field: a tale based on three core journals

Aurora A.C. Teixeira[1,2,3], Elsa Ferreira[4]

[1] CEF.UP, Faculdade de Economia, University of Porto, Portugal
[2] INESC Porto, Portugal
[3] OBEGEF, Portugal
ateixeira@fep.up.pt

[4] Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Portugal
elsa.ferreira@fcna.up.pt

Abstract. Underlying the scientific structure of a field is the network of informal communication linkages established among the most influential scholars within the area. These groups of mutually interacting and prolific scientists who exchange knowledge through communication channels are named "invisible colleges". In this study, we perform a two-stage analysis to identify invisible colleges in the field of entrepreneurship using three core journals: Entrepreneurship Theory and Practice (ETP); Journal of Business Venturing (JBV), and Small Business Economics (SBE). Using bibliometrics, a in depth analysis was conducted on the most influential authors, their professional affiliation and educational training, in order to map the informal links between the most-cited authors. Based on over 90 thousand citations from these 3 journals two invisible colleges emerged: ETP and JBV have similar intellectual groundings, targeting especially corporate and entrepreneurship venturing, while SBE gives emphasis to more economics-oriented research, namely innovation, growth and policy, and industrial dynamics.

Keywords. Invisible College, Entrepreneurship, Bibliometrics.

1 Introduction

Academic research on entrepreneurship has increased over the last few decades, accompanying society's interest in the matter (Landström, 2005; Aldrich, 2012; Shane, 2012; Carlsson et al., 2013). In fact, entrepreneurship research and teaching has been one of the most prominent social sciences in recent years, with jobs with a focus on entrepreneurship and faculty expertise in entrepreneurship continuing to rise (Finkle, 2007; Venkataraman et al., 2012; Gartner, 2013).

The explosion of entrepreneurship scholarship led to the need to measure scientific production (namely through bibliometric and scientometric approaches) in entrepreneurship and to understand the scientific structure of the field, such that several studies have dedicated significant attention to the matter (Cornelius et al., 2006, Grégoire et al., 2006, Schildt et al., 2006; Teixeira, 2011; Landström et al., 2012). Underlying the scientific structure of a field is a network of informal communication linkages among the most influential scholars within that area. These groups of mutually interacting and prolific scientists, who exchange knowledge through communication channels, were named "invisible colleges" (Crane, 1972; McMillan, 2008; Vogel, 2012) and are the focus of our study. In spite of the academic interest in entrepreneurship, research on invisible colleges, per se, are still relatively unexplored (some of the few articles on the subject include Reader and Watkins

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(2006) and Teixeira (2011)).

According to Landström et al. (2012), despite some signs of differentiation, the field of entrepreneurship is increasingly formalized and anchored in a small set of intellectual bases. The signs of fragmentation and specialization, reflected in the emergency of a number of subject specialties, are demonstrated in Teixeira (2011), who following a formal selection procedure to delimit the 'relational environment' of the field of entrepreneurship, analyzes the existence and characterizes the (in)visible college(s) of this field.

The 'invisible colleges' facilitate a process of social diffusion that fuels the growth of scientific specialties (Carey, 2011). This diffusion of ideas operates both through linkages between researchers and published journal articles. The former channel is particularly emphasized in the study of Teixeira (2011). The present paper seeks to complement Teixeira's (2011) contribution by focusing the analysis on three core entrepreneurship journals and thus providing a more in depth, though with lesser scope, perspective of the (potential) invisible colleges in the field. Researchers have long noted the importance of 'invisible colleges' in transmitting knowledge within disciplines. Thus, an analysis of the three core entrepreneurship journals provides valuable insights on how knowledge flows and who are the knowledge gatekeepers in those journals, permitting to uncover potential signs of differentiation and specialization which are likely to be useful for both newcomer and established researchers aiming to publish in this challenging area.

Contrary to Teixeira (2011), who used a statistical delimitation procedure to identify the 7 journals that 'defined' the entrepreneurship field, in the present paper we opted for a more conventional selection procedure based on relevant literature which identifies Entrepreneurship Theory and Practice (ETP); Journal of Business Venturing (JBV) and Small Business Economics (SBE) as core entrepreneurship journals (Katz, and Boal, 2002; Ritzberger, 2008; Stewart and Cotton, 2013). For each journal we collected all the articles published from their inception until the end of 2008. The main unit of analysis for identifying invisible colleges is citations to these articles (Zuccala, 2006; Dos Santos et al., 2011). Given that recent articles (those published in the last 3 years) receive few citations and the citations structure of rather old articles is unlike to change significantly in a three year period (Vieira and Teixeira, 2010), the truncation date we established for gathering citations (February 2009) might be acceptable. However, it is important to remark that the citations structure of articles published in the neighborhood of the the truncation date are likely to be significantly influenced by such a truncation option.

Resorting to Zuccala's (2006) framework, we gathered evidence about the most-cited authors, studies (articles or books) and journals for each of the core journals, enabling us to characterize the intellectual groundings of entrepreneurship, comparing the results for each of the selected journals. We then confirmed the existence of linkages between the most influential (i.e., most-cited) authors, through a all-inclusive study of their affiliations, educational training and research areas. Examining the social ties (or links) that connect influential authors in the field of entrepreneurship is fundamental to understanding the multifaceted nature of invisible colleges, since these are based on the (formal and informal) exchange of scientific knowledge. The combination of evidence gave us empirical support to conclude that there are distinct invisible colleges within the field of entrepreneurship.

The paper is structured as follows. In Section 2 the concept of invisible college is defined and related literature reviewed, including a description of Zuccala's (2006) approach. Section 3 details the bibliometric and scientometric methods, illustrating their main applications in entrepreneurship and other scientific areas; additionally, it describes the data and methodology pursued. The following section analyzes the most-cited authors, studies and journals in each core journal, further performing a

comprehensive study of the linkages among the most-cited authors. Finally, we draw the main conclusions, pointing out the study's limitations and suggesting paths for future research.

2 Searching for Invisible Colleges in entrepreneurship scientific research: a literature review

Back in the 1970s, Price (1971) defined an 'invisible college' as a hierarchical and elitist group of scholars, supported by an expectable inequality and a high level of connection. Influenced by Price's work Crane (1972) advanced with a wide-ranging examination of the invisible college phenomenon and expanded the scope of the concept of informal communication, to include informal discussions, relationships between teachers and students during thesis preparation, and the influence of a scientist's work on another (Teixeira, 2011).

More recently, Zuccala (2006: 155) emphasized the need to understand the multifaceted nature of the invisible college, proposing the following definition:

> *An invisible college is a set of interacting scholars or scientists who share similar research interests concerning a subject specialty, who often produce publications relevant to this subject and who communicate both formally and informally with one another to work towards important goals in the subject, even though they may belong to geographically distant research affiliates*.

The novelty in the definition, as Zuccala (2006) pointed out, is its openness to the possibility of combining different types of analysis – bibliometric, sociometric and qualitative – in the study of invisible colleges, benefiting from their unique contributions.

The majority of the studies which aim to identify the invisible colleges of the respective journals (e.g., McMillan and Casey, 2007; Casey and McMillan, 2008) undertake co-citation analyses. Indeed, co-citation analyses have developed into the main bibliometric technique to explore the intellectual structure of scientific communication (Lievrouw, 1989; Bayer et al., 1990; Gmür, 2003). According to Bellardo (1980: 231), co-citation analysis is founded on the premise that "the greater the number of times that a pair of documents is cited together, the more likely it is that they are related in content". A co-citation occurs when two references or authors are mentioned in the same bibliography and serves as a measurement for the closeness of content (Small, 1973; Garfield et al., 1978; Gmür, 2003). Although there has been some criticism regarding the use of citation and co-citation analysis, as the use of citation links is considered an inadequate representation of communication among researchers (Lievrouw, 1989), their credibility as indicators of scientific communication was vouched for by authors such as Small (1978) and Garfield (1979), and they constitute the grounding for identifying invisible colleges (Gmür, 2003).

Studies in general, as mentioned earlier, define invisible colleges as social processes, based on informal links. However, empirically, 'operational' invisible colleges are treated as structures of scholarship, measured by formal elements such as published documents. Although co-citation analysis is based on formal links, the key issue here is that the invisible colleges measured as such, involve research networks of authors who refer to each other in their documents without being linked by 'formal' organizational ties. Applications of this process encompass distinct areas such as economics (McMillan and Casey, 2007; Casey and McMillan, 2008) and management (McMillan, 2008). Verspagen and Werker (2004) apply a slightly different

methodology by using a survey to map the intellectual relations between active contributors in the discipline and identified possible social networks, i.e., invisible colleges.

In the scientific area of entrepreneurship, Reader and Watkins (2006) explored the existence of invisible colleges by complementing a co-citation analysis of the field's scientific structure with a questionnaire survey. The authors employed a comprehensive database, created by the Southampton Business School, which includes full coverage of the major niche journals in entrepreneurship, conference proceedings and other major, but not so specific, journals such as those on the Social Sciences Citation Index. The key authors were identified through a process of cross-referencing that reduced a list of 4405 documents initially generated by a keyword search of the word "Entrepreneur$" within the database. Using author co-citation and factor analysis, the authors try to identify, respectively, groups of entrepreneurship scholars whose work falls into similar areas and the topics that characterize and define the field. The survey allowed them to explore the social and collaborative nature of entrepreneurship research among the leading co-cited authors, unveiled in the first stage of the work. Therefore, the subfields identified in the author co-citation analysis of informal communication links between closely related authors and then validated by the survey, represent the "invisible colleges" to Reader and Watkins (2006).

In spite of the high-quality research dedicated to assessing the intellectual structure of the field of entrepreneurship, namely the presence and nature of scholarly communities that comprise the field, literature specifically focused on the matter of invisible colleges is still rare. The multifaceted nature of this phenomenon, particularly the structure versus social process issue, requires, as Lievrouw (1989) recommended, distinct approaches to the subject in order to provide new insights. Thus, we aim to explore the existence of invisible colleges in the field of entrepreneurship, undertaking a citation analysis of the articles published in three core journals in the area – Entrepreneurship Theory and Practice; Journal Business Venturing and Small Business Economics. For this purpose, and similarly to Teixeira (2011), the methodology proposed by Zuccalla (2006) was used, in order to explore the (widely debatable) concept of 'invisible college'. We argue that although the theory underlying the concept is well developed and relatively consensual, the empirical application of such a concept lags far behind theoretical achievements. Moreover, in our view, there is a need for an objective framework structure which enables, in a more precise manner, the 'measurement' and 'assessment' of invisible colleges.

According to Zuccala's (2006) definition of Invisible Colleges, mentioned earlier, and the corresponding research framework, an invisible college is a consequence of an interrelationship (through formal and informal communication) between three key elements: subject specialty, the social actors and Information Use Environment. The first informs the invisible college of its disciplinary rules and research problems, the second refers to the scientific scholars who understand and agree to the rules and interact with one another to solve problems, and the third and last element, represents the scientific workspace, i.e., the "set of elements that affect the flow and use of information messages into, within, and out of any definable entity" (Taylor, 1986: 3). The social actors, i.e., the most influential authors, make use of the invisible college to support their search of information and sharing patterns (informal communication) and reinforce the invisible college through bibliometric artefacts (formal communication). Therefore, Zuccala (2006: 8) concludes that the invisible college is an organizational structure produced by "the space that intersects the Information Use Environment, the subject specialty and the social actors" (cf., Fig. 1).

Thus, similarly to previous studies (e.g., McMillan, 2008; Casey and McMillan, 2008;

McMillan and Casey, 2007; Teixeira, 2011; Landström et al., 2012), this work applies a bibliometric analysis in order to obtain empirical evidence from which the development of the field's intellectual bases can be assessed. However, unlike some of these studies which are constrained to a narrow definition of invisible colleges and provide few insights regarding scholars interrelatedness through informal channels, but in line with the approach followed by Teixeira (2011), we complement the study of the most-cited authors, articles/books and journals, with an analysis of the linkages between the most influential (i.e., most-cited) authors, based on their educational affiliation, professional affiliation and research area.

