

The relationship between collaboration, productivity and publications: an empirical analysis in field of family business

Collaboration
in the field of
family
business

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Abstract

Purpose – It is widely accepted that coauthorship and collaboration promotes intellectual partnerships and improves the quality of publications. This paper examines the relationship between collaboration, productivity and publications in the field of family business.

Design/methodology/approach – The authors identify the most prolific authors, affiliations and countries and focus on the evolution of research in the field of family business. In doing so, the authors employ social network analysis to discover the structure of the networks and the ways in which authors, institutions and countries interact.

Findings – The empirical results show that collaboration is positively related to productivity, and there is significant evidence that the shaped networks exhibit small-world characteristics, a condition in which collaboration within authors becomes integrated in conjunction with time.

Practical implications – The findings highlight the mechanics of collaborative research production and can be useful to understand the importance of collaboration patterns to be followed in the field of family business.

Originality/value – The contributions are as follows: (a) application of social network analysis to model the coauthorship patterns among individuals, institutions and countries in family business; (b) distinguishing the most degree-central authors in the social network of collaborating academics; (c) investigation of the academic collaborations in family business that have the characteristics of a small-world social network and (d) suggesting a unique connection, through published keywords, between the research priorities of the most central or prolific authors with the research trends in the family business literature. The authors demonstrate that authors' collaboration becomes integrated in conjunction with time.

Keywords Family business, Collaboration, Productivity, Coauthorship, Social network analysis

Paper type Research paper

1. Introduction

Research in the field of family business began to form a separate academic area in the 1980s. Later, in the 1990s, it attracted more researchers who explored a wide range of research dimensions (Zahra and Sharma, 2004). In the following decades, research in this field showed a growth trend (Debicki *et al.*, 2009).

Many researchers tried to perform content analysis in family business research, through bibliometric reviews, forming conceptual research frameworks (Dyer and Sánchez, 1998; Sharma, 2004). In a more general framework, they highlighted the dimensions of succession,



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family role and family member relationships, gender effect, nonfamily members' role and professionalization, management and governance processes, as well as the environmental effect. Other scholars developed more focused research frameworks, investigating the concept of entrepreneurship (Randerson *et al.*, 2015) and innovation (Feranita *et al.*, 2017) in family business, the participation of women in family business (Campopiano *et al.*, 2014), the family governance mechanisms (Suess, 2014), the strategic thinking (Astrachan, 2010) and the concepts of branding (Astrachan *et al.*, 2018) and socioemotional wealth (Dawson and Mussolino, 2014) in family firms and many others.

A third group of researchers tried to identify research trends in the field of family firm by studying the authors' relationships and the papers' citations. Casillas and Acedo (2007) used the author co-citation analysis (ACA) and highlighted succession, strategic management, conflict management, innovation and internationalization as the most important challenges for family businesses. Debicki *et al.* (2009) conducted a network analysis of the authors' relationships, identifying six main research categories and 21 subcategories in the research field and Chrisman *et al.* (2010) developed three general thematic dimensions in the field through the study of the 25 most cited articles in family business literature. Zamudio *et al.* (2014) highlighted the need for network-related research in family business. Finally, Rovelli *et al.* (2021) presented a comprehensive bibliometric overview of the last 30 years of research in family business investigating three journals dealing with family business, while Aparicio *et al.* (2021) also implemented a bibliometric review based on family firm research articles published the last decade.

The evolution of academic research is supported by collaboration among authors. Collaboration contributes to the production of quality papers by the scientific community. According to Hagstrom (1965), collaboration constitutes a substantial principle of academic social activity, and Jones and Roberts (2005) underline that a considerable portion of papers that are published in leading academic journals are written by more than one author. While collaboration bears the risk of creative compromise, collaborative work helps increase output by sharing creative tasks. Collaboration helps to improve the quality by bringing together expertise from diverse and remote topical areas. Additionally, collaboration is important in diffusing the risk of rejection by submitting an increasing number of produced papers to different journals (Andrikopoulos *et al.*, 2016).

Coauthorship helps researchers overcome the insufficient knowledge resources they may face when publishing a paper. Coauthorship is an ongoing process that can be described as divided segments that motivate people to share knowledge, skills and information. It can be assumed that social networks strengthen the groups of people involved in the process of publishing a paper (Samitas and Kampouris, 2018). Chen *et al.* (2013) explain that coauthorship in academic networks can promote innovation in the transition from knowledge transfer to innovative partnerships between institutions. Furthermore, coauthorship helps strong personalities come together, and it is reasonable to suppose that coauthorship increases the quality and quantity of published papers.

From the bibliometric perspective, quantifying coauthorship is a challenging task, often approached using network analysis, which is a powerful method to evaluate the topological structure of a network. Groups of tightly interconnected nodes can explain why information spreads so rapidly among well-organized institutions. This methodology goes beyond a simple analysis of coauthorship since it reveals the existence of collaboration in groups of actors (e.g. authors, institutions or countries). This methodology provides significant evidence regarding how information passes within a network. Social network analysis is attracting extensive interest since it demonstrates how resources spread throughout academics and provides profitable information to quantify coauthorship.

The purpose of this study is to explore the patterns of collaboration among individuals, institutions and countries and to analyze the social structure of collaborative work in family

business research. We investigate the variation of intellectual partnerships in family business across scientists, countries, academic institutions and time and perform network analysis to measure the connectivity of authors when they exchange information over large, interconnected networks. We use an extended sample of 1,176 articles published from 1989 to 2020 in family business [1]. Our evidence suggests that the network of intellectual collaboration in family business research exhibits small-world properties, with a group of connected nodes covering the largest part of the network and a plethora of clusters. We focus on family business because it is a field that is underrepresented in the relevant research, despite the fact that family firms represent the largest percentage of all enterprises and institutions worldwide. Analysis of collaboration networks can shed light on some aspects of the structure of family business academia since the social networks among coauthors in this scientific space have yet to be investigated.

Our work makes the following contributions to the extant literature. First, we demonstrate how social network analysis can be applied to model the coauthorship patterns among individuals, institutions and countries in family business. Second, we distinguish the most degree-central authors in the social network of collaborating academics. Third, we investigate academic collaborations in family business that have the characteristics of a small-world social network. Fourth, we suggest a unique connection, through published keywords, between the research priorities of the most central or prolific authors with the research trends in the family business literature. We show that authors' collaboration becomes integrated in conjunction with time. Specifically, we find highly clustered collaboration patterns and show that there exists one component of significant size that covers the largest part of the social network of authors, institutions and countries. We also find only a small average distance among collaborating authors, institutions and countries within the giant component of the social network. All these findings in the field of family business are relatively scarce in the literature.

The rest of the paper is organized as follows. The next section reviews previous research, while the third section outlines the modeling strategy for publishing patterns. In the fourth section, we discuss our sample and methodology. The fifth section assesses and demonstrates the results of the social network analysis, and the final section concludes the paper.

2. Literature review

Bibliometric reviews have been gaining popularity in the recent literature and in many research fields (Andrikopoulos *et al.*, 2016; Samitas and Kampouris, 2018; Ji *et al.*, 2021; Molontay and Nagy, 2021). In terms of family business, relevant studies are only recently starting to emerge, with Aparicio *et al.* (2021) and Rovelli *et al.* (2021) offering a bibliometric perspective and also discussing the most common topics and themes, thus suggesting possible paths for future research. On a similar note, Ratten *et al.* (2020) suggest researchers should pursue collaborations with family business managers in order to produce more impactful research output. Ferreira *et al.* (2021) suggest focusing on sustainability in family business, while Hart (2007) demonstrates that impact (as measured through citations) can be increased through collaborations, where researchers have yet to formulate a quantitative theory to account for the effectiveness of collaborations, as a result of the limited extant literature towards this end. On the other hand, Medoff (2003) disagrees with this finding and suggest that coauthorship does not necessarily lead to more impactful research. Measuring the extent of coauthorship requires the collection and analysis of data from published journal articles in order to evaluate the contributions of research teams and the institutions they are affiliated with (Casillas and Adeco, 2007; Chrisman *et al.*, 2005).