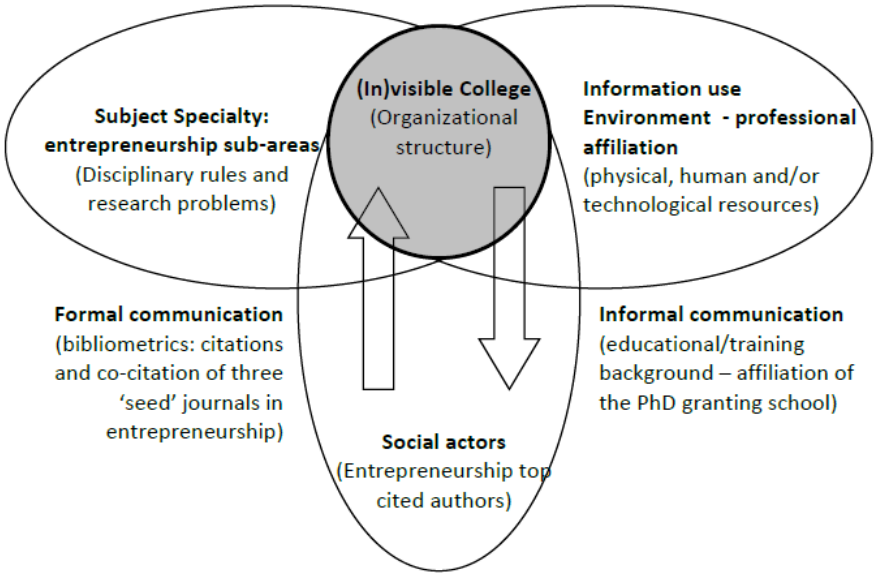


Fig. 1. Conceptual model to analyze the structure of an invisible college in entrepreneurship.
Source: In Teixeira (2011: 10), and adapted from Zuccala (2006: 156)

The use of three core journals, instead of only a single journal analysis (e.g., McMillan, 2008), permits determining whether there are distinct invisible colleges within the field of entrepreneurship according to the core journal considered. By circumscribing the study to three niche journals but including all articles available until February 2009, we ensure a wide-ranging analysis that preserves all relevant information. This is not the case of the studies which rely on a wider range of data sources, but confine their sample to a process based on the initial search of a specific keyword, within the chosen database – a limitation present in the studies mentioned previously (e.g., Cornelius et al., 2006; Schildt et al., 2006; Reader and Watkins, 2006). In fact, obtaining data through such a broad process does not ensure that the interacting authors share similar research areas, as proposed by Zuccala (2006), which constitutes a handicap in those studies. Additionally, and compared to Teixeira (2011), who uses more journals than us, her data is restricted to a shorter period of time (2005-2010).

3 Searching for the 'invisible colleges' in the Entrepreneurship literature: methodological underpinnings

3.1 Bibliometrics as a tool for identifying the intellectual structure of a field

Bibliometric methodology remains a fundamental tool to researchers by providing a concrete representation of the relationships among the products of science and enabling the mapping of documents generated by communication acts (Lievrouw, 1989). The term Bibliometrics gained notoriety with Pritchard, who suggested replacing the term "statistical bibliography" with the term "bibliometrics", describing it as the "the application of mathematical and statistical methods to books and other media of communication" (Pritchard, 1969: 349). Bibliometrics has been applied in monitoring the development of a specific scientific field, making use of journals and analyses of scientific areas (e.g., Ratnatunga and Romano, 1997; Phelan et al., 2002; Silva and Teixeira, 2008; Silva and Teixeira, 2009; Cruz and Teixeira, 2010) or individuals (e.g., Garfield, 1985); studying the intellectual development of a scientific field (e.g., Schildt et al., 2006; Cornelius et al., 2006; Culnan, 1987), and exploring the linkages between researchers (Reader and Watkins, 2006; McMillan and Casey, 2007). Beyond these applications, bibliometric methods are also crucial for research performance assessment (e.g., van Raan, 2003), serving as an instrument of science policy and research management (Glänzel, 2003), for decision-makers in government, management and institutional administration, such as universities (e.g., Garfield and Weeljams-Dorof, 1992; Moed, 2006), enabling them to evaluate research productivity for the purpose of resource allocation and promoting decisions (Laband and Piette, 1994).

Tables A1a-d (in Appendix) summarize and highlight several articles, according to their scientific area, and the main application areas of bibliometrics, namely: journal analysis (Table A1a), categorization of themes (Table A1b), intellectual structure (Table A1c) and invisible colleges (Table A1d). It is not meant to be a comprehensive list but rather a selection of the scientific areas based on its contiguity, in terms of knowledge, to our field of research – entrepreneurship – and on the similarity of employed methodology (as is the case of the scientific area of Industrial Relations & Labour).

In terms of the application of bibliometric analysis to the field of economics, Laband and Piette (1994) updated the work of Liebowitz and Palmer (1984) and uncovered possible transformations in the economics journal market, between 1970 and 1990. The authors justify that update with the usefulness of the Liebowitz-Palmer rankings to the evaluation of scholarly productivity by universities and colleges. To achieve their goal, Laband and Piette employed, among others tools that are detailed in Table A1a, a widely-used bibliometric indicator, citation analysis (Smith, 1981; Kostoff, 2002). Citation-based indicators are viewed as forms of measurement of the impact or international visibility of scientific research (Narin, 1976; Garfield, 1979), based on the assumption that bibliometric instruments accurately reflect scientific activity (Rinia et al., 1998). In the field of entrepreneurship, Gamboa and Brouthers (2008) conducted a review of the articles published by nine selected journals (from the areas of entrepreneurship, international business and management) over two five-year time frames, 1986-1990 and 2000-2004, in order to discover the role of international entrepreneurship research in major entrepreneurship, international business, and management journals. Complementarily, Romano and Ratnatunga (1996) developed a citation analysis to assess the impact of small enterprise journals and articles during the period 1986-1992, with the intention of providing an objective evaluation of scholarly research and the relative importance of publications.

Bibliometric analysis of topics and abstracts has recently been used in distinct research areas: structural change (Silva and Teixeira, 2008), evolutionary economics (Silva and Teixeira, 2009), regional studies (Cruz and Teixeira, 2010), and also entrepreneurship (Ratnatunga and Romano, 1997; Watkins and Reader, 2004; Van Praag and Versloot, 2008).

Ratnatunga and Romano (1997) provided a qualitative categorization of the topics, methodology and objectives of the most-cited articles, to identify the intellectual origins and directions of entrepreneurship research, whereas Watkins and Reader (2004) employed an original approach to identify current trends in the field of entrepreneurship. These authors used textual analysis and the ARPENT corpus as a data source, which allowed them to obtain a better understanding of the major topics in the literature. More recently, Van Praag and Versloot (2008) conducted a thoroughly research of title, abstract and full-text of 57 studies in order to discover if recent empirical evidence could corroborate the common notion that entrepreneurs are beneficial to the economy.

With regard to researching intellectual structures, authors in general employ co-citation analyses, exploring the relationships between the interdisciplinary specialties, namely management information systems (Culnan, 1987), innovation (Cottrill et al., 1989), and strategic management (Nerur et al., 2008). In entrepreneurship research, Cornelius et al. (2006) performed a bibliometric analysis of cited articles in three periods, 1986-1990, 1993-1997 and 2000-2004, in order to examine the intellectual structure of the field and assess its stage of maturation. The data is provide by the Social Sciences Citation Index, through a search of academic articles that include the word "entrep*" in the title, keywords, or abstract between 1986 and February 2005. The intention was to determine the field's research forefront, perceiving the most influential scholars and discovering the linkages among them and other authors. By evaluating the research output of key authors and the research topics over time, the authors found evidence to support the idea that entrepreneurship is evolving into a mature field. Similarly to the purpose of this latter work, Grégoire et al. (2006) studied the intellectual bases of entrepreneurship to understand the extent and nature of conceptual convergence in entrepreneurship research. In the study, they analyzed the co-citation networks provided by the articles published between 1981 and 2004 in the Frontiers of Entrepreneurship series and complemented it with an analysis by period (1981-1986, 1987-1992, 1993-1998 and 1999-2004). The emergence of consistent networks of co-citation provide evidence to support the argument that there has been convergence in entrepreneurship research over the last twenty-five years, although the overall levels of convergence observed were relatively low. In a complementary way, Schildt et al. (2006) conducted a bibliometric study and analyzed co-citations patterns of entrepreneurship-related articles, published during the period between 2000 and 2004, obtaining some evidence regarding the research directions of the subject, clarifying the state of entrepreneurship as a discipline and filling a gap in the literature. Twenty-five major research trends were identified; being present in the ten most-cited groups of study and subsequently explored their interrelatedness, through a co-citation network. The ten most-cited groups identified were: Entrepreneurial Networks and Resource Accumulation; Corporate Entrepreneurship and Venturing; Conceptualizations of Entrepreneurial Processes; Value Creation from Corporate Entrepreneurship; Alertness, Opportunity Creation, and Creative Destruction; Psychological Characteristics of Entrepreneurs, Qualitative Research Methods; Entrepreneurial Firm Survival and Growth; Societal Consequences of Entrepreneurship and Born-Global Firms (Schildt et al., 2006).

In the more restricted area of international entrepreneurship, Etemad and Lee (2003) studied the knowledge network of this sub-field from 1992 to 2000, through a

Boolean progression of keywords that focused on the Social Sciences Citation Index database. By using a bibliometric methodology, namely citation analysis, they found that scholars of international entrepreneurship depend highly on the disciplines of international business and entrepreneurship to support their scientific research.

3.2 Some descriptive information on the selected journals

Leading academic journals have played an increasingly important role in the dissemination of scientific results (Ratnatunga and Romano, 1997; Stewart and Cotton, 2013). In this study, based on the three top Level I journals in the John Carroll University Classification of entrepreneurship journals (see Table A2), the Entrepreneurship Theory and Practice (ETP), Journal of Business Venturing (JBV) and Small Business Economics (SBE) were selected as core journals. This choice is also supported by that fact that several studies (e.g., Fried, 2003; Ritzberger, 2008; Stewart and Cotton, 2013) suggest that these three journals stand as the most highly ranked in the field of entrepreneurship.

ETP began publication as the American Journal of Small Business from 1976 until 1988, year when the journal changed to its current title. ETP is a scholarly journal, published bi-monthly at Baylor University, and covering a broad range of topics, in compliance with its ultimate goal of contributing to the development of the field of entrepreneurship. JBV started its publication in 1985 and is established as a scholarly forum that provides innovative insights into the phenomenon of entrepreneurship, publishing presently 6 issues a year. SBE is the youngest of the three journals, having begun in 1989. With four issues per year, SBE focuses on entrepreneurship and small business research.

Since their first publication to the end of 2008, the three journals published a total of 2716 articles (see Fig. 2) - Obituaries, corrections and editorial comments were not included. ETP, being the eldest, is the most prolific journal, with a total of 1015 articles. SBE, although the youngest journal, follows ETP with 979 articles against the 722 articles published in JBV. Analyzing the period from 1989 to 2008 – common to the three journals – SBE is the most prolific journal, surpassing ETP and JBV in number of articles every year, with the exception of 1993, 2007 and 2008. JBV comes second, exceeding ETP, although ETP has been improving its publication numbers since 2005.

Table 1 provides a list of the 20 most prolific authors (i.e., with the highest number of published articles) for each journal until 2008, ordered by the total number of articles published in the three journals. The first three leading positions (black cells in Table 1) are different for each of the journals. James Chrisman (Mississippi State University, US) is the most prolific author on the list and is also ETP's most prolific author (although he occupies the 7th position in JBV and has not published any article in SBE). Ian MacMillan (University of Pennsylvania, US) and Roy Thurik (Erasmus University Rotterdam, NL) are, respectively, the leading contributors to JBV and SBE, although the first has not published any articles in ETP and SBE, and the second occupies a very low position in ETP and JBV.

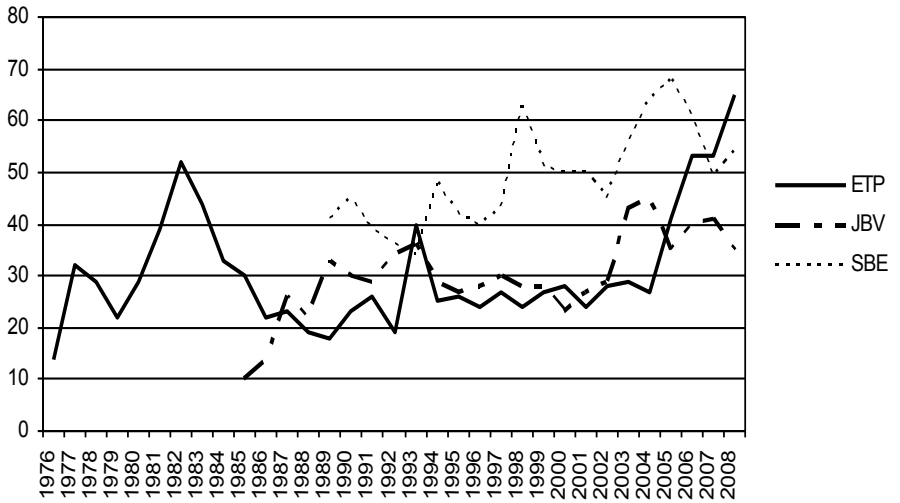


Fig. 2. Evolution of the number of articles per year published in ETP, JBV and SBE, 1976-2008
Source: Authors' computations based on our sample of articles collected manually for ETP and from Social Sciences Citation Index (SSCI) of the ISI Web of Science, for JBV and SBE, (n=2716). The number of articles included in the years 1985 and 1986 for JBV, and 1989, 1990 and 1991 for SBE were collected manually, since they were unavailable in the ISI database.

With regard to the total number of articles published, as mentioned above, James Chrisman (Mississippi State University, US) is the author with the highest number of published articles. He is followed by William Gartner (Clemson University, US), Michael Wright (University of Nottingham, UK) and Shaker Zahra (University of Minnesota, US). These three authors belong to a set of sixteen authors common to all three journals (grey cells in Table 1).