In terms of the literature on the field of family business, Dyer and Sanchez (1998) recognized that *Family Business Review (FBR)* is one of the journals with a significant

contribution to the development of the field and is the best source available from which to review the evolution of the theory and practice in the field. In its first decade (1988–1997), the journal published papers investigating the current state of family business in theory and practice, as reflected by a total of 186 articles. [Dyer and Sanchez \(1998\)](#) and [Ratten et al. \(2020\)](#) suggested that more collaboration between academics and practitioners, along with more case studies and cross-cultural work, could prove useful to both developing increasingly better theories and to enhancing practice. Since *FBR* was the only major scholarly publication devoted to family business, they performed a frequency count of multiple-author articles and found that half of the articles were coauthored. Of the 93 coauthored articles, 16 (17.2%) were by interdisciplinary authors, 19 (20.4%) were by authors in different professions, while 58 (62.4%) were by authors within the same profession and discipline. To the best of our knowledge, from 1998 until today, their work on collaboration/coauthorship in the family business field has not been extended or reviewed.

[Matherne et al. \(2009\)](#) analyzed 291 family business articles published in 30 management journals from 2001 to 2007 and reported the contributions of individual scholars and academic institutions to family business research. The authors found that even though the family business research community is growing, it remains small and closely knit, a finding shared by [Cisneros et al. \(2018\)](#). They also indicated that the field exhibits a relatively high degree of connectivity among scholars and suggest that knowledge generation and diffusion are likely to be purposeful and rapid in the years to come.

[Matherne et al. \(2013\)](#) conducted a second study in which they reviewed articles published in 30 management journals from 2001 to 2009. The authors identified 394 family business articles after applying a wide definition of family firms, so as to include more works in their database. Analyzing the network relationships among the authors provided a more nuanced understanding of why certain scholars and institutions have been more productive than others in the field of family business. Their study identified the scholars whose work has made the largest contribution to the recent development of the literature, which is based on their number of contributions, adjusted by the quality of the outlets in which they have published and the number of coauthors with whom they have worked. Moreover, they provided a listing of the academic institutions that have been the most active in contributing to family business research. They also conducted a network analysis to gain a better understanding of the extent to which family firm scholars are collaborating, the relationships among the individual scholars and how the nomological net of family firm research has developed.

Focusing on the structure of collaboration, [Cisneros et al. \(2018\)](#) showed that leading researchers in the field remain interconnected, with the networks among them remaining strong. A similar finding is reported by [Andrikopoulos et al. \(2016\)](#), who examined publication and coauthorship patterns in the *Journal of Econometrics*, focusing on the collaboration networks and the internationalization of the econometrics research. They reported the most prolific authors, institutions and countries and found that the share of collaborative articles has increased over time and that most contributions come from affiliations that are based in the USA. They also applied social network analysis and discovered the most central authors, institutions and countries in the *Journal of Econometrics*. [Samitas and Kampouris \(2018\)](#) examined the publication data of the papers published in eight elite journals related to mathematical finance from 1999 to 2016. They found that the large component (the network's largest component) captured 43.75% of the author network. Their study showed that simply measuring the structure of collaboration in a network is not the main target but indicates the mechanisms responsible for the fine structure. Identifying the coauthorship structure may provide a better understanding of how and why authors collaborate by revealing more about the coauthors beyond a simple connectivity structure. [Andrikopoulos and Trichas \(2018\)](#) also studied the publication patterns in the *Journal of Corporate Finance* from 1994 to 2017. They discussed the number and size of the published

papers and collaborative research in terms of coauthorship, editorial board characteristics and citations as approximations of the scientific impact. They identified the most prolific authors and institutions and analyzed how published research has exhibited an increasing number of authors per paper (2.38 on average), and how the percentage of USA-based affiliations is gradually decreasing.

In the field of accounting, the most characteristic part of the literature can be classified in three major strands: surveys of perceived journal quality, citation analysis and analysis of publishing patterns. The latter strand demonstrates the cross-sectional and time series variations of publishing authors, their areas of expertise, their affiliations, the institutions that granted them their PhDs, their number of coauthors and the nationalities of their datasets. [Andrikopoulos and Kostaris \(2017\)](#) employed social network analysis to explore the relational structure of the coauthorship in five accounting journals. They discovered that the network of accounting academic authors exhibits “small-world” properties. These results have implications for the quality of the production and dissemination of novel ideas. Within the small world of scholars, the dissemination of new ideas may be fast across the network; however, a closely connected network may be less open to the influx of heterodoxical or radical ideas. Analysis of collaboration networks is necessary to explore the centrality of the authors and institutions in the production or output of research, the magnitude and the importance of cohesive groups of authors, and the evolution of the authorship community over time.

Based on the aforementioned analysis, investigating collaboration in family business may provide an opportunity to highlight the significance of historical trends and may act as a guide to potential authors that could help them shape their future efforts and reveal new opportunities and directions for the journal that have hitherto been unexplored. Therefore, our empirical analysis can yield fruitful outcomes. We provide a summary of our review of the literature in [Table 1](#). Most of the extant literature research seems to focus on coauthorship patterns, with many researchers focusing on the geographic or the institutional concentration of authors. In addition, recent work tends to identify topics and trends in the literature in order to suggest possible new pathways for new research.

Themes	Examples
Coauthorship metrics and networks	De Castro et al. (2021) , Niebla-Zatarain et al. (2020) , Cisneros et al. (2018) , Andrikopoulos and Trichas (2018) , Samitas and Kampouris (2018) , Andrikopoulos and Kostaris (2017) , Andrikopoulos et al. (2016) , López-Fernández et al. (2016) , Chen et al. (2013) , Matherne et al. (2013) , Matherne et al. (2009) , Casillas and Adeco (2007) , Hart (2007) , Chrisman et al. (2005) , Jones and Roberts (2005) , Medoff (2003) , Dyer and Sanchez (1998)
Topics and themes	Aparicio et al. (2021) , Dana et al. (2021) , Ferreira et al. (2021) , Galvagno and Pisano (2021) , Nguyen et al. (2021) , Rovelli et al. (2021) , Niebla-Zatarain et al. (2020) , Ratten et al. (2020) , Caputo et al. (2018) , Cisneros et al. (2018) , Andrikopoulos and Kostaris (2017) , Benavides-Velasco et al. (2013)
Institutional productivity	Niebla-Zatarain et al. (2020) , Andrikopoulos and Trichas (2018) , Andrikopoulos et al. (2016) , Chen et al. (2013) , Matherne et al. (2013) , Casillas and Adeco (2007) , Chrisman et al. (2005)
Geographic productivity	Niebla-Zatarain et al. (2020) , Ratten et al. (2020) , Cisneros et al. (2018) , Samitas and Kampouris (2018) , Andrikopoulos et al. (2016) , Tang (2011)
Interdisciplinarity in research output	Ratten et al. (2020) , Morillo et al. (2001) , Dyer and Sanchez (1998)

Table 1.
Overview of literature
reviews in the field of
family business

3. Methodology

To measure the collaboration dynamics in a specific field of the literature, authors used different types of approaches. Most common methodology is the bibliometric analysis. Bibliometric analysis uses data and information related to libraries that studies bibliographical data (e.g. authors, affiliations, country and the year of publication) by using a quantitative approach as mentioned by [Broadus \(1987\)](#) and [Pritchard \(1969\)](#). We have seen this method in many different areas, from management to economics, finance, sociology, biology, etc. ([Podsakoff et al., 2008](#); [Bonilla et al., 2015](#); [Fagerberg et al., 2012](#); [Ferreira et al., 2019](#); [Samitas and Kampouris et al., 2018](#); [Moody, 2004](#); [Newman, 2004](#)).

Within the same framework, other studies did significant work on bibliometric analysis and provided deep and comprehensive analysis on family business ([Casillas and Acedo, 2007](#); [Debicki et al., 2009](#); [Aparicio et al., 2021](#); [Rovelli et al., 2021](#)). However, none of these papers highlighted the presence of small-world characteristics or the dynamics of fundamental measures of social network analysis, which is the types of centralities, clustering coefficient, average shortest path and diameter of the network. Small-world properties can give more detailed analysis about the dynamics and the structure of the networks than the simple bibliometric analysis, as we can extract elements that give us information related to how integrated is the network, if there is a tendency for increasing collaboration within authors (given that the giant component gets bigger in conjunction with time), or to highlight the mechanics of collaborative research production. This information can be proved quite important for the administration of academic institutions and policymaking in higher education.

This paper uses social network analysis for the purpose of investigating authors collaborating in terms of paper publishing and its extent. This analysis helps to study coauthorship within the domain of academia. Our focus is not exclusively geared towards the fundamental elements of such an analysis; however, this study emphasizes the features that were deemed appropriate for the research at hand ([Samitas and Kampouris, 2018](#)).

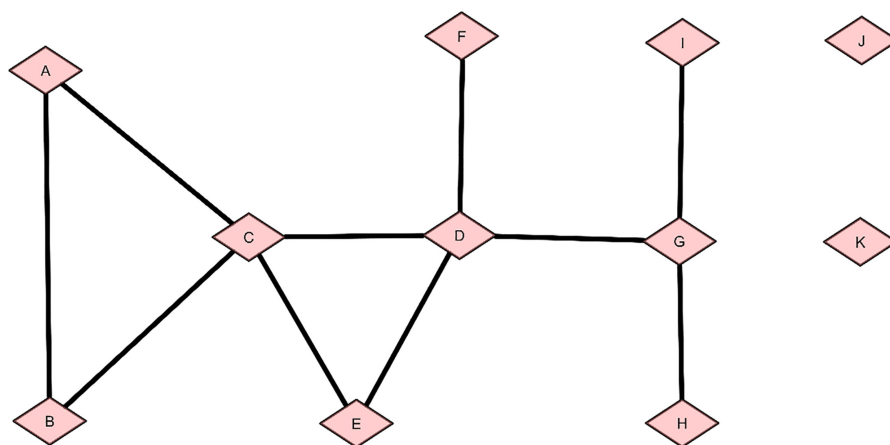
A social network is built on the basis of nodes, which within the current context are countries, institutions and authors. When two nodes link, a line forms between the two points; this line is known as an “edge.” Nodes use edges to link to one another. An example of this is a situation in which a paper is published by one author (or country or institution) through collaboration with another. The coming together of two entities is what forms the edge. A path is born from an interconnected set of nodes; the path can be long or short, depending on the requirements at hand. The lengthiest path in a component of such a network has been termed the “diameter”. [Figure 1](#) demonstrates the distance between A and G, which may be three, four or more depending on the path taken. In addition, the network diameter is three.

A “degree” is the nodes’ neighbors that are found within the network under discussion. As shown in [Figure 1](#), the nodes I, D and H are only linked to node G. However, as can be observed, C is linked to several more nodes. ABCDEFGHI can be seen as a single component within the network. Both J and K can be seen as sharing a link with no nodes; therefore, they act independently within this framework. A node such as these two is known as an “isolated” node. Our research holds that authors who publish papers on their own without any collaborations are “isolated” nodes ([Andrikopoulos et al., 2016](#)).

Another tool of network analysis is the clustering coefficient. This is the ratio P/Q , where P denotes the number of edges shared by a node neighbor set, and the maximum edge number is denoted as Q , which shows the most edges that could exist among the neighbors of n .

Definition 3.1. The clustering coefficient C_n of a node n is defined as follows:

$$C_n = \frac{2r_n}{k_n(k_n - 1)} \quad (3.1)$$



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Figure 1.
Social network
example

where k_n is the number of neighbors of n , and r_n is the number of connected pairs between all neighbors of n . The clustering coefficient measures the ratio of a node's neighbors' connections to other nodes. The clustering coefficient is a number from 0 to 1 and can only be measured when at least two neighbors appear. As indicated in Figure 1, the clustering coefficient of C is 33.33% because there are only two connections (AB and DE) out of six possible connections (AB, AE, AD, BE, BD and DE). Therefore, F, G, H, I, J and K have clustering coefficients equal to 0. More details about the technical part and the calculations about the social network fundamentals can be found on Wasserman and Faust (1994).

A network can be populated fairly densely, which highlights the fact that nodes present a higher average in regard to the neighbor population. "Density" can be used to measure this aspect.

Definition 3.2. The density of a network is calculated as follows:

$$D = \frac{L}{g(g-1)/2} = \frac{2L}{g(g-1)} \quad (3.2)$$

where L is the number of lines, and g is the number of connected nodes. Density is a value from 0 to 1 and indicates the density of the component's population. Network density is essentially the ratio of the edges over all possible edges that are present within the graph. Nodes that are "isolated" have no density or zero density. The biggest element in this network is known as the "giant" component. This component will eat the ends and grow larger if the nodes persist in their interaction with one another. Further implementation of the social network analysis can be studied through Wasserman and Faust (1994).

Centrality measures were also added. Landherr *et al.* (2010) found that a large issue or challenge is the networks' own key nodes. Centrality measures the impact and significance that they hold in a network. By distinguishing key nodes, we underline the "who is who" of the network better, which helps develop a more appropriate understanding of the network structure and provides a comprehensive evaluation of the elite nodes in place (Goyal *et al.*, 2006).

Betweenness centrality looks at the frequency with which a node has acted as a link or bridge for two other nodes that are using it as a path to pass through.

Definition 3.3. The betweenness centrality index can be represented as follows:

$$C_B(n_i) = \sum_{f < d} \frac{g_{fd}(n_i)}{g_{fd}} \quad (3.3a)$$

here g_{fd} is the total number of shortest paths from f to node d , and $g_{fd}(n_i)$ is the number of those paths that pass through n_i . The standardized version is calculated as follows:

$$C'_B(n_i) = \frac{C_B(n_i)}{[(g-1)(g-2)/2]} \quad (3.3b)$$

The betweenness centrality measure for a node represents the limit to which it can become the connector between others that are not directly linked. In this case, the betweenness centrality measure would have to mean that the author that is connected to two others; if the author has collaborated with both, but the other two are not and have not worked with each other, betweenness can help shed light on the interpersonal influence (Freeman, 1979). A central node is basically a node that connects two or more nodes that are not yet linked with each other and do not interact but are connected anyway because of the central node that stands between them.

Centrality is measured to shed light on the significance and impact of a social network (Wasserman and Faust, 1994). Degree centrality represents the number of nodes that are linked to a single node. In this context, this number is the number of authors, institutions or nations that are collaborating on research.

Definition 3.4. The degree centrality of a network is as follows:

$$C_D = \frac{\sum_{i=1}^g [C_d(n^*) - C_d(n_i)]}{[(g-1)(g-2)]} \quad (3.4)$$

$C_d(n_i)$ in the numerator is the g node degree indices, while $C_d(n^*)$ is the largest observed value. Degree measures a node's centrality in the network, and degree centrality can act as the nodes' prestige and impact proxy in terms of the network (Andrikopoulos and Economou, 2015).

Eigenvector centrality shows the connectedness of the node's links. More specifically, eigenvector centrality represents the impact that the node has on others in the same setup. In other words, eigenvector centrality measures a node's influence over other nodes within the network.

Definition 3.5. For a given network, if vertex i is linked to vertex j , and R_{ij} is the adjacency matrix, the eigenvector centrality is calculated by the eigenvector equation $\lambda e = Re$ and is expressed as follows:

$$e_i = \frac{\sum_j R_{ij} e_j}{\lambda} \quad (3.5)$$

where e is the eigenvector of R_{ij} , and λ is the associated eigenvalue. The eigenvalue is a constant need and helps ensure that there are nonzero outcomes within the equations. Different eigenvalues exist; therefore, they necessitate an eigenvector solution. On the other hand, it is solely the highest eigenvalue outcome that is the preferred centrality measure. It is within reason to assume that the largest λ is the required measure to gauge eigenvector centrality (Bonacich, 1987). Nodes with high values are ones that are linked with several others, and those are, in turn, linked to many others as well.

Finally, closeness centrality has to do with the smallest paths and is explained as a range of interactions in regard to linked nodes.