Table 1: List of the top 20 most prolific authors in ETP, JBV and SBE

		Rank			Number of Articles			
Author	**Affiliation**	ETP	JBV	SBE	ETP	JBV	SBE	**Total**
Chrisman, J.J.	Mississippi State University, US	1	7	-	31	10	0	41
Gartner, W.B.	Clemson University, US	4	3	40	15	16	3	34
Wright, M.	University of Nottingham, UK	3	9	7	16	9	9	34
Zahra, S.A.	University of Minnesota, US	2	5	177	17	13	1	31
Shepherd, D.A.	Indiana University, US	8	2	-	11	17	0	28
Macmillan, I.C.	University of Pennsylvania, US	-	1	-	0	25	0	25
Thurik, A.R.	Erasmus University Rotterdam, NL	128	92	1	2	2	20	24
Mcdougall, P.P.	Indiana University, US	9	10	69	11	9	2	22
Acs, Z.J.	George Mason University, US	-	-	2	0	0	19	19
Sapienza, H.J.	University of Minnesota, US	11	12	178	10	8	1	19
Westhead, P.	University of Durham, UK	33	17	19	6	7	6	19
Birley, S.	Bae Sistems (Retired), UK	26	6	-	7	11	0	18
Chua, J.H.	University of Calgary, CA	6	30	-	13	5	0	18
Audretsch, D.B.	Max Planck Institute of Economics, DE	78	61	4	3	3	11	17
Katz, J.A.	Saint Louis University, US	10	42	70	11	4	2	17
Brush, C.	Babson College, US	16	22	179	9	6	1	16
Kuratko, D.F.	Indiana University, US	5	203	-	15	1	0	16
Covin, J.G.	Indiana University, US	12	31	-	10	5	0	15
Reynolds, P.D.	George Mason University, US	299	32	8	1	5	9	15
Shane, S.	Case Western Reserve University, US	300	4	-	1	14	0	15
Busenitz, L.	University of Oklahoma, US	20	23	-	8	6	0	14
Hisrich, R.	Thunderbird School of Global Management, US	36	13	180	5	8	1	14
Hoy, F.	University of Texas at El Paso, US	13	43	-	10	4	0	14
Cooper, A.C.	Purdue University (Retired), US	79	8	-	3	10	0	13
Winn, J.	University of Denver, US	7	-	-	13	0	0	13
Honig-Haftel,	Wichita State University,	129	62	14	2	3	7	12

S.	US (Retired)							
Storey, D.J.	University of Warwick, UK	-	-	3	0	0	12	12
Wiklund, J.	Syracuse University, US	17	93	181	9	2	1	12
Bruton, G.	Texas Christian University, US	21	63	-	8	3	0	11
Cowling, M.	Institute for Employment Studies, UK	301	-	5	1	0	10	11
Deeds, D.	University of St. Thomas, US	80	14	-	3	8	0	11
Gatewood, E.J.	Wake Forest University, US	22	94	182	8	2	1	11
Reid, G.C.	University of St Andrews, UK	302	-	6	1	0	10	11
Sharma, P.	Family Firm Institute, Inc., US	18	95	-	9	2	0	11
Steier, L.	University of Alberta, CA	23	65	-	8	3	0	11
De Cenzo, D.A.	Coastal Carolina University, US	14	-	-	10	0	0	10
Franklin, C.M. †	University of Southern California, US	15	-	-	10	0	0	10
Oviatt, B.	University of New South Wales, AU	24	96	-	8	2	0	10
Phan, P.H.	Johns Hopkins University, US	-	11	183	0	9	1	10
van Stel, A.	EIM Business and Policy Research, NL	303	205	11	1	1	8	10
Baron, R.A.	Oklahoma State University, US	130	18	-	2	7	0	9
Bird, B.	American University, US	19	-	-	9	0	0	9
Carree, M.	Maastricht University, NL	-	206	12	0	1	8	9
Cressy, R.	University of Birmingham, UK	-	-	10	-	-	9	9
Kellermanns, F.W.	Mississippi State University, US	25	207	-	8	1	-	9
Wagner, J.	University of Lueneburg, DE	-	-	9	-	-	9	9
Abetti, P.A.	Rensselaer Polytechnic Institute, US	-	15	-	-	8	-	8
Autio, E.	Imperial College London, UK	-	208	15	-	1	7	8
Fitzroy, F.R.	University of St Andrews, UK	-	-	13	-	-	8	8
Kaufmann, P.J.	Boston University, US	305	19	-	1	7	-	8
Venkataraman, S.	University of Virginia, US	-	16	-	-	8	-	8
Dant, R.P.	University of Oklahoma, US	-	20	-	-	7	-	7

Henrekson, M.	Research Institute of Industrial Economics, SE	-	-	16	-	-	7	7
Johnson, P.	Durham University, UK	308	-	20	1	-	6	7
Karlsson, C.	Jönköping University, SE	-	-	17	-	-	7	7
Levesque, M.	University of Waterloo, CA	-	21	-	-	7	-	7
Watson, R.	University of Durham, UK	-	-	18	-	-	7	7

Source: Authors computations based on our sample of citations in ETP, JBV and SBE collected manually for ETP and from Social Sciences Citation Index (SSCI) of the ISI Web of Science, for JBV and SBE; the years 1985-1986 for JBV and 1989-1991 for SBE were not included, since they were not available on ISI database.
Note: Since the affiliation of the authors could be changed in the future, the validity of data concerning current affiliation is only guaranteed until August of 2009.

In spite of the existence of common authors in the three journals, SBE presents a very distinct ranking of entrepreneurship authors, with poor (or none) ranking positions for the majority of the authors listed in Table 1, with the exception of Michael Wright (University of Nottingham, UK). This results contrast with ETP and JBV, revealing clear signs of similarity: seven of the 20 most prolific authors in ETP and JBV are common to both journals and, at the same time, belong to the ten leading contributors to the total number of published articles. One could point out as a possible explanation for the differences found between ETP and JBV, on the one hand, and SBE, on the other, is the stricter scope (economics) of the latter.

With respect to the affiliation of the most prolific authors, Indiana University (US) provides the highest number of contributing researchers (five), followed by the University of Durham (UK) and the University of Minnesota (US), with four contributors each. The Mississippi State University (US) and the University of Nottingham (UK) are each affiliated with three authors. Exploring the affiliation according to the core journal, Indiana University (US) and the University of Minnesota (US) are the largest providers of prolific authors to ETP and JBV, whereas, to SBE, the most relevant institution is the University of Durham (UK).

Extending the analysis to the country where the institutions affiliated with the leading contributors are located, the United States of America clearly stands out as the major provider of the most prolific authors, with a total of thirty-four leading authors, followed by the United Kingdom with twelve contributors. This result, however, differs according to the core journal. While the United States is responsible for about 84% and 81% of the most prolific authors to ETP and JBV, respectively, its contribution to SBE is around 15%. In fact, the United Kingdom is the country that represents the largest proportion of prolific authors in SBE, a journal which receives contributions from a wider group of countries such as The Netherlands, Sweden and Germany.

We compiled and sorted the citations obtained from the source journals selected: ETP, JBV and SBE. JBV and SBE are indexed to the Social Sciences Citation Index (SSCI), managed by the Institute for Scientific Information (ISI)'s Web of Science Service, and export all the cited references included in SSCI of each of the articles published by JBV and SBE, from, respectively, 1987 and 1992 until February 2009. Cited references contained in articles from 1985 and 1986 for JBV and 1989, 1990 and 1991 for SBE were not included in the study due to their unavailability in ISI database. A different data gathering procedure was applied to the ETP journal, as SSCI did not provide any data prior to 2003. Thus, all the cited references of each article published between 1976 and February 2009 were collected manually and typed

in order to be processed. The citation database of each journal consisted of the relevant details of every cited reference: name of the author(s) of the cited reference, title of the cited reference, published source (i.e., title of the journal or book) and year of publication. Citations extracted from SSCI, however, only refer to the first author of the cited reference (authors who do not obtain first authorship are not represented), which bias the results and constitutes a database limitation for JBV and SBE. As mentioned previously, we did not consider as "articles" obituaries, corrections and editorial comments. Therefore, references/citations included in editorials, research notes, corrections, comments, replies and rejoinders were excluded. The data files of each journal were transferred to Microsoft Office Excel 2003 which enabled the harmonization and validation of the references/citations. Due to differences of format and text codification (for instance, in the names of the authors, titles of the cited paper, titles of journals or books and year of edition), between journals and within the journal itself, Excel functions were used to standardize the sample of citations.

A total of 2.598 articles were published in ETP (40%), JBV (27%) and SBE (33%), during the period considered (from 1976 (ETP), 1987 (JBV) and 1992 (SBE) to February 2009), which resulted in a total of 91.172 citations. Thus, the average number of citations provided per article was 35. Analyzing separately for each of the journals, JBV has the highest average of citations – 44 – followed by SBE with 34 and, finally, ETP with an average of 30 citations.

Table 2: Distribution of articles and citations per journals and year from 1992 to 2008

	Entrepreneurship Theory and Practice					Journal of Business Venturing					Small Business Economics				
	Number of Articles	%	Number of Citations	%	Average of citations per article	Number of Articles	%	Number of Citations	%	Average of citations per article	Number of Articles	%	Number of Citations	%	Average of citations per article
1992	18	4%	780	3%	43	34	6%	1001	4%	29	36	4%	816	3%	23
1993	25	5%	960	4%	38	36	6%	1276	5%	35	34	4%	779	3%	23
1994	27	6%	1154	4%	43	29	5%	1238	4%	43	48	6%	1201	4%	25
1995	15	3%	510	2%	34	27	5%	1118	4%	41	42	5%	1199	4%	29
1996	13	3%	558	2%	43	28	5%	1424	5%	51	40	5%	1106	4%	28
1997	14	3%	778	3%	56	30	5%	1381	5%	46	43	5%	1309	4%	30
1998	29	6%	1282	5%	44	28	5%	1286	5%	46	63	7%	2081	7%	33
1999	36	8%	1943	8%	54	28	5%	1276	5%	46	51	6%	1769	6%	35
2000	25	5%	1074	4%	43	23	4%	1208	4%	53	50	6%	1635	5%	33
2001	22	5%	1074	4%	49	27	5%	1611	6%	60	50	6%	1634	5%	33
2002	27	6%	1542	6%	57	29	5%	1659	6%	57	45	5%	1577	5%	35
2003	22	5%	1256	5%	57	43	8%	2071	7%	48	56	7%	2180	7%	39
2004	21	4%	1073	4%	51	45	8%	2339	8%	52	64	7%	2373	8%	37
2005	38	8%	2643	10%	70	35	6%	2150	8%	61	68	8%	2596	9%	38
2006	18	4%	1022	4%	57	40	7%	2365	8%	59	61	7%	2756	9%	45
2007	66	14%	4122	16%	62	41	7%	2205	8%	54	49	6%	2563	8%	52
2008	63	13%	3883	15%	62	35	6%	2248	8%	64	54	6%	2643	9%	49
Total	**479**	**100%**	**25654**	**100%**	**54**	**558**	**100%**	**27856**	**100%**	**50**	**854**	**100%**	**30217**	**100%**	**35**

Since the period considered differs according to the selected journal, Table 2 provides some insights regarding data distribution during the common period to all three journals: 1992 to 2008. ETP contributes with the lowest proportion of articles and citations, obtaining an average of 54 citations per article. Analyzing the evolution per year, ETP reveals an average increase since 2005. SBE, on the contrary, is the major publisher of articles that provided the largest proportion of citations, having the lowest average of citations per article.

After consolidating the citation databases, we were able to construct three distinct yet complementary rankings, for each of the core journals: the twenty most-cited (first in the case of SBE and JVB) authors; the ten most-cited studies and the twenty most-cited journals. The rankings allowed us to answer the first research question of the study, identifying the most-cited authors, studies (article or book), and journals, in each of the entrepreneurship journals selected. Once the key authors had been identified, we could then explore if there were similarities among the leading authors and answer the second research question, through an analysis that implied gathering personal data on the authors' educational background, research area and professional affiliation. The mapping of the intellectual groundings of the three core journals combined with the analysis of the relationships between the most-cited authors provided the fundamental tools to infer about the presence of invisible colleges in the scientific field of entrepreneurship, answering the last research question and achieving the main purpose of the study.

4 Empirical results

4.1 The most-cited authors, studies and journals submission

The most widely-cited author in ETP since its first publication to February 2009, is Michael Wright (University of Nottingham, UK). The author ranks 71st and 77th in JBV and SBE, respectively. The most cited first author in JBV, from 1987 to February 2009, is Arnold Cooper (Purdue University, US), who takes the 3rd and 37th positions in the ETP and SBE rankings, respectively. Zoltan Acs is the most-cited first author in SBE, during the period from 1992 to February 2009, raking 96th in ETP and 126th in SBE.

Table 3 presents the 20 most cited authors per journal, ordered by descending number of citations. The three rankings of the Top 20 most-cited authors only have one author in common: Howard Aldrich (University of North Carolina, US). Similarities regarding top cited authors are notoriously higher between ETP and JBV than with SBE. ETP and JBV have nine top cited authors common to them both, whereas JBV and SBE only share two authors, and ETP and SBE have no top author in common.

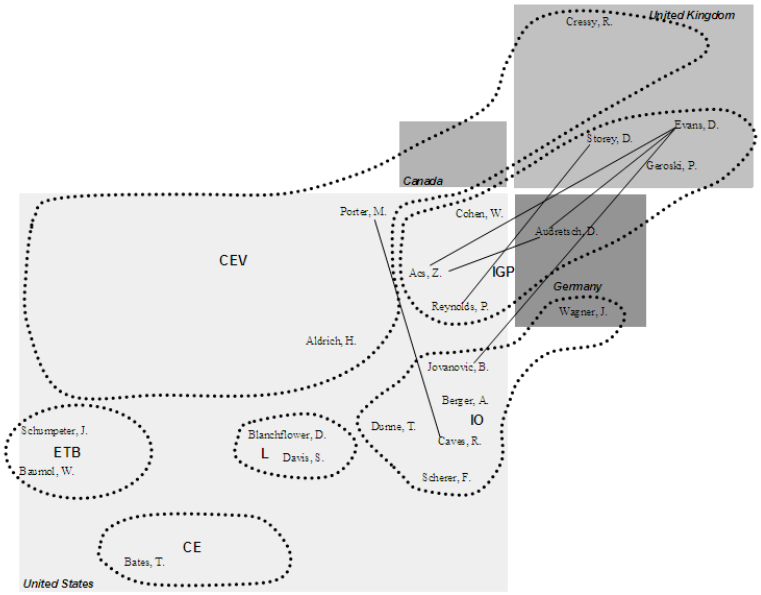
According to Zuccala (2006) (cf. Section 2), there are three main elements to take into consideration when defining an invisible college: influential scholars (i.e., most-cited authors); subject specialty (i.e., research areas) and information use environment (i.e., affiliation environment, such as institution and country). Following this framework, we assigned a main research area to each of the most-cited authors and analyzed, for each "core journal" and for all journals combined, the geographical distribution of the authors' current affiliation (Fig. 3).

Table 3: Ranking of the Top 20 most cited authors in ETP, JBV and SBE (name and number of citations)

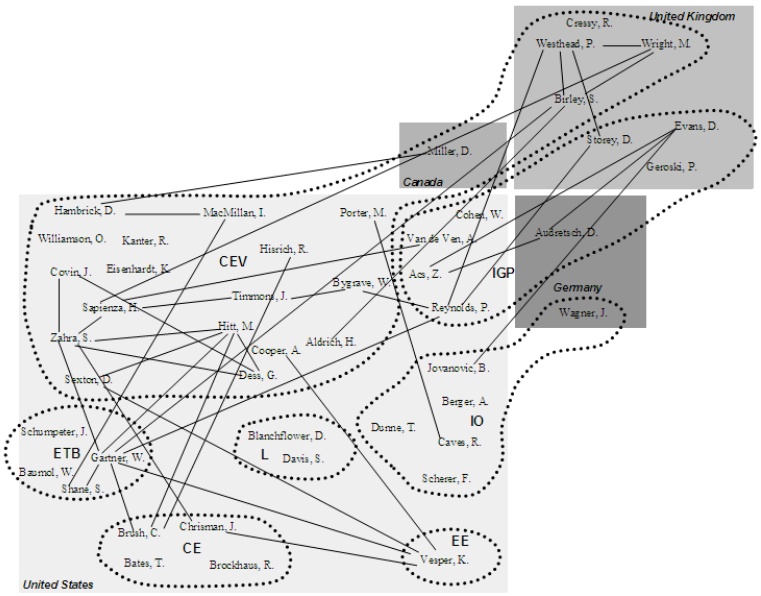
Entrepreneurship Theory and Practice (ETP)		Journal of Business Venturing (JBV)		Small Business Economics (SBE)	
Name	**#**	**Name**	**#**	**Name**	**#**
Wright, M.	178	Cooper, A.	307	Acs, Z.	509
Zahra, S.	168	Aldrich, H.	241	Audretsch, D.	508
Cooper, A.	144	MacMillan, I.	213	Storey, D.	276
MacMillan, I.	138	Gartner, W.	209	Reynolds, P.	258
Brush, C.	122	Miller, D.	183	Evans, D.	248
Bygrave, W.	121	Porter, M.	183	Schumpeter, J.	173
Chrisman, J.	118	Zahra, S.	182	Porter, M.	130
Covin, J.	118	Shane, S.	180	Blanchflower, D.	126
Aldrich, H.	117	Vesper, K.	143	Geroski, P.	123
Hitt, M.	115	Hambrick, D.	141	Dunne, T.	116
Miller, D.	113	Covin, J.	135	Jovanovic, B.	116
Gartner, W.	112	Bygrave, W.	130	Cressy, R.	112
Westhead, P.	111	Birley, S.	129	Bates, T.	107
Sexton, D.	107	Eisenhardt, K.	128	Wagner, J.	100
Reynolds, P.	103	Schumpeter, J.	124	Baumol, W.	99
Sapienza, H.	103	Van de Ven, A.	121	Aldrich, H.	98
Hisrich, R.	100	Williamson, O.	120	Berger, A.	97
Birley, S.	90	Brockhaus, R.	118	Caves, R.	96
Dess, G.	87	Kanter, R.	116	Cohen, W.	94
Hambrick, D.	86	Timmons, J.	115	Davis, S.	93
				Scherer, F.	93

Source: Own computations based on citations in ETP, JBV and SBE, collected manually for ETP and from Social Sciences Citation Index (SSCI) of the ISI Web of Science, for JBV and SBE. In the case of JBV and SBE citations refer only first authors.

Common to all three journals
Only common to ETP and JBV
Only common to JBV and SBE
Only common to ETP and SBE



SBE



ALL

Legend: **ETB** - Entrepreneurship Theory Building; **CE** – Characteristics of the Entrepreneur; **CEV** - Corporate and Entrepreneurship Venturing; **EE** - Entrepreneurship Education; **IGP** – Innovation, Growth and Policy; **L** – Labor; **IO** – Industrial Organization

Fig.1. Mapping the international scientific linkages of the most influential authors in entrepreneurship by 'core journal'

The designation of the core research areas is based on a comprehensive survey of the

research topics in entrepreneurship (in Santos and Teixeira, 2009), which allowed for the establishment of five distinct research areas within the field of entrepreneurship. Santos and Teixeira (2009) identified eleven major topics on entrepreneurship literature: Entrepreneurship theory building; Entrepreneurial psychological issues; Demographic traits; Entrepreneurial context; Corporate entrepreneurship; Venture capital; Entrepreneurship education; Policy; Innovation; Growth and Regional. Due to the wide scope of academic interests reflected in the influential authors' publications, we aggregated these topics into five, so that we could assign only one major research area to each of the authors, which enabled mapping the constructions in this study. Furthermore, the analysis of the academic publications and areas of interest of the most-cited authors of each journal revealed that it was necessary to include two additional research areas (Labour and Industrial Organization), economics-oriented, outside the entrepreneurship field (Table 4).

Table 4: Areas of scientific research associated with top cited authors

Research Areas	Abbreviaton
Entrepreneurship Theory Building	ETB
Characteristics of the Entrepreneur	CE
Corporate and Entrepreneurship Venturing	CEV
Entrepreneurship Education	EE
Innovation, Growth and Policy	IGP
Labor	L
Industrial Organization	IO

Legend: ETB - Entrepreneurship Theory Building; CE – Characteristics of the Entrepreneur; CEV - Corporate and Entrepreneurship Venturing; EE - Entrepreneurship Education; IGP – Innovation, Growth and Policy; L – Labour; IO – Industrial Organization.

Considering all the core journals, the United States is the most prominent country, covering around 79% of the most-cited authors. The United Kingdom comes in second, with 15%. Germany and Canada are less prominent, affiliating, respectively, two and one of the influential authors in entrepreneurship research. With regard to research areas, CEV has the highest proportion of most-cited authors (47%), followed by IGP (17%) and IO (13%). The other research areas have less influence. While this pattern is seen in the UK, in the US CEV remains the research area with the highest number of top cited scholars (46%), followed by IO (14%). IGP represents 11%, along with CE and ETP. Overall, the US is the only country with influential scholars in all seven research areas.

By examining the map comprising all the core journals (Fig. 4), we can see that the most cited authors in entrepreneurship-specific areas collaborate with key authors from other research areas, particularly CVE, where different authors relate to other scholars from five distinct areas. The economics-oriented areas are the exception to this scenario, containing highly-cited authors who are rather isolated from each other, with occasional or no collaboration ties.

Comparing the mapping for the most-cited authors for each of the selected journals, we found that both ETP and JBV present similar intellectual structures, with respect to the research areas, EE being the exception – there are no key authors in this area in ETP. For both journals, CVE is the subject specialty involving the highest number of

influential authors and the economics-oriented subject specialties of IO and L do not appeared in the set. The main difference between the two journals seems to lie on the areas of CE and EE.

CE appears to be a more influential research area in ETP in comparison to JBV, namely through contributions from Candida Brush and James Chrisman (5th and 7th in ETP's top 20 most-cited authors, respectively), boosting collaboration between researchers from distinct subject specialities. In JBV, this area has only one influential author – Robert Brockhaus – with no visible collaborations. The opposite situation occurs with EE: although excluded in the ETP mapping, it plays a significant role in JBV, due to the work of Karl Vesper (9th in JBV's top 20 most-cited authors). Nevertheless, influential authors such as Gartner, Zahra, Covin, Hambrick, MacMillan, Aldrich and Birley and their collaborations remain common to both journals. The geographical distribution of the top cited authors is also very similar: both journals have no influential authors located in Germany, maintaining the US, Canada and the UK (although the UK concentrates a higher number of key scholars in ETP when compared to JBV). The results obtained support the assessment of existing similarities in the intellectual structure and linkages among influential authors for ETP and JBV, which suggests that they could be part of the same invisible college.

SBE's mapping is substantially different from the other two core journals. The core area with the highest number of most-cited authors is Innovation, Growth and Policy, IGP (with seven authors), followed by Industrial Organization, IO (with six authors). CEV, previously the top research area for ETP and JBV, occupies here the third position, with only three key authors. SBE is the only journal to contemplate the economics-oriented areas of IO and L and, contrarily to ETP and JBV, collaborations between influential authors from distinct subject specialties are almost nonexistent. Instead, the mapping of SBE unveils a high concentration of collaborations between the most-cited authors within the main research area – IGP. Additionally, SBE's top five authors belong to this subject specialty. The geographic distribution of the most-cited authors also differs: American dominion is counterbalanced by the UK and Germany. The two European countries account for more than half of the total key authors' affiliations in the core area of IGP, and three of these key scholars are among the top five authors in SBE. Canada is absent in SBE. The findings seem to indicate that the core journal SBE represents a rather distinct invisible college within the field of entrepreneurship.

The differences found above would not have surfaced if this study had been based on a single data source, thus emphasizing the importance of using three core journals to determine the existence of invisible colleges. Table 5 presents, for each of the selected journals, the top 10 most-cited studies, ranking them by number of citations.

Table 5. Ranking of the Top 10 most-cited studies in ETP, JBV and SBE

	Author(s)	Date	Title	Source	Number citations
ETP	Schumpeter, J.	1934	The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle	-	90
	Gartner, W.	1988	"Who is an entrepreneur?" is the wrong question	American Journal of Small Business	63
	Shane, S.; Venkataraman, S.	2000	The promise of entrepreneurship as a field of research	Academy of Management Review	59
	Barney, J.	1991	Firm resources and sustained competitive advantage	Journal of Management	57

	Gartner, W.	1985	A conceptual framework for describing the phenomenon of new venture creation	Academy of Management Review	57
	McClelland, D.	1961	The achieving society	-	55
	Porter, M.	1980	Competitive strategy: Techniques for analyzing industries and competitors	-	55
	Stinchcombe, A.	1965	Social structure and organizations	-	52
	Low, M.; MacMillan, I.	1988	Entrepreneurship: Past research and future challenges	Journal of Management	49
	Covin, J.; Slevin, D.	1991	A conceptual model of entrepreneurship as firm behavior	Entrepreneurship Theory and Practice	45
	Vesper, K.	1980	New venture strategies	-	45
JBV	Schumpeter, J.	1934	The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle	-	80
	Porter, M.	1980	Competitive strategy: Techniques for analyzing industries and competitors	-	79
	Vesper, K.	1980	New venture strategies	-	66
	Stinchcombe, A.	1965	Social structure and organizations	-	61
	Low, M.; MacMillan, I.	1988	Entrepreneurship: Past research and future challenges	Journal of Management	59
	Gartner, W.	1985	A conceptual framework for describing the phenomenon of new venture creation	Academy of Management Review	56
	Jensen, M.; Meckling, W.	1976	Theory of the firm: Managerial behavior, agency costs and Ownership structure	Journal of Financial Economics	53
	McClelland, D.	1961	The achieving society	-	52
	MacMillan, I.; Siegel, R.; Subbanarasimha, P.	1985	Criteria used by venture capitalists to evaluate new venture proposals	Journal of Business Venturing	47
	Porter, M.	1985	Competitive advantage: Creating and sustaining superior performance	-	47
	Storey, D.	1994	Understanding the small business sector	-	92
	Jovanovic, B.	1982	Selection and the evolution of industry	Econometrica	91
	Schumpeter, J.	1934	The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle	-	89
SBE	Audretsch, D.	1995	Innovation and Industry Evolution		85
	Acs, Z.; Audretsch, D.	1990	Innovation and small firms		77
	Evans, D.; Jovanovic, B.	1989	An estimated model of entrepreneurial choice under liquidity constraints	Journal of Political Economy	75
	Porter, M.	1985	Competitive advantage: Creating and sustaining superior performance	-	66

Schumpeter, J.	1942	Capitalism, socialism, and democracy	-	53
Stiglitz, J.; Weiss, A.	1981	Credit rationing in markets with imperfect information	American Economic Review	52
Acs, Z.; Audretsch, D.	1988	Innovation in large and small firms: An empirical analysis	American Economic Review	49
Dunne,T.; Roberts, M.; Samuelson, L.	1989	The growth and failure of U.S. manufacturing plants	Quarterly Journal of Economics	49

Source: Authors computations based on our sample of citations in ETP, JBV and SBE, collected manually for ETP and from Social Sciences Citation Index of the ISI Web of Science, for JBV and SBE.