Definition 3.6. The closeness centrality C_c of a node n is defined as follows:

$$C_c = \left[\frac{\sum_{j=1}^N d(n_i n_j)}{N - 1} \right]^{-1} \quad (3.6)$$

where $d(n_i n_j)$ is the length of the shortest path between two nodes n_i and n_j . This represents the distance that a node has in terms of incoming arcs and outgoing arcs. $\bar{d}(n_i n_j)$ is the total inversed distance in the context of the other nodes that are present. Ductor *et al.* (2014) found that an author's position in the network extends the obvious explanatory power of their recent performance in terms of their future productivity. An author's future performance is strongly linked to their closeness centrality and their coauthors' productivity as well as that of their coauthors' coauthors. Closeness centrality is a number from 0 to 1. The higher a node's closeness centrality is, the lower its distance from all other connected nodes.

We also examined whether social networks have characteristics of small-world properties. An example of this theory was developed by Goyal *et al.* (2006) for author networks. In their study, data were collected from published papers in EcoLit over a 30-year period. A network can exhibit small-world properties if it satisfies the following conditions:

- (1) The number of nodes is very large compared to the average number of links;
- (2) The network is highly integrated, focusing on a giant component that is very large compared to the whole network;
- (3) The clustering coefficient is rather high and
- (4) There is a small average distance between the nodes in the giant component.

The components can be ordered by size. The network has a giant component if the largest component fills a relatively large part of the graph, and all the other components are small. Goyal *et al.* (2006) suggest that most connected nodes in a giant component are similar to stars. Deleting 5% of the star nodes will completely fragment the network. Thus, giant components are spanned by a set of interlinked stars, which is the main explanation for the small average distances. The average distances remain small regardless of whether the giant component continues to occupy a larger proportion in the network over time.

The approach that we used in this study aims to improve the current literature by adding networks of institutions and countries. Moreover, the data used in this paper are more recent (1989–2020), in contrast to previous small-world property studies. If a network has small-world characteristics, it essentially means that the network is integrated to a great extent. A small-world property might be a good thing in the sense of producing evidence for increased communication in the production of new knowledge. This theory may become essential to increase coauthorship in the area of family business studied in this paper.

4. Dataset and preliminary analysis

The dataset consists of 1,176 papers published in *FBR*, *Journal of Family Business Strategy* and *Journal of Family Business Management* from 1989 to 2020. To obtain pure collaborations between authors, we included only original papers, excluding book reviews or editorials. We restricted our attention to these journals because they are specialized in family business research and cover the largest proportion of academic research in the studied area.

Additionally, they are highly ranked journals in the *ABS*, *ABDC* and *SCIMAGO* lists in the field of family business. Moreover, we incorporated the articles in accordance with the year of publication since *Journal of Family Business Strategy* and *Journal of Family Business Management* are younger than *FBR* [2]. It should be noted that we faced some difficulties in collecting and assembling data because these processes required meticulous work [3].

Tables 2–4 display the 30 most central authors, institutions and countries in terms of betweenness centrality, closeness centrality, eigenvector centrality and degree centrality, respectively. As seen in these tables, the centralities share common nodes (authors, institutions and countries) in every category. It is apparent that specific nodes (key nodes) have significant influences in the network. For the analysis, we used Cytoscape [4].

Centrality	Closeness	Degree	Betweenness	Eigenvector
1	Thomas M. Zellweger	Franz W. Kellermanns	Clay Dibrell	Franz W. Kellermanns
2	Joseph H. Astrachan	Joseph H. Astrachan	Justin Craig	James J. Chrisman
3	Franz W. Kellermanns	James J. Chrisman	Joseph H. Astrachan	Daniel T. Holt
4	Laura Stanley	Mattias Nordqvist	Franz W. Kellermanns	Kristen Madison
5	Francesco Chirico	Daniel T. Holt	Thomas M. Zellweger	Alfredo De Massis
6	James J. Chrisman	Peter Jaskiewicz	Francesco Chirico	Francesco Chirico
7	Daniel T. Holt	David Pistrui	Carlo Salvato	Lucia Naldi
8	Robert S. Nason	Francesco Chirico	Ivan Lansberg	Esra Memili
9	Lucia Naldi	Kosmas X. Smyrniotis	Daniel T. Holt	Erick P. C. Chang
10	Giovanna Campopiano	Alfredo De Massis	Peter Jaskiewicz	Jess H. Chua
11	Kristen Madison	John A. Davis	James J. Chrisman	Josip Kotlar
12	Tim Barnett	Lucia Naldi	Kosmas X. Smyrniotis	Tim Barnett
13	Ivan Lansberg	Tim Barnett	David Pistrui	Giovanna Campopiano
14	Peter Jaskiewicz	Matthew W. Rutherford	John A. Davis	Kartono Liano
15	Esra Memili	Justin B. Craig	Matthew W. Rutherford	Curtis F. Matherne, III
16	Erick P. C. Chang	Kristen Madison	Justin B. Craig	Bart J. Debicki
17	David Pistrui	Carlo Salvato	Mattias Nordqvist	Kam C. Chan
18	Annette L. Ranft	Jess H. Chua	Pietro Mazzola	Annette L. Ranft
19	Kosmas X. Smyrniotis	Ivan Lansberg	Robert S. Nason	Timothy P. Munyon
20	Kartono Liano	Pietro Mazzola	Tim Barnett	Federico Frattini
21	Curtis F. Matherne, III	Clay Dibrell	Pramodita Sharma	Rebecca G. Long
22	Bart J. Debicki	Harold Welsch	Alfredo De Massis	Joshua J. Daspit
23	Kam C. Chan	A. Frank Adams, III	Guido Corbetta	William Tabor
24	Harold Welsch	Josip Kotlar	Daniel L. McConaughy	James M. Vardaman
25	Pietro Mazzola	Allison W. Pearson	Allison W. Pearson	Laura Stanley
26	Barbara Bird	Danny Miller	Ken Moores	Allison Pearson
27	Sabine B. Klein	Trish Reay	Lucia Naldi	Kimberly A. Eddleston
28	A. Frank Adams, III	Harold P. Welsch	Danny Miller	M. Lane Morris
29	Sabine B. Rau	Ken Moores	Timothy G. Habbershon	David S. Jiang
30	Allison Pearson	Thomas M. Zellweger	Harold Welsch	Christian Koropp

Table 2.
Thirty most central
authors

Centrality	Closeness	Degree	Betweenness	Eigenvector
1	Kennesaw State University	Mississippi State University	Kennesaw State University	Mississippi State University
2	Mississippi State University	Kennesaw State University	Mississippi State University	The University of North Carolina
3	Monash University	The University of North Carolina	California State University	Jönköping University
4	Bocconi University	Jönköping University	Jönköping University	Lancaster University
5	Jönköping University	The University of Alberta	The University of Alberta	The University of Calgary
6	Northeastern University	Montana State University	Bocconi University	The University of Bergamo
7	The University of North Carolina	The University of Minnesota	Texas Tech University	The University of St. Gallen
8	California State University	Northeastern University	Northeastern University	Witten/Herdecke University
9	RMIT University	University of Calgary	Monash University	The University of Tennessee
10	The University of Calgary	Lancaster University	The University of Calgary	Politecnico di Milano
11	DePaul University	Babson College	The University of Manitoba	Northeastern University
12	Lancaster University	The University of St. Gallen	The University of St. Thomas	Oklahoma State University
13	Florida Atlantic University	Bocconi University	Dalhousie University	Wilfrid Laurier University
14	The University of Alberta	DePaul University	The University of North Carolina	The University of Manitoba
15	Babson College	The University of Bergamo	Syracuse University	Northwestern University
16	Dalhousie University	Loyola University	DePaul University	Florida Atlantic University
17	The University of Texas	Iowa State University	Loyola University	Saint Louis University
18	Trier University	The University of St. Thomas	Babson College	RMIT University
19	Oklahoma State University	Yale University	Lancaster University	Babson College
20	The University of Lugano	Texas Tech University	Purdue University	Ball State University
21	Wilfrid Laurier University	Northwestern University	Texas A&M University	The University of Nebraska–Lincoln
22	Witten/Herdecke University	Monash University	Montana State University	Valdosta State University
23	University of St. Gallen	California State University	Michigan University	University of Bern
24	University of Bergamo	RMIT University	Cornell University	Villanova University
25	University of Manitoba	Witten/Herdecke University	Loyola University	The University of Bozen-Bolzano
26	American University	The University of Manitoba	Iowa State University	East Carolina University
27	Yale University	Loyola University	Oklahoma State University	Georgia Southern University
28	Loyola University	North Dakota State University	The University of Illinois	Bocconi University
29	Loyola University	The University of Bern	Florida Atlantic University	The University of Minnesota
30	Texas Tech University	Montreal University	North Dakota State University	Western Kentucky University