Common to all three journals
Only common to ETP and JBV
Only common to JBV and SBE
Only common to ETP and SBE

The most-cited study in ETP (90 citations) and JBV (80 citations) is the book, The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle, a seminal contribution by Joseph Schumpeter to the conceptualization of entrepreneurial processes (Schildt et al., 2006). Schumpeter's book is also the only cited study common to all three journals and ranks as the 3rd most-cited study in SBE. The most-cited study in SBE (cited 92 times) is David Storey's book, Understanding the small business sector, where the author summarizes research on small businesses and draws conclusions from a policy perspective (Landström, 2005).

Again, we can identify several similarities between ETP and JBV regarding top-cited studies. ETP and JBV's rankings have seven frequently-cited studies in common, contrasting emphatically with SBE's ranking, which, besides Schumpeter's book, only has Michael Porter's book, Competitive advantage: Creating and sustaining superior performance, in common with JBV. The differences between ETP, JBV and SBE extend to the main subjects of the most-cited studies. Whereas in ETP and JBV's studies prevail on topics related with corporate entrepreneurship and venture capital, SBE's topics revolve around innovation combined with industrial issues. The evidence gathered and illustrated in Table 5 further corroborates the distinct intellectual structure underlying ETP and JBV, on the one hand, and SBE, on the other.

The most-cited journals in ETP, JBV and SBE are identified and ranked in Table 6. The most-cited journal in ETP is ETP itself. The same occurs with JBV and SBE. The results are not surprising and they were to some extent expected, since it has been established by several authors that a journal will cite itself more often than other citing journals (Ratnatunga and Romano, 1997). Considering the total number of citations from the three journals, JBV is the most influential journal, receiving the highest number of citations (a total of 5468 citations). ETP ranks as the second most-cited journal with 3329 citations, followed by Strategic Management Journal (3206 citations). SBE appears in 6th place, being cited by the core journals 1841 times. The evidence obtained is in line with previous studies that highlighted ETP and JBV as the journals with the greatest impact on the field of entrepreneurship (e.g., Dean et al., 2007; Chandler and Lyon, 2001; Shane, 1997; Romano and Ratnatunga, 1996). The relatively low 'impact' of SBE may, at least in part, be explained by its youth as it was only first published in 1989, whereas ETP started in 1976 and JBV in 1985.

The three journals have eight cited journals in common but their distribution and citation pattern differs from ETP and JBV to SBE. Whereas in ETP and JBV, six of

the eight cited journals in common rank among the ten most-cited journals, SBE's top ten only includes three cited journals from the eight shared by all the core journals. The citation pattern also confirms the differences between SBE and the other two journals. In ETP and JBV, management-oriented journals dominate the top positions in the raking, whereas SBE gives preference to economics-oriented journals. The Academy of Management Review and the Journal of Finance are illustrative of the distinction between ETP/JBV and SBE. If the core journals' rankings were to only contemplate the ten most-cited studies, the gap between ETP/JBV and SBE would be even more visible: the selected journals would have only two of the most-cited journals in common, although ETP and JBV would still have nine journals in common. The similarities between ETP and JBV are notorious: from the twenty most-cited journals, sixteen are common to the two journals, and eight are exclusively common to the both.

The analysis of the most-cited authors, studies and journals attests to the multidisciplinary nature of research in entrepreneurship. The citations gathered arise from a wide range of disciplines across the social sciences, such as economics, management, marketing, finance, sociology and psychology.

Table 6. Ranking of the Top 20 most-cited journals in ETP, JBV and SBE

Entrepreneurship Theory and Practice		Journal of Business Venturing		Small Business Economics	
Cited Journal	#	Cited Journal	#	Cited Journal	#
Entrepreneurship Theory and Practice	2053	Journal of Business Venturing	2825	Small Business Economics	1662
Journal of Business Venturing	2047	Strategic Management Journal	1573	American Economic Review	762
Strategic Management Journal	1253	Entrepreneurship Theory and Practice	974	Journal of Business Venturing	596
Academy of Management Review	1134	Academy of Management Journal	933	Journal of Political Economy	564
Academy of Management Journal	971	Academy of Management Review	878	Journal of Finance	387
Administrative Science Quarterly	674	Administrative Science Quarterly	809	Strategic Management Journal	380
Journal of Small Business Management	660	Frontiers of Entrepreneurship Research	639	Review of Economics and Statistics	377
Family Business Review	516	Harvard Business Review	473	Quarterly Journal of Economics	361
Journal of Management	500	Management Science	428	Journal of Industrial Economics	331
Harvard Business Review	494	Journal of Small Business Management	418	Regional Studies	315
Management Science	300	Journal of Management	388	Entrepreneurship Theory and Practice	302
Organization Science	280	Organization Science	268	The Economic Journal	297
Journal of Financial Economics	235	Journal of Financial Economics	248	International Journal of Industrial Organization	292
Journal of Management Studies	231	Journal of Finance	246	Research Policy	278
Journal of Finance	230	American Economic Review	231	Econometrica	276
Journal of International Business Studies	222	Journal of International Business Studies	206	Journal of Small Business Management	237
Entrepreneurship & Regional Development	191	American Journal of Sociology	203	Journal of Financial Economics	234
American Journal of Sociology	189	Family Business Review	192	Administrative Science Quarterly	213
Small Business Economics	179	Journal of Marketing	191	Journal of Economic Literature	208
California Management Review	171	Research Policy	184	Academy of Management Review	205

Source: Authors computations based on our sample of citations in ETP, JBV and SBE, collected manually for ETP and from Social Sciences Citation Index (SSCI) of the ISI Web of Science, for JBV and SBE.

Common to all three journals
Only common to JBV and SBE
Only common to ETP and JBV
Only common to ETP and SBE

Several authors (e.g., Grégoire et al., 2006; Cornelius et al., 2006) report the diversity of entrepreneurship research, pointing out that this field attracts authors with different backgrounds and different methodological traditions. When comparing the most prolific authors with the most-cited authors, we observe that nineteen scholars fall into both categories, confirming that a highly productive author tends to stand as a highly influential author and, ultimately, vouches for the field's maturity. This conclusion is also congruent with Cornelius et al.'s (2006) results of an increasing internal orientation in entrepreneurship research. The fact that authors with research areas outside mainstream entrepreneurship research (such as IO and L) are among the most-cited authors appears to be a contradiction to the previous conclusion, since, as Cornelius et al. (2006) stress, entrepreneurship research has been increasingly self-reflective and the influence of outsiders (researchers who do not cite but are being cited by entrepreneurship researchers) has been decreasing over time. However, a closer look into the results reveals that the majority of outsiders comes from Small Business Economics, a more recent and economics-oriented journal than ETP and JBV, which underpins another finding of Cornelius et al. (2006): entrepreneurship scholars have increasingly specialized thematically, indicating that autonomous research groupings will develop.

The evidence obtained with regard to the most-cited authors, studies and journals, performed on the selected journals, characterizes the intellectual bases of the field of entrepreneurship and suggests that similarities between ETP and JBV could indicate the presence of an invisible college and, at the same, SBE's distinct intellectual structure may denote another invisible college.

4.2 Research areas and educational and professional affiliation of top cited authors

Through a (co)citation analysis, we identified 47 highly cited authors in the field of entrepreneurship. Co-citation techniques, although assessing the intellectual structure of a research field, do not capture all the insights related with the phenomenon of the invisible college (Zuccala, 2006). The issue here is, as Reader and Watkins (2006) put it, whether the most-cited authors are strictly part of a set of ideas constructed in the minds of the citers or there is an effective network of social interactions between the influential scholars. In order to more effectively answer this question, we complemented the (co)citation analysis, exploring the possible collaborations between highly cited authors, based on the analysis of their professional affiliation, educational background and main research area.

Table 7 presents personal data on the 47 most-cited authors (employer institution, research area and PhD granting school – the validity of authors' current professional affiliation is only guaranteed until August 2009; due to the absence of information, it was not possible to identify the granting school of one author and the graduation year of four authors), ranking them by the total number of citations obtained from the three selected journals. Among the top authors, David Audretsch is the scholar with the highest number of citations in all the core journals, although he is not part of ETP and JBV's top 20 rankings. With regard to the key authors' current affiliation – represented in the column "employer institution" – we found that a total of 40 institutions employ the 47 most-cited authors (three authors, Miller, Hambrick and Sexton, are affiliated with two institutions each). Harvard University (US) employs the highest number of most-cited authors (5), followed by Babson College (US) and University of Minnesota (US), with three authors each and George Mason University (US) and New York University (US), both with two. The remaining 32 institutions employ only one influential author each. With respect to the organizations' geographical distribution, the US hosts the highest number of institutions (29),

followed by the UK (7) and then, Germany and Canada, with two institutions each. By combining the number of citations presented in Table 7, with the corresponding research area, for each cited author, we confirm the previous results regarding research areas. CVE is the main research area for twenty-two influential authors, IGP involves eight scholars, followed by IO, with six scholars. CE, ETB, L and EE are less prominent areas of interest.

CVE is the most frequent research area associated with ETP and JBV, whereas in SBE, IGP dominates, as mentioned previously. Beyond that, we can also draw further evidence: IGP, although not the most frequent research area, is the main research area for the two most-cited authors – Audretsch and Acs – among the 47. Another point should be stressed: the bottom most-cited authors are exclusively associated with SBE (they are seldom cited by ETP and JBV) and eight of them are related with economics-oriented areas, whereas authors with research areas not related with entrepreneurship do not rank in ETP's and JBV's top 20. These findings support the previous evidence suggesting that the three entrepreneurship core journals embody two (in)visible colleges in the entrepreneurship field: one associated with ETP and JBV and the other with SBE.

Educational background is also explored here by gathering information concerning the institution granting the PhD degree and year of graduation. We identify 31 distinct universities granting a doctoral degree to 44 of the most-cited authors. Harvard University (US) granted 4 PhDs, followed by the Stanford University US), University of Michigan (US) and University of Washington (US), with 3 PhDs each. Pennsylvania State University (US), University of Chicago (US), University of Wisconsin (US) and University of London (UK) have two PhDs each among the most-cited authors. The remaining 23 universities granted a PhD to only one top cited author.

The geographical distribution of the cited authors' granting schools follows a similar pattern to that of their affiliation. The US concentrates a vast majority of the universities (33), followed by the UK (7). The only two differences are the inclusion of New Zealand and Austria, in the granting schools of the most-cited authors. In terms of graduation year, 44 of the most-cited authors took their PhDs a relatively long time ago (the most recent PhD degree was granted 17 years ago to Scott Shane).