Table 3.
Thirty most central
institutions

Table 4.
Thirty most central
countries

Centrality	Closeness	Degree	Betweenness	Eigenvector
1	The USA	The USA	The USA	The USA
2	Italy	Italy	Italy	Italy
3	The UK	Germany	Spain	Canada
4	Canada	Canada	Canada	Sweden
5	Germany	The UK	The UK	Germany
6	Sweden	Sweden	France	The UK
7	Spain	Spain	Chile	Switzerland
8	Switzerland	Switzerland	Belgium	Australia
9	Australia	Australia	Ireland	Spain
10	Belgium	France	Germany	Belgium
11	France	Chile	Australia	Chile
12	Chile	Denmark	The Netherlands	Denmark
13	China	Belgium	Sweden	China
14	Israel	China	Denmark	Finland
15	Poland	Israel	China	The Netherlands
16	Finland	The Netherlands	Israel	Poland
17	Taiwan	Poland	Poland	France
18	Luxembourg	Finland	Finland	Israel
19	Greece	Taiwan	Taiwan	Taiwan
20	New Zealand	Ireland	Colombia	Luxembourg
21	Hungary	Colombia	Luxembourg	Greece
22	Korea	Luxembourg	Greece	New Zealand
23	Netherlands	Greece	New Zealand	Hungary
24	Ireland	New Zealand	Hungary	Korea
25	Denmark	Hungary	Korea	India
26	Argentina	Korea	Argentina	Ireland
27	India	Argentina	India	Argentina
28	Brazil	India	Brazil	Brazil
29	Uruguay	Brazil	Uruguay	Uruguay
30	Austria	Uruguay	Austria	Austria

The coauthorship network of authors is illustrated in [Figure 2](#). Likewise, [Figures 3 and 4](#) display the coauthorship networks of institutions and countries.

According to [Table 5](#), our research comprises 1,176 papers, of which 71.51 % had more than one author. Specifically, 33.59% of the papers had two authors. Column 1 of [Table 6](#) summarizes the average number of pages per paper. As seen, the quantity increased over the years (per period), and the overall average was 14.48 pages. We observe from [Figure 5](#) that the number of published output papers displays a remarkable decrease of 38.09% from the first to the seventh period. It is evident from the results that the average number of pages increased over time while the production of papers decreased. These findings may be an indication that fewer, but higher quality articles are produced now. Moreover, we found 944 authors that collaborated, creating 498 affiliations in 39 countries. On the contrary, [Andrikopoulos et al. \(2016\)](#) studied all the articles from the first four decades of *Journal of Econometrics* and found that over time, the number of published papers has increased.

The evidence shown in [Figure 6](#) indicates that collaborative authorship has increased over time. We observe that the number of single-author papers decreased by a substantial 96.47% and that the number of papers published by two authors decreased by 29.27%. There was a significant increase in the number of papers published by three and four authors of 583% for three and 850% for four. In the same framework, the data presented in Column 2 of [Table 6](#) show a remarkable increase of 155% in the number of published papers by more than one author from the first to the seventh period. Furthermore, as detailed in Column 3, the average

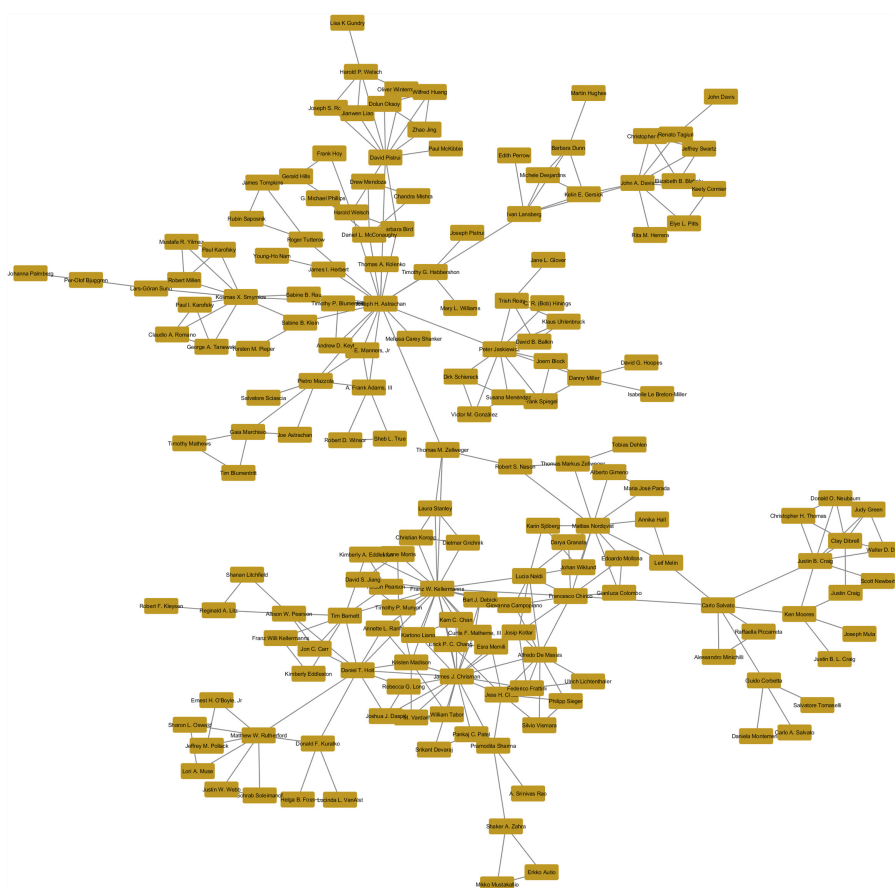


Figure 2.
Network of authors
in the field of family
business

number of authors per paper increased over time from 1.44 in 1989–1993 to 2.97 (106%) in the seventh period.

As indicated in Column 4 of Table 6, the average percentage of affiliations of only “academic institutions” has increased over time from 56.72 to 98.84%. However, the average percentage of “non-academic authors” has decreased (from 43.28% to 1.16%), as shown in Column 5. Comparing Columns 4 and 5, there is a tendency for more academic involvement in scientific publications. Regarding the origin of papers, the data in Column 6 show a considerable increase, from 12.69 to 69.11%, in the average percentage of papers published by institutions not based in the USA. Although US-based institutions dominate the production of knowledge, it is likely that for the sake of quality science, authors seek coauthorship from non-US based institutions. This fact may stem from the increasing integration of academic networks.

Column 7 of Table 6 illustrates the average percentage of papers in which all the authors originated from the same institution. The findings reveal a significant decrease of 68.21% in this quantity. It may be assumed that there is a tendency for institutional diversification since the authors seem to collaborate at a more integrated level and seek quality coauthorship outside their affiliations. Regarding author gender, as shown in Columns 8 and 9 of Table 6,

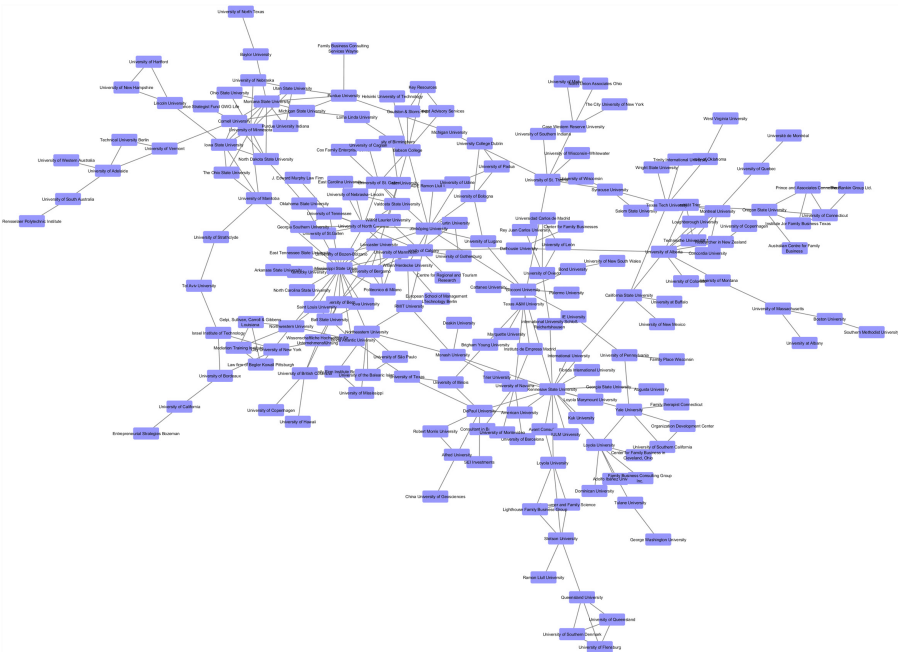


Figure 3.
Network of institutions

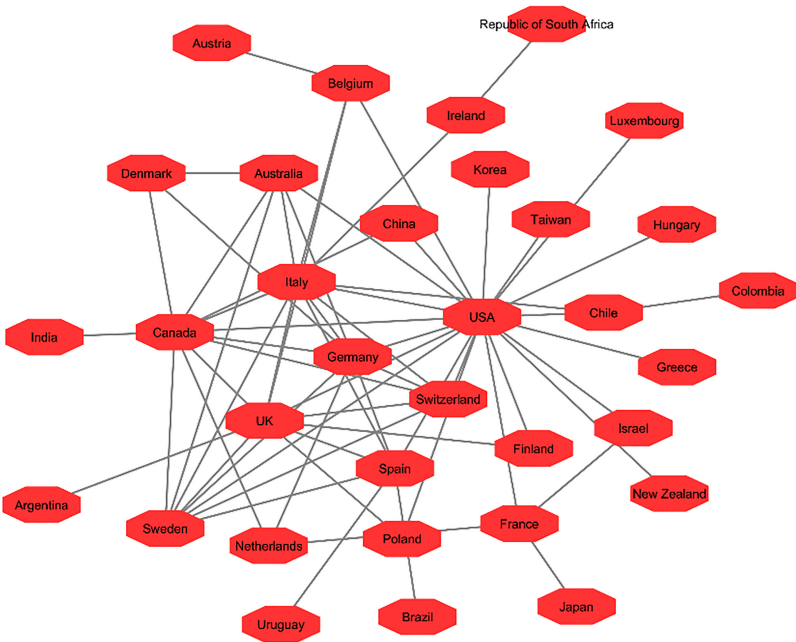


Figure 4.
Network of countries

male authors dominate in the journal, but there is an increasing involvement of women, increasing from 33.16% in the first period to 38.11% in the seventh. [Bear and Woolley \(2011\)](#) claimed that gender diversity can enhance coauthorship. Their evidence shows that gender diversity can promote coauthorship as collaboration becomes a force in the production of science. The enhancements of coauthorship and higher levels of collective intelligence can lead to more integrated scientific discovery and later to innovation. This finding argues that gender-balanced collaboration can lead to better outcomes for productive science because men and women have equal influence.

[Table 7](#) summarizes the 30 most productive authors, institutions and countries. As discussed previously in Column 6 of [Table 6](#), there is a significant dominance of US-based institutions in the research industry. Furthermore, US-based institutions are the most prolific in this journal. However, the field of family business seems to have a tendency for internationalization. It is obvious that the involvement of foreign institutions increases over time, whereas the ratio of US-based institutions is reduced. According to [Tables 2–4 and 7](#) (the first three represent the centralities and the last the productivity rankings), the evidence show that high connectivity (in terms of centrality) does not correlate directly with productivity (prolific authors). This would suggest that collaborations do not necessarily imply high productivity, which is somewhat counterintuitive. Indeed, authors with low (high) centrality appear in higher (lower) positions in productivity. In an effort to interpret this unexpected finding, we identified some authors and institutions (spread out in relatively few countries) whose centralities were high (i.e. frequent collaborations) but demonstrated much lower productivity rankings. On the other hand, several authors and institutions with high productivity rankings seem to have low centralities. This observation does indeed suggest that collaboration is not directly related to productivity, and this seems to be fueled primarily by collaborations of productive authors within their institutions. Our findings suggest that in more productive institutions (in terms of papers published in the field), academics are organized in co-author teams, which focus on collaborations within their own academic institutions. Within this framework, it seems that they tend to publish collaborative papers where co-authors have the same affiliation, which explains the low centrality levels in high productivity rankings. This result is in line with [Samitas and Kampouris \(2018\)](#).

5. Empirical results

[Table 8](#) indicates the presence of small-world characteristics for all networks (authors, institutions and countries). It appears that the number of nodes in the giant component is very large compared to that of the whole network. The percentage of nodes in the giant component reached 18.33% in the network of authors, 40.16% in that of institutions and 84.62% in that of countries. It seems that nearly 20% of authors collaborated within the past 30 years to publish papers in the field of family business. It is evident from the results that the giant

Number of authors	Published papers	Percentage (%)
1	335	28.49
2	395	33.59
3	272	23.13
4	130	11.05
5	39	3.32
6	4	0.34
7	1	0.09
SUM	1,176	100.00

Table 5.
Allocated number of
authors

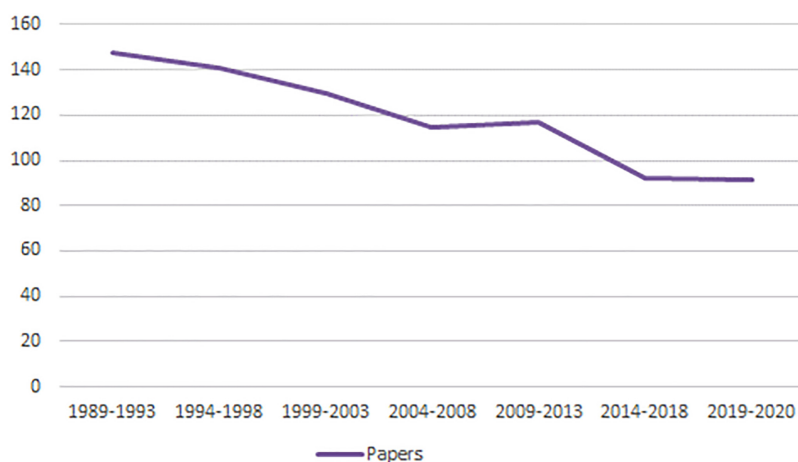
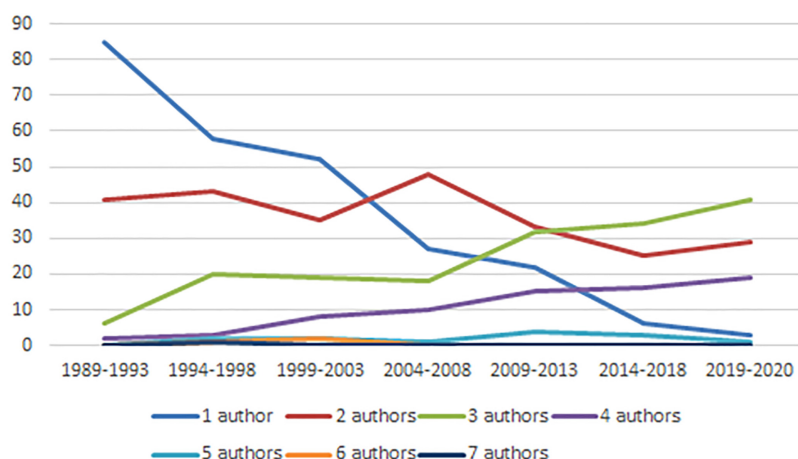


Figure 5.
Number of published
papers per period



Note(s): We observe a significant increase in the number of papers published by three, four and five authors. Conversely, the proportion of single-author papers decreases

Figure 6.
Collaboration patterns
per period

component occupies a large quantity in all the networks. Moreover, it seems that the average number of neighbors in all the networks' giant components is relatively high, except for the institution network.