Table 7: Information on the professional affiliation, educational background and research area of the 47 most cited authors

		Number of Citations							
	Author	ETP	JBV	SBE	Employer institution	Secondary unit	Research Area	Granting School (Ph.D.)	Year
1	Audretsch, D.	48	39	508	Max Planck Institute of Economics, DE	Entrepreneurship, Growth and Public Policy Group	IGP	University of Wisconsin-Madison, US	1980
2	Acs, Z.	32	37	509	George Mason University, US	School of Public Policy	IGP	Graduate Faculty, The New School, US	1980
3	Cooper, A.	144	307	73	Purdue University (Retired), US	Krannert School of Management (Retired)	CEV	Harvard University, US	1962
4	Aldrich, H.	117	241	98	University of North Carolina, US	Kenan-Flagler Business School	CEV	University of Michigan, US	1969
5	Reynolds, P.	103	94	258	George Mason University, US	School of Public Policy	IGP	Stanford University, US	1969
6	Gartner, W.	112	209	77	Clemson University, US	Arthur M. Spiro Institute for Entrepreneurial Leadership	ETB	University of Washington, US	1982
7	Zahra, S.	168	182	38	University of Minnesota, US	Carlson School of Management	CEV	University of Mississippi, US	1982
8	Porter, M.	55	183	130	Harvard University, US	Harvard Business School	CEV	Harvard University, US	1973
9	MacMillan, I.	138	213	14	University of Pennsylvania, US	Wharton School of Business	CEV	University of South Africa, ZA	1975
10	Storey, D.	49	36	276	University of Warwick, UK	Warwick Business School	IGP	Newcastle University, UK	1978
11	Schumpeter, J. †	49	124	173	Harvard University, US	-	EBT	University of Vienna, AT	1906
12	Miller, D.	113	183	42	University of Montréal and University of Alberta, CA	Ecole des Hautes Etudes Commerciales and Family Enterprise and Strategy	CEV	McGill University, CA	1976
13	Shane, S.	78	180	78	Case Western	Weatherhead	EBT	University of	1992

					Reserve University, US	School of Management		Pennsylvania, US	
14	Evans, D.	13	48	248	Law and Economics Consulting Group (LECG) Europe, UK	-	IGP	University of Chicago, US	1983
15	Bygrave, W.	121	130	33	Babson College, US	-	CEV	-	-
16	Birley, S.	90	129	54	Bae Sistems (Retired), UK	-	CEV	*N/a*	*N/a*
17	Covin, J.	118	135	17	Indiana University, US	Kelley School of Business	CEV	University of Pittsburgh, US	1985
18	Wright, M.	178	47	35	University of Nottingham, UK	Nottingham University Business School	CEV	University of Nottingham, UK	*N/a*
19	Brush, C.	122	86	36	Babson College, US	-	CE	-	-
20	Westhead, P.	111	47	85	University of Durham, UK	Durham Business School	CEV	University College of Wales, UK	1988
21	Hambrick, D.	86	141	12	Pennsylvania State University and Columbia University, US	Smeal College of Business and Graduate School of Business	CEV	Pennsylvania State University, US	1979
22	Williamson, O.	35	120	79	University of California, Berkeley, US	Walter A. Haas School of Business	CEV	Carnegie Mellon University, US	1963
23	Vesper, K.	64	143	15	University of Washington, US	University of Washington Business School	EE	Stanford University, US	1969
24	Eisenhardt, K.	63	128	26	Stanford University, US	Department of Industrial Engineering and Engineering Management	CEV	Stanford University, US	1982
25	Hisrich, R.	100	87	28	Thunderbird School of Global Management, US	Walker Center for Global Entrepreneurs hip	CEV	University of Cincinnati, US	1971
26	Sexton, D.	107	96	11	Ohio State University (Retired)/ Ewing Marion Kauffman Foundation, US	-	CEV	Ohio State University, US	1972

27	Van de Ven, A.	81	121	11	University of Minnesota, US	Carlson School of Management	IGP	University of Wisconsin, US	1972
28	Timmons, J. †	75	115	20	Babson College, US	-	CEV	Harvard University, US	1971
29	Sapienza, H.	103	80	27	University of Minnesota, US	Carlson School of Management	CEV	University of Maryland, US	1989
30	Bates, T.	25	76	107	Wayne State University, US	Department of Economics	CE	University of Wisconsin, US	1972
31	Brockhaus, R.	63	118	13	Saint Louis University, US	John Cook School of Business	CE	University of Washington , US	1976
32	Hitt, M.	115	59	9	Texas A&M University, US	Mays Business School	CEV	University of Colorado, US	1974
33	Chrisman, J.	118	47	15	Mississippi State University, US	College of Business and Industry	CE	University of Georgia, US	1986
34	Dess, G.	87	78	14	University of Texas at Dallas, US	School of Management	CEV	University of Washington, US	1980
35	Baumol, W.	20	48	99	New York University, US	Leonard N. Stern School of Business	ETB	University of London, UK	1949
36	Kanter, R.	47	116	3	Harvard University, US	Harvard Business School	CEV	University of Michigan, US	1967
37	Cohen, W.	11	53	94	Duke University, US	Fuqua School of Business	IGP	Yale University, US	1981
38	Blanchflower, D.	5	9	126	Dartmouth College, US	Department of Economics	L	University of London, UK	1985
39	Caves, R.	10	34	96	Harvard University, US	Department of Economics	IO	Harvard University, US	1958
40	Geroski, P. †	3	9	123	University of London, UK	London Business School	IGP	University of Warwick, UK	*N/a*
41	Jovanovic, B.	4	14	116	New York University, US	Department of Economics	IO	University of Chicago, US	1978
42	Cressy, R.	4	12	112	University of Birmingham, UK	Birmingham Business School	CEV	University of Edinburgh, UK	*N/a*
43	Scherer, F.	11	24	93	Harvard University, US	John F. Kennedy School of Government	IO	University of Michigan, US	1954
44	Dunne, T.	0	10	116	Federal Reserve Bank of Cleveland, US	Research Department	IO	Pennsylvania State University, US	1987
45	Berger, A.	9	11	97	University of South Carolina, US	Moore School of Business	IO	University of California, US	1983

46	Wagner, J.	12	4	100	University of Lueneburg, DE	Institute of Economics	IO	University of Hannover, DE	1984
47	Davis, S.	6	6	93	University of Chicago, US	Booth School of Business	L	Brown University, US	1986

Note: Authors are ordered by the total of citation in each journal. The grey cells indicate that the author is part of the Top 20 most cited authors in the designated journal.

Legend: **ETB** - Entrepreneurship Theory Building; **CE** – Characteristics of the Entrepreneur; **CEV** - Corporate and Entrepreneurship Venturing; **EE** - Entrepreneurship Education; **IGP** – Innovation, Growth and Policy; **L** – Labor; **IO** – Industrial Organization.

According to Zuccala (2006), the Information Use Environment is a key element to identify invisible colleges, representing a scientific workspace where information-related behaviours occur. Based on this concept, we included additional information regarding the academic experience of the most-cited authors, so that our analysis captures all the (invisible) links between the key scholars. Thus, to infer if there are social correlations between the most frequently cited authors, in addition to PhD university and current professional affiliation, data on other current affiliations was gathered, besides the main employer institution, and present visiting academic institutions along with data on previous affiliations (the past affiliations prior to the cited authors' doctoral degree were disregarded) and past visiting academic institutions (Table A3 provides the information collected in detail with respect to these two items).

Fig. 4 illustrates the links between the most highly cited authors, based on the academic institutions that received the authors over their professional career. We only considered institutions that had received or are currently employing more than two top cited authors, which gave us a total of 24 institutions. The map represents the links between a total of 44 authors, across 24 organizations. Each of the top cited authors is identified by their ranking as established in Table 7, as well as the colour of the respective research area. Each link is represented by straight lines and denotes that at least one top cited author worked in the two linked institutions. An overall analysis of the map tells us that all institutions have received at least one top cited author, which suggests a substantial degree of linkage among the most-cited authors in entrepreneurship research.

The connections between the institutions and number of influential authors associated with them are distinct, according to each institution. Harvard University (US) is the institution that gathers the highest number of top cited authors (9), followed by the University of Pennsylvania (US), with 7 key authors. A total of 12 institutions is linked to 3 top cited authors. The University of Pennsylvania (US) holds the highest number of links (11), which implies that top cited authors connect with others, through 11 distinct institutions. The University of London (UK) comes in second, with connections to 10 institutions. The least interactive institutions, among the top ones, are the University of Michigan (US) and the University of Washington (US), with 2 and 3 links, respectively.

It should be noted that the number of top cited authors associated with an institution is not, per se, an indication of the degree of connectivity between influential authors. For instance, the University of Washington (US) hosts 4 top cited authors but only links with 3 other institutions.

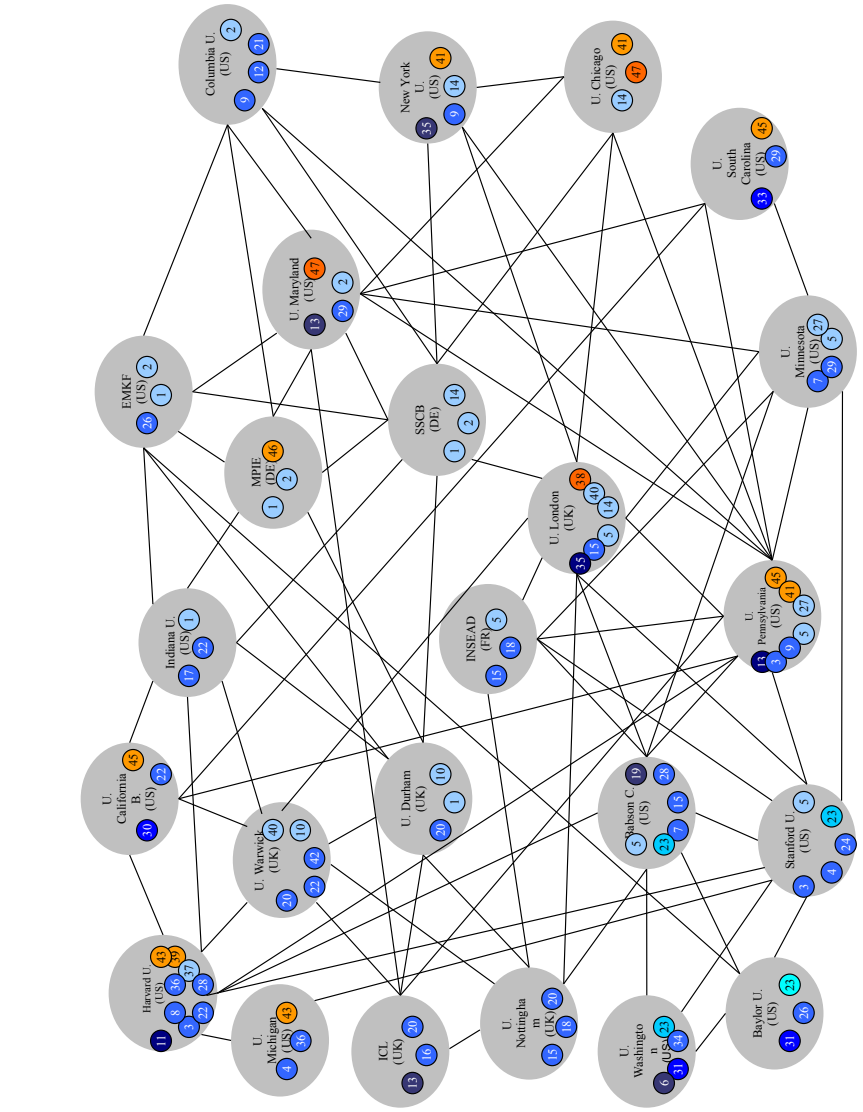


Fig. 2. Mapping links among top cited authors in entrepreneurship scientific area

Note: Each link means that at least one top cited author worked in the two linked organizations

ETB	Entrepreneurship Theory Building	CE	Characteristics of the Entrepreneur
EE	Entrepreneurship Education	IGP	Innovation, Growth and Policy
CEV	Corporate and Entrepreneurship Venturing		
IO	Industrial Organization	L	Labor

On the other hand, the Social Science Centre of Berlin (DE) receives only 3 top cited authors, but establishes connections with 9 distinct institutions, which attests to the top cited authors' professional mobility, confirmed when we identify two of the cited authors, Audretsch and Acs, the two most-cited authors in our study and renowned academics, with a vast and prolific career.

An analysis on the research area of the 44 most-cited authors indicates that the degree of collaboration, represented by the links between institutions, agrees with the initial distribution of authors by research areas, i.e., the majority of the links established belong to top cited authors, whose main research area is CVE, with IGP appearing in second, followed by IO. The exception to this pattern comes from the EE research area that, with only one top cited author, connects with 4 other institutions, surpassing the research area of Labour (L) with two influential authors but no established collaborations outside their current affiliation. The evidence obtained indicates that top cited authors are highly connected, which is particularly visible in the research areas of CVE and IGP.

5 Conclusions

The disciplinary rules and research problems of a scientific domain and their acknowledgment by scholars within that domain are rooted in the internal ties that link scientists with similar research interests in the form of what Crane (1972) calls "invisibles colleges". In this sense, Invisible Colleges are valuable instruments to identify processes of knowledge dissemination and monitor the dynamics of scientific developments (Reader and Watkins, 2006).

Identifying the most-cited authors, studies and journals for the three core journals selected allowed us to explore the intellectual structure of entrepreneurship research. Evidence supports the multidisciplinary nature of the field of entrepreneurship, since results show that highly influential authors in the field are working in several subject specialties, including research areas that are not so directly focused on entrepreneurship, such as economics.

These "non-entrepreneurship" researchers are highly related with the specific orientation of each of the core journals. The present study empirically corroborates the idea that ETP and JBV are the most influential journals in the field of entrepreneurship and SBE is more specialized and economics-oriented. In fact, the (co)citation analysis confirms several similarities between ETP and JBV regarding the most cited authors, studies and journals and main research area, as well as the distinct intellectual structure of SBE.