As indicated in [Tables 9–11](#), the ratio of the network clustering coefficient of the nodes' giant component ranges from 0.47 to 0.85 for the authors' network, from 0.47 to 0.62 for the institutions' network and from 0 to 0.48 for the countries' network. The empirical evidence confirms the presence of small-world properties. Small-world characteristics imply that the network is greatly integrated. Our results provide compelling evidence for coauthorship and suggest that this approach is effective in the communications structure that may clarify the complexity of academic networks. These findings can be a strong motivation for future research on the structure of the networks.

Table 7.
Thirty most prolific
authors, institutions
and countries

	Authors	Institutions	Countries
1	Joseph H. Astrachan	Mississippi State University	The USA
2	James J. Chrisman	Kennesaw State University	Canada
3	John L. Ward	Jönköping University	Spain
4	Pramodita Sharma	Texas Tech University	Italy
5	Jess H. Chua	Bocconi University	The UK
6	Ritch L. Sorenson	Loyola University	Australia
7	Ivan Lansberg	The University of Minnesota	Sweden
8	John A. Davis	Harvard University	Germany
9	Kenneth Kaye	Northeastern University	Belgium
10	Paul I. Karofsky	The University of Oklahoma	Switzerland
11	Ken Moores	Yale University	France
12	Mattias Nordqvist	Oregon State University	Taiwan
13	Carlo Salvato	The University of Calgary	Finland
14	Francesco Chirico	The University of Navarra	People's Republic of China
15	Alfredo De Massis	Brigham Young University	The Netherlands
16	Fredda Herz Brown	DePaul University	Austria
17	Mary Winter	California State University	India
18	Michael Harvey	The University of St. Gallen	Chile
19	W. Gibb Dyer, Jr	Iowa State University	Colombia
20	Daniel L. McConaughy	Bond University	Singapore
21	Sharon M. Danes	Montana State University	Cyprus
22	David Pistrui	The University of Las Palmas de Gran Canaria	Israel
23	Kosmas X. Smyrnios	The University of Michigan	Brazil
24	Peter Jaskiewicz	Montreal University	Norway
25	Louis B. Barnes	The University of London	Denmark
26	Barbara R. Rowe	Lancaster University	Uruguay
27	Miguel Angel Gallo	The University of Pennsylvania	The Philippines
28	Ernesto J. Poza	Boston University	Lebanon
29	Margaret A. Fitzgerald	The University of Jyväskylä	Ireland
30	Reginald A. Litz	The University of Quebec	Korea

Tables 9–11 also represent the evolution of networks over the 30-year period. We split our data into seven time periods to observe how the networks mutate. The nodes increased in all the networks, and simultaneously, the isolated nodes decreased over time, which means that the authors had a tendency for new connections and collaboration. In addition, the giant components also increased as a proportion of the whole network. Specifically, the nodes of the giant component for the authors’ network increased from 3 to 14% (become almost 5 times bigger in 30 years from the first to the seventh period), the institutions’ network range increased from 8.4 to 31.5%, and the countries network increased from 50% to 77%. Although the small-world characteristics exist in all the networks, they also tend to evolve. All the networks are getting bigger, which means that there is a tendency for increasing communication between authors (and institutions/countries) in terms of increasing the productivity and collaboration. Based on the aforementioned evidence, the phenomenon of increasing communication implies higher rates of collaboration. Furthermore, as seen from Figure 7, the average number of degrees (neighbors) significantly increased in all the networks: by 142% for the authors’ network, 74% for the institutions’ network and 284% for the countries’ network.

In the last step of our analysis, we investigated the most common keywords from papers published in the field of family business the last decade. We investigate the hottest topics and keywords in two periods (2009–2014 and 2015 to 2020). We also analyze whether these keywords were published by the most prolific or central authors. Figures 8 and 9 conclude the

	Authors	Institutions	Countries	Collaboration in the field of family business 697
Nodes	944	498	39	
Clustering coefficient	0.484	0.244	0.287	
Connected components	333	197	7	
Network diameter	10	14	5	
Network centralization	0.022	0.035	0.49	
Characteristic path length	4,705	5,629	2,367	
Average number of neighbors	2,025	1,691	3,333	
Network density	0.002	0.003	0.088	
Isolated nodes	131	131	6	
Isolated nodes (%)	0.139	0.263	0.154	Table 8. Small-world characteristics
Multi edge nodes pairs	26	0	0	
<i>Giant component</i>				
Nodes	173	200	33	
Nodes (%)	0.183	0.402	0.846	
Clustering coefficient	0.613	0.344	0.34	
Connected components	1	1	1	
Network diameter	10	14	5	
Network centralization	0.115	0.081	0.568	
Characteristic path length	4,988	5,664	2,367	
Average number of neighbors	3,491	2.96	3,939	
Network density	0.02	0.015	0.123	

20 most common keywords found in published papers from 2009 to 2014 and 2015 to 2020, respectively [5]. We observe that keywords like firms, business, family, theory and performance have dominated interest in both five-year periods in the family business field.

Due to data availability, we started the investigation of the most common keywords after 2009. So, we analyzed the last decade in terms of keywords. We observe that keywords like capital, orientation, work, quality, social, values and research are no longer on the second period. Accordingly, we have new entries, which are agency, analysis, socioemotional, institutional, corporate, decisions and involvement. It is worth mentioning that the agency keywords are ranked fifth in the second and most recent period. Among others, keywords like ownership, innovation, development and identity appear in both periods and the cover middle to low level positions in the rankings. In general, there is a trend that the leading most common keywords remain the same across periods. Authors tend to research similar subjects; and these subjects tend to be the same over time with few changes.

Our results show that 65 out of 100 most common keywords are published by the ten most prolific authors. In addition, 74 out of 100 most common keywords are published by the 20 most prolific authors. This means that most prolific authors also publish the most common keywords or at least to a great extent. The ten of the most prolific authors of all time seem to dominate not only the output but also the hot topics and the most common keywords per period.

Another key finding is that the most notable authors are very central, with the convergence at the 60% mark for the 30 authors that are most prolific and most central. Our findings about prolific authors also relate to central authors as for the most part (60%) they are the same persons. This means that most central authors publish the most common keywords. The trends with the highest increases per period are generated by the ten most central authors of all time. The same authors determine the publication of the most common keywords per five-year period. Lastly, the most central authors per period were involved into the publication of the hottest issues at that period.

Table 9.
Small-world
characteristics per
period – the network of
authors

	1989– 1993	1994– 1998	1999– 2003	2004– 2008	2009– 2013	2014– 2018	2019– 2020	Trend
<i>Authors</i>								
Nodes	163	187	184	195	217	197	223	
Clustering coefficient	0.147	0.398	0.487	0.451	0.63	0.689	0.691	
Connected components	105	91	80	80	75	59	45	
Network diameter	3	3	4	4	4	4	4	
Network centralization	0.013	0.019	0.04	0.028	0.032	0.055	0.057	
Characteristic path length	1.183	1.296	2.003	1.637	1.735	2.097	2.101	
Average number of neighbors	0.859	1.444	1.717	1.703	2.147	2.335	2.485	
Network density	0.005	0.008	0.009	0.009	0.01	0.012	0.014	
Isolated nodes	63	42	34	22	19	6	5	
Isolated nodes (%)	0.387	0.225	0.185	0.113	0.088	0.030	0.022	
Multi-edge nodes pairs	0	3	0	0	0	0	0	
<i>Giant component</i>								
Nodes	5	8	21	15	18	30	32	
Nodes (%)	0.031	0.043	0.114	0.077	0.083	0.152	0.143	
Clustering coefficient	0.467	0.292	0.747	0.664	0.639	0.817	0.845	
Connected components	1	1	1	1	1	1	1	
Network diameter	3	3	4	4	4	4	4	
Network centralization	0.417	0.571	0.308	0.335	0.331	0.32	0.301	
Characteristic path length	1.7	2.000	2.571	2.519	2.373	2.437	2.511	
Average number of neighbors	2	2	3,429	2,933	4	4.333	4.565	
Network density	0.5	0.286	0.171	0.21	0.235	0.149	0.115	

Our findings show that in the first semi-period of our sample, the areas of succession, performance, capital, ownership and management are the most prominent research fields. In the second semi-period, some fields, such as succession, are of less interest to researchers. At the same time, other dimensions, such as agency or other theories, wealth and governance, become more attractive for the researchers. Finally, there are research areas, such as innovation, that remain relatively unexplored by the research community. Since keyword analysis is not employed in existing work, this paper adds to the pure bibliometric analysis approach by demonstrating a unique connection between the research behavior of the most central or prolific authors with the research trends in the family business literature through the two semi-periods of the last decade. Therefore, apart from the formulation of the small world networks, we connect the leading authors and their research priorities with the research trends of the whole scientific community in the field of family business.