Additionally, by collecting personal data regarding the top cited authors' current and past professional affiliation, educational background and combining it with the research areas assigned, it was possible to infer about the social ties established among the most influential authors. The results reveal that 44 key authors are highly linked among themselves, through 24 different institutions where they developed or are currently developing their work.

The two-stage procedure enabled finding the key elements to assess the existence of invisible colleges: social actors (the most-cited authors); subject specialty (research areas) and information use environment (professional affiliation of the most-cited authors). Formal and informal communication is represented by, respectively, the most-cited studies/journals and professional affiliation linkages. Accordingly, we identified two invisible colleges: one associated with ETP and JBV and the other associated with SBE. The results obtained are summarized in Fig. 5. Social actors are represented by the top five most-cited authors of each core journal; the scientific

research area that attracts the highest number of most-cited authors is the "subject specialty", and the information use environment is defined by the professional affiliation where the most frequently cited authors currently work (until August 2009). Formal and informal communication is given, respectively, by the top five studies and journals for each of the three journals and the linkages extracted from information regarding top cited authors' current and past affiliations and PhD granting affiliation.

Based on an analysis on the core journals (ETP, JBV and SBE), we conclude that there are two invisible colleges in the field of entrepreneurship. The first invisible college is focused specifically on entrepreneurship research, the key orientation of ETP and JBV. The similarities between these two journals were a constant in all the stages of the study. The second invisible college is originated by the evolution of the entrepreneurship field into an increasingly specialized thematic discipline, developing autonomous research groupings, such as the one represented by SBE.

This study suffers from a series of limitations that must be highlighted. First, only one research area was imputed to each top cited author, which narrows down the academic scope of the researchers. The inclusion of more than one area of research would have been insightful to a better understanding of the social network formed by key scholars. Second, the analysis although involving a rather long time span is quite static; to compare the overall analysis with by-period analyses would provide insights regarding the evolution of the field which would enrich the research. Third, the subjective nature of the key element, "informal communication relations", underlying the concept of invisible colleges, raises some concern. We employed data regarding professional affiliations and educational background, but other methods, such as direct questionnaires, mailings, conference participation, could have been used.

Future research on the matter could combine bibliometric techniques with ethnographic methods of research so as to enhance our interpretation of the invisible college phenomenon. Nevertheless, we still believe that identifying and analyzing the two invisible colleges in entrepreneurship research provides a useful understanding of the scientific discipline, enlightening researchers, students and the public in general.

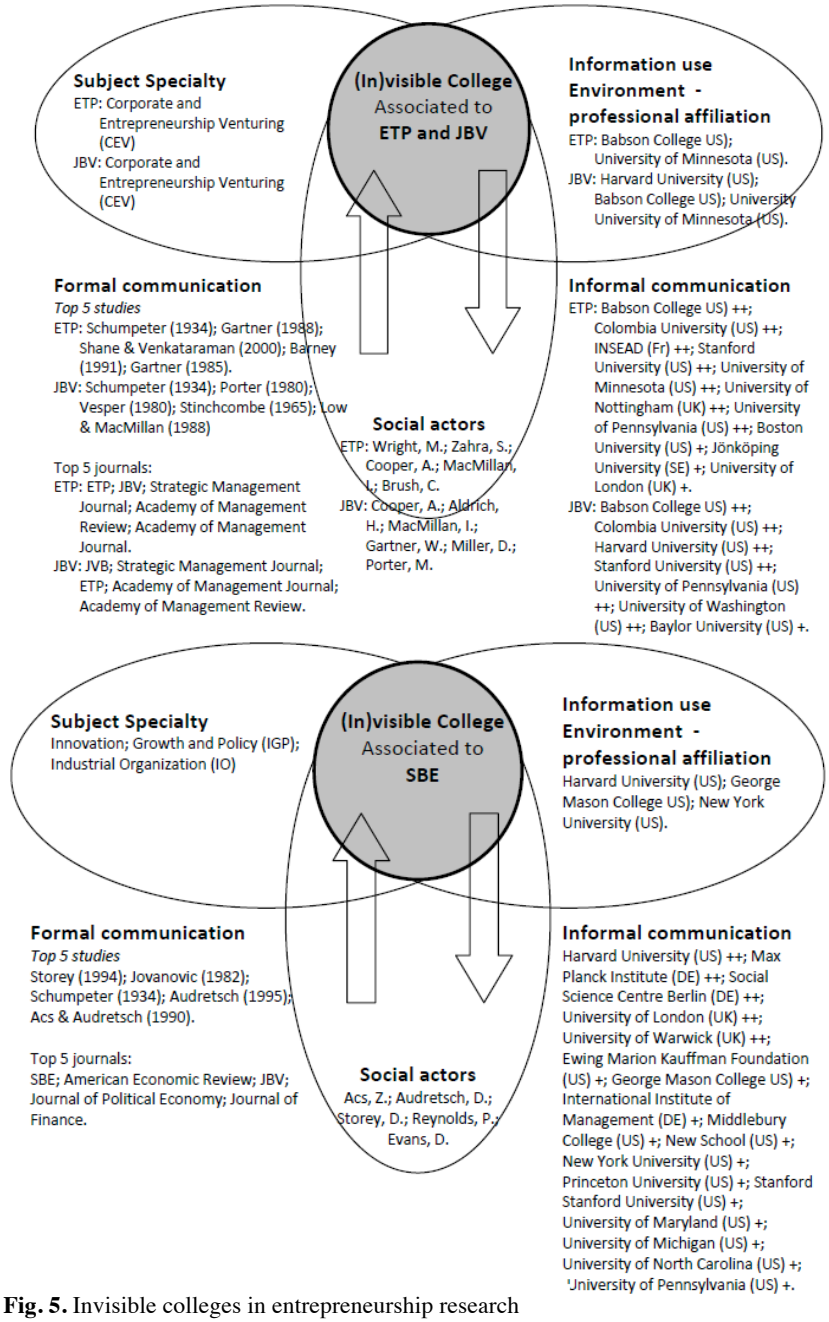


Fig. 5. Invisible colleges in entrepreneurship research

Notes: Universities listed in "Informal Communication" have affiliated at least 3 of the most-cited authors in the Journal (++) or have affiliated 2 of the most-cited authors in the Journal who have more than 3 links with universities that also affiliates most-cited authors in the Journal(+)

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Appendix

Table A1a: Bibliometric studies – Journal analysis

Application Areas - Journal Analysis			
Scientific Areas	**Authors (Date)**	**Main Research Items**	**Main Results**
Economics	Laband and Pieters (1994)	Objectives: - Update paper by Liebowitz and Palmer (1984 - Research possible changes in the economics journal market, during 1970-1990 Bibliometric Indicators : - Number of citations - Number of citations per article - Number of articles - Distribution of citations, via Lorenz-curve analysis	- Steady decrease in concentration of citations among the top economics journals between 1965-1990 - Market share has been taken by new entrants, but inequality in distribution of citations remained stable from 1970 to 1990 - Decline in the influence of "second-tier" general-interest journals in contrast with the increasing influence of specialized journals
Management	Phelan et al. (2002)	Objectives: - Examine internal changes in content of the *Strategic Management Journal*, over time Bibliometric Indicators: - Number of citations - Number of citations per article - Number of articles	- Increase in the length of articles, number of references per article and number of authors - Publication lag has increased - More intra-journal citations - Proportion of North American authors remains constant but there are signs of greater international collaboration - Increase in empirical papers
Marketing	Baumgartner and Pieters (2003)	Objectives: - Explore the overall and sub-area influence of marketing journals at three points in time: 1996-97, 1981-82 and 1966-67 Bibliometric Indicators: - Number of citations - Number of citations per article - Number of articles - Index of structural influence - Journal impact factor	- Influence share of general business and managerially oriented journals has declined in contrast with the increase in the influence of specialized marketing journals - Select set of journals concentrate influence in marketing and their position remained stable over the studied period - *Journal of Marketing* is considered the most influential marketing journal
Accounting	Van Campenhout et al. (2008)	Objectives: - Compare the overall and sub-area journal influence in accounting Bibliometric Indicators: - Number of citations - Number of articles - Index of structural influence	- Substantial differences exist between overall and sub-areas journal influences - For some sub-areas in accounting, specialized journals are not the ones with the highest influence
Entrepreneurship	Gamboa and Brouthers (2008)	Objectives: - Discover role of international entrepreneurship research in major entrepreneurship, international business and management journals - Assess possible differences in the type of international entrepreneurship articles published in the three type of	- Substantial increase in international entrepreneurship content in the top entrepreneurship journals by contrast to a much more modest increase in the top international business journals and management journals - Entrepreneurship journals tend to favour replication studies while

		journals Bibliometric Indicators: - Number of articles - Number and percentage of international studies	international business and management journals prefer nonreplications
	Romano and Ratnatunga (1996)	Objectives: - Assess the impact of small enterprise journals and articles during the 1986-1992 period Bibliometric Indicators: - Number of citations - Number of articles - Average number of citations per article - Average citation rate per published article - Self citedness; Uncitedness - Citation frequency - Journal impact factor	- Increasing level of impact in more recent years of the source journal articles as group on contemporary small enterprise research - Substantial number of articles were never cited - Self-citation problem was seen to be of limited impact - Entrepreneurship Theory and Practice and Journal of Business Venturing were the more influential journals during the studied period

Table A1b: Bibliometric studies – Themes categorizations

Application Areas - Journal Analysis

Scientific Areas	Authors (Date)	Main Research Items	Main Results
Structural Change	Silva and Teixeira (2008)	Objectives: - Provide a comprehensive survey of the economic literature on structural change Bibliometric Indicators: - Number of citations; Number of articles - Co-authoring; Abstracts analysis; Keyword analysis	- Technological issues increased there relevance during the studied period - Recent trends reflect a rising interest towards empirical work, despite the increased relevance of formal work in the nineties
Evolutionary Economics	Silva and Teixeira (2009)	Objectives: - Explore main research paths and contributions in the field of evolutionary economics Bibliometric Indicators: - Number of citations; Number of articles; Abstracts analysis; Keyword analysis	- Evolutionary contributions do not converge to an integrated approach - Appearance of two extreme strands: “History of Economic Thought and Methodology” and “Games” - Increase of formal approaches in contrast with the stagnation of empirical work
Regional studies	Cruz and Teixeira (Forthcoming)	Objectives: - Provide evidence that empirically complements the qualitative surveys of cluster-related literature Bibliometric Indicators: - Number of citations; Number of articles; Co-authoring - Abstracts analysis	- Share of “Appreciative+Empirical” and “Formal+Empirical” articles published in the top ranked cluster-related journals are above average - Evidence of positive correlation between the “quality” of the journals and formal-related research
Entrepreneurs hip	Van Praag and Versloot (2008)	Objectives: - Assess the contribution of entrepreneurs to the economy comparatively to non-entrepreneurs Bibliometric Indicators. - Keyword analysis - Title, abstract and full-text analysis	- Entrepreneurs have a higher, but more volatile, contribution to employment generation. They pay lower wages, but their employees appear to be more satisfied - Entrepreneurs contribute with equal importance to innovation but through different aspects - Entrepreneurs do not have higher

			productivity levels than their counterparts. They contribute more than their counterparts to growth of value added and productivity - Despite having lower and riskier incomes, entrepreneurs are more satisfied
	Watkins and Reader (2004)	Objectives: - Identify current trends in entrepreneurship research, in 2000 and 2001 Bibliometric Indicators: - Textual analysis (keyword and abstract analysis); Co-occurrence matrix	- Identification of twenty-two clusters - Incidence of work in areas very attended in the past or in vogue in the present, such as, respectively, Entrepreneurial Psychology and Social Entrepreneurs or Networking among Female Entrepreneurs was lower than expected
	Ratnatunga and Romano (1997)	Objectives: - Analyze, with a quantitative and qualitative approach, the articles in contemporary small enterprise research Bibliometric Indicators: - Number of citations; Number of articles - Articles full-text analysis	- Increase percentage of most-cited articles, published by the source journals - Substantial percentage of articles (more than 50%) are well-grounded in observational and contemplative theory - Diversity of topic areas, empirical support that there is no coherent structure for research in the field

Table A1c: Bibliometric studies – Research Intellectual Structures

Application Areas - Research Intellectual Structures

Scientific Areas	Authors (Date)	Main Research Items	Main Results
Innovation	Cottrill et al. (1989)	Objectives: - Explore the interrelationships between the specialties of the diffusion of innovations and technology transfer, in the 1966-1972 period Bibliometric Indicators: - Number of citations; Number of articles; Co-citation analysis; Cluster and factor analysis; Multidimensional scaling	- Clusters of authors obtained are similar to those identified in major reviews of innovation literature Little cross-referencing between the authors of diffusion of innovations and technology transfer Technology transfer research tradition is less integrated than the diffusion of innovations tradition
Strategic Management	Nerur et al. (2008)	Objectives: - Trace the evolution of the intellectual structure of the strategic management field during the period 1980–2000 Bibliometric Indicators: - Number of citations; Number of articles; Co-citation analysis; Multidimensional scaling; Factor analysis; Pathfinder analysis	- Multidisciplinary origins of strategy - Large number of significant inter-correlation between factors suggests that the field did not become fragmented - Theories of the firm have become central to strategy research, which suggests a greater theoretical orientation
Management Information Systems	Culnan (1987)	Objectives: - Document the intellectual structure of Management Information Systems, from 1980 to 1985 Bibliometric Indicators: - Number of citations; Number of articles; Co-citation analysis	- Identification of five clusters: foundations; psychological approaches to MIS design and use; MIS management; organizational approaches to MIS design and use; and curriculum

Entrepreneurship	Cornelius et al. (2006)	Objectives: - Analyze the development of entrepreneurship with respect to the research forefront and knowledge base, during the periods of 1986-1990, 1993-1997 and 2000-2004 Bibliometric Indicators: - Number of citations; Number of articles; Co-citation analysis; Cluster analysis	- Entrepreneurship research has been increasingly self-reflective - The number and influence of outsiders has decreased steadily over time while the reliance on insiders is greater - Theoretical issues are more pervasive - Research interests have evolved, despite their consistency - Researchers have increasingly specialized thematically
	Grégoire et al. (2006)	Objectives: - Assess conceptual convergence in the entrepreneurship field, through network co-citation analysis Bibliometric Indicators: - Number of citations; Number of articles; Co-citation analysis; Cluster analysis	- Evidence of convergence in entrepreneurship research over the last twenty-five years - Levels of convergence comparatively low - Entrepreneurship research based on the contributions of other disciplines, but evidence indicates that the field relies increasingly on its own literature
	Schildt et al. (2006)	Objectives: - Analyze co-citation patterns of entrepreneurship-related articles published, from 2000 to 2004 Bibliometric Indicators: - Number of citations; Number of articles; Co-citation analysis; Jaccard index; Cluster algorithm	- Evidence of fragmentation in entrepreneurship research - Research findings appear to be noncumulative - Research mostly centred on the United States, but other countries contribute significantly - Signs of isolation among entrepreneurship scholars
	Etemad and Lee (2003)	Objectives: - Define the knowledge network associated with the field of international entrepreneurship, during the period of 1992 to 2000 Bibliometric Indicators: - Number of citations; Number of publications; Bolean search progression of keywords; Co-authoring; Analysis of authors' affiliations	- Scholarly articles, followed by book reviews, dominate the document types - Upward movement over time in both the number of articles and their associated citations - Mild upward trend in both size of scholarly teams and theirs co-authorship, during the period of 1992-1998 - Authors affiliated with institutions located in the US dominate the distribution, but other country affiliations are also reported - Scholarly articles and books constitute the most important sources upon which research relays

Table A1d. Bibliometric studies – Research Invisible Colleges

Application Areas - Research Invisible Colleges			
Scientific Areas	**Authors (Date)**	**Main Research Items**	**Main Results**
Industrial Relations & Labor	Casey and McMillan (2008)	Objectives: - Compare Industrial & Labor Relations Review intellectual bases across three periods: 1974-1984, 1985-1995 and 1996-2006 Bibliometric Indicators:	- The most-cited journals were economic-oriented during the studied period Emergence of the field of human resources and management in recent years

		- Number of citations; Number of articles; Co-citation network analysis	
	McMillan and Casey (2007)	Objectives: - Uncover British Journal of Industrial Relations for two time periods, 1986-1995 and 1996-2005 Bibliometric Indicators: - Number of citations; Number of articles; Co-citation network analysis	- Evidence suggests that economics literature remains important, but sociological and management literature has dominated in recent years - Regarding authors, Millward's initial influence has been replaced by Kelly and Wood - Possible signs of internationalization
Management	McMillan (2008)	Objectives: - Examine R&D Management, in four time periods, 1986-1990, 1991-1995, 1996-2000 and 2001-2005 Bibliometric Indicators: - Number of citations; Number of articles; co-citation network analysis	- During the two first periods R&D Management focuses on more traditional technology and innovation management sources, contrasting with the last two periods, in which R&D Management was based on journals more detached from the traditional sources - Cohen and Levinthal's absorptive capacity model dominates the final two periods and possibly constitutes an emerging base
Economics of Technology and Innovation	Verspagen and Werker (2004)	Objectives: - Identify the role of "intellectual leaders" in connecting the research network - Study the structure of the field in terms of sub-communities Bibliometric Indicators: - Survey analysis	- The network of scholars in the field may be characterized as a scale-free network - The field does not seem to evolve in a mode of competition between paradigmatic approaches to the object of study
Entrepreneurship	Reader and Watkins (2006)	Objectives: - Identify groups of entrepreneurship authors whose work falls into similar areas and explore the themes that characterize entrepreneurship field - Investigate the social and collaborative structure of entrepreneurship research Bibliometric Indicators: - Number of citations; Number of articles; Co-citation analysis; Cluster analysis; Correlation matrix; Factor analysis; Questionnaire survey	- Findings reveal nine clusters of authors whose work falls into similar areas - Little evidence of international sharing of ideas - Strong evidence that closely related authors share both formal and informal communication links

Table A2. John Carroll University Classification of entrepreneurship journals

Level I
1. Journal of Business Venturing
2. Small Business Economics
3. Entrepreneurship: Theory & Practice
4. Journal of Small Business Management
Level II
1. Entrepreneurship, Innovation and Change
2. Family Business Review
3. International Journal of Entrepreneurship Development, Education and Training
4. International Journal of Entrepreneurship
5. International Journal of Technological Innovation and Entrepreneurship
6. Journal of Developmental Entrepreneurship
7. Journal of Enterprising Culture
8. Journal of Entrepreneurship Education
9. Journal of Private Enterprise
10. New England Journal of Entrepreneurship
11. Small Business and Enterprise Development
Level III
1. Economic Analysis: A Journal of Enterprise and Participation
2. Enterprise and Innovation Management Studies
3. Entrepreneurship Development Review
4. Journal of Entrepreneurship
5. Journal of International Business and Entrepreneurship
6. Journal of Technology Transfer
7. Small Enterprise Research: The Journal of SEAANZ
8. Studies in Cultures, Organizations and Societies

Source: Katz, J. and Boal, K. (2002), "Entrepreneurship Journal Rankings", in http://www.marketingtechie.com/articles/mtart20020307.pdf, accessed on July 2009.

Table A3: Information on current and previous professional affiliations/ visiting academic institutions of top authors

	Author	Affiliations/ Visiting Academic Institutions [a]	Previous Affiliations/ Visiting Academic Institutions [b]
1	Audretsch, D.	Indiana University, US	Georgia State University, US
		Ewing Marion Kauffman Foundation, US	Middlebury College, US
		Friedrich-Schiller-University Jena, DE	Social Science Centre Berlin, DE
		ZEW, Centre for Economic Research, DE	University of Durham, UK
		CEPR, Centre for Economic Policy Research, UK	Kiel Institute of World Economics, DE
		EIM Consulting for Small and Medium-Sized Business, NL	Tinbergen Institute, NL
2	Acs, Z.	Max Planck Institute of Economics, DE	University of Maryland, US
		University of Baltimore, US	Social Science Centre Berlin, DE
		Ewing Marion Kauffman Foundation, US	University of Illinois Springfield, US
		-	Manhattan College, US
		-	Columbia University, US
		-	Middlebury College, US
		-	Santa Anna School of Advanced International Studies, IT
		-	Université Aix-Marseille II, FR
		-	University of St Andrews, UK
3	Cooper, A.	Harvard University, US	Stanford University, US
		-	University of Pennsylvania, US
		-	University of Manchester, UK
		-	International Institute for Management Development, CH
4	Aldrich, H.	-	Cornell University, US
		-	Stanford University, US
		-	International Institute of Management, DE
		-	University of Oxford, UK
		-	Centre for Environmental Studies, UK
		-	Universita' Commerciale Luigi Bocconi, IT
		-	Wirtschaftsuniversität Wien, AT
		-	BI Norwegian School of Management, NO
		-	Universita' degli Studi di Trento, IT
		-	University of British Columbia, CA
		-	Keio University, JP
		-	Jönköping University, SE
		-	Universitat Autònoma de Barcelona, ES
5	Reynolds, P.	-	Florida International University, US
		-	University of London, UK
		-	Babson College, US
		-	Marquette University, US
		-	University of Minnesota, US
		-	University of Pennsylvania, US
		-	INSEAD, European Institute of Business Administration, FR
6	Gartner, W.	-	University of Southern California, US
		-	San Francisco State University, US
		-	Georgetown University, US
7	Zahra, S.	-	Babson College, US
		-	Georgia State University, US
8	Porter, M.	-	-
9	MacMillan, I.	-	New York University, US
		-	Columbia University, US
10	Storey, D.	University of Reading, UK	-
		University of Manchester, UK	-
		University of Durham, UK	-
11	Schumpeter, J. †	-	-
12	Miller, D.	-	McGill University, CA
		-	Columbia University, US

(…)

	Author	iliations/ Visiting Academic Institutio	Previous Affiliations/ Visiting Academic Institutions [b]
13	Shane, S.	-	Imperial College London, UK
		-	University of Maryland, US
		-	National University of Singapore, SG
		-	Massachusetts Institute of Technology, US
		-	Georgia Institute of Technology, US
14	Evans, D.	University of London, UK	Fordham University, US
		-	Social Science Centre Berlin, DE
		-	New York University, US
15	Bygrave, W.	University of London, UK	University of Nottingham, UK
		-	INSEAD, European Institute of Business Administration, FR
		-	Bryant University, US
		-	Boston University, US
		-	University of Massachusetts Dartmouth, US
16	Birley, S.	-	Imperial College London, UK
17	Covin, J.	-	Georgia Institute of Technology, US
18	Wright, M.	Erasmus University Rotterdam, NL	EMLYON Business School, FR
		INSEAD, European Institute of Business Administration, FR	University of Ghent, BE
		University of Siena, IT	-
19	Brush, C.	Norwegian University of Science and Technology, NO	Boston University, US
		-	Jönköping University, SE
20	Westhead, P.	Bodø University College, NO	
		-	University of Warwick, UK
		-	University of Stirling, UK
		-	University of Nottingham, UK
		-	Imperial College London, UK
21	Hambrick, D.	-	-
22	Williamson, O.	-	Australian National University, AU
		-	Panthéon-Sorbonne University, FR
		-	Northwestern University, US
		-	Saarland University, DE
		-	Indiana University, US
		-	Harvard University, US
		-	University of Kyoto, JP
		-	University of Warwick, UK
23	Vesper, K.	-	Baylor University, US
		-	Babson College, US
		-	University of Calgary, CA
24	Eisenhardt, K.	-	-
25	Hisrich, R.	-	Case Western Reserve University, US
26	Sexton, D.	-	Baylor University, US
27	Van de Ven, A.	-	University of Pennsylvania, US
		-	Kent State University, US
28	Timmons, J. †	-	Northeastern University, US
		-	Boston College, US
		-	Colgate University, US
29	Sapienza, H.	-	University of South Carolina, US

(…)

	Author	Affiliations/ Visiting Academic Institutions [a]	Previous Affiliations/ Visiting Academic Institutions [b]
30	Bates, T.	-	New School, US
		-	University of Vermont, US
		-	University of North Carolina, US
		-	University of California, Berkeley, US
		-	University of California, Los Angeles, US
31	Brockhaus, R.	-	Kansas State University, US
		-	University of Waikato, NZ
		-	Baylor University, US
32	Hitt, M.	-	Arizona State University, US
33	Chrisman, J.	University of Alberta, CA	University of Calgary, CA
		-	Louisiana State University, US
		-	University of South Carolina, US
		-	University of Kentucky, US
34	Dess, G.	-	Chinese University of Hong Kong, CN
		-	BI Norwegian School of Management, NO
		-	Dartmouth College, US
		-	University of Oporto, PT
35	Baumol, W.	Princeton University, US	-
36	Kanter, R.	-	Yale University, US
		-	Brandeis University, US
37	Cohen, W.	-	Carnegie Mellon University, US
		-	Harvard University, US
38	Blanchflower, D.	University of Munich, DE	University of Surrey, UK
		University of Bonn, GE	-
		University of Stirling, UK	-
39	Caves, R.	-	Harvard University, US
40	Geroski, P. †	-	-
41	Jovanovic, B.	-	University of Pennsylvania, US
42	Cressy, R.	-	University of Warwick, UK
		-	University of Hull, UK
43	Scherer, F.	-	Princeton University, US
		-	Swarthmore College, US
		-	Northwestern University, US
		-	International Institute of Management, DE
44	Dunne, T.	-	University of Oklahoma, US
45	Berger, A.	University of Pennsylvania, US	-
		Tilburg University, NL	-
		-	Georgetown University, US
46	Wagner, J.	Max Planck Institute of Economics, DE	-
		IZA Institute for the Study of Labor, DE	-
		ZBW, German National Library of Economics, DE	-
47	Davis, S.	-	Massachusetts Institute of Technology, US
		-	University of Maryland, US

Source: Authors' personal web pages and universities web pages.

Note: Due to the absence of information, we have not identified the current visiting institutions or last affiliation of 6 authors.

[a] Validity guaranteed until August 2009.

[b] Last affiliation(s) post-doctoral program.