The literature provides much evidence regarding the increasing tendency in coauthorship. Many studies investigate networks in many different academic areas and provide various kinds of evidence. [Acedo et al. \(2006\)](#) conducted an exploratory analysis in the field of management. They found an increasing trend for coauthored work. Specifically, their results were not significantly different from those of our own work. The main aspect in this study takes up 45.5% of the network, and their results show a progressive growth in

	1989– 1993	1994– 1998	1999– 2003	2004– 2008	2009– 2013	2014– 2018	2019– 2020	Trend	Collaboration in the field of family business
<i>Institutions</i>									
Nodes	119	113	112	117	124	117	124		
Clustering coefficient	0.084	0.198	0.171	0.172	0.388	0.353	0.387		
Connected components	85	67	65	59	48	39	28		
Network diameter	4	4	8	6	4	7	9		
Network centralization	0.02	0.045	0.073	0.051	0.045	0.08	0.101		
Characteristic path length	1.415	1.620	2.538	2.407	1.783	2.781	2.825		
Average number of neighbors	0.639	1.097	1.054	1.214	1.597	1.829	2.168		
Network density	0.005	0.01	0.009	0.01	0.013	0.016	0.019		
Isolated nodes	62	45	47	32	14	11	9		
Isolated nodes (%)	0.521	0.398	0.420	0.274	0.113	0.094	0.073		
Multi edge nodes pairs	0	0	0	0	0	0	0		
<i>Giant component</i>									
Nodes	10	10	15	18	12	32	39		
Nodes (%)	0.084	0.088	0.134	0.154	0.097	0.274	0.315		
Clustering coefficient	0.467	0.073	0.404	0.247	0.347	0.571	0.618		
Connected components	1	1	1	1	1	1	1		
Network diameter	4	4	5	6	4	7	8		
Network centralization	0.139	0.556	0.544	0.309	0.418	0.269	0.382		
Characteristic path length	1.857	2.244	2.381	2.837	2.318	2.998	3		
Average number of neighbors	2	2	2.4	2.333	2.167	3.187	3.489		
Network density	0.222	0.222	0.171	0.137	0.197	0.103	0.858		

699

Table 10.
Small-world
characteristics per
period – the network of
institutions

the quantity of the papers, i.e. coauthored ones. In the same field, [Matherne et al. \(2009\)](#) discovered that the overall network density was low in absolute terms, and this density was substantially higher than the network density reported from [Acedo et al. \(2006\)](#) for a management study.

In the field of entrepreneurship, [Bozeman et al. \(2013\)](#) examined the extant literature on research collaboration. They stated that scientific research collaboration studies are incredibly disjointed and somewhat ambiguous in focus. However, the more conventional literature review they provided revealed the focus of the field and showed that their findings on the research gaps needed more attention. Moreover, [Reader and Watkins \(2006\)](#) explored the structure of the “meta-field” of entrepreneurship. They used cluster analysis and multidimensional scaling to explore the intellectual structure of entrepreneurship research. Their study showed that there are actual and robust social and collaborative networks underlying the generation of work. Equally, the co-cited authors, while recognizing overlapping concerns, may have difficulty in categorizing this commonality in their papers. Entrepreneurship research is shown to be a social activity, although this may be invisible to outsiders or novitiates.

The likelihood of coauthoring varies in terms of time and discipline. [Moody \(2004\)](#) looked at such networks in the field of sociology and showed that steady growth existed in the

Table 11.
Small-world
characteristics per
period – the network of
countries

	1989– 1993	1994– 1998	1999– 2003	2004– 2008	2009– 2013	2014– 2018	2019– 2020	Trend
<i>Countries</i>								
Nodes	10	13	21	27	22	21	26	
Clustering coefficient	0	0	0.138	0.101	0.272	0.362	0.418	
Connected components	8	7	11	14	6	4	3	
Network diameter	1	2	3	3	4	4	5	
Network centralization	0.083	0.402	0.374	0.188	0.295	0.55	0.618	
Characteristic path length	1	1.625	1.964	1.673	2.221	2.098	2.321	
Average number of neighbors	0.4	0.923	1.238	1.481	2.364	3.048	3.418	
Network density	0.044	0.077	0.062	0.057	0.113	0.152	0.198	
Isolated nodes	6	5	10	9	5	3	2	
Isolated nodes (%)	0.600	0.385	0.476	0.333	0.227	0.143	0.077	
Multi edge nodes pairs	0	0	0	0	0	0	0	
<i>Giant component</i>								
Nodes	5	6	11	10	17	18	20	
Nodes (%)	0.500	0.462	0.524	0.370	0.773	0.857	0.769	
Clustering coefficient	0	0	0.264	0.273	0.352	0.423	0.481	
Connected components	1	1	1	1	1	1	1	
Network diameter	1	2	3	3	4	4	5	
Network centralization	0.264	1	0.689	0.389	0.35	0.625	0.678	
Characteristic path length	1	1.667	1.964	1.733	2.221	2.098	2.384	
Average number of neighbors	1.57	1.667	2.364	3.20	3.059	3.556	3.915	
Network density	0.293	0.333	0.236	0.356	0.191	0.209	0.175	

cohesive core from the initial to subsequent periods, where 45–62% was seen, which is a result that agrees with our own work. Furthermore, around two-thirds of the works had more than one author. [Stegano et al. \(2013\)](#) explained in their work that not only was a substantial pattern of collaboration present but also that the small-world properties displayed great integration (90%), as the major aspect for Italian academic statisticians. On the other hand, [Bordons et al. \(2015\)](#) reported contradictory results. They found that nanoscience and pharmacology presented denser coauthorship in scientific publications compared to statistics. The results showed that this percentage was 60.12% for nanoscience, whereas pharmacology and statistics followed with 66.35 and 27.4%, respectively. The last result is close to the study at hand.

[Newman \(2001\)](#) used computer science, biomedical research and physics databases to determine the integration in network analysis. All these fields herein were greater than 50% in terms of the giant components, where some of them were greater than 80%. Furthermore, physicists have “the largest average number of collaborators.” Additionally, evidence from biology, physics and mathematics databases showed that biological scientists have a tendency to produce substantially more papers than physicists and mathematicians. This finding shows the predominantly experimental and labor-focused nature of current biology. The giant component climbed to 92%. It

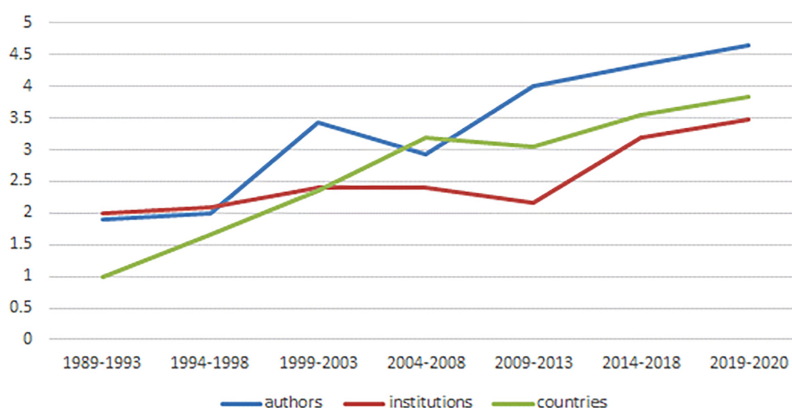


Figure 7.
Average number of
degrees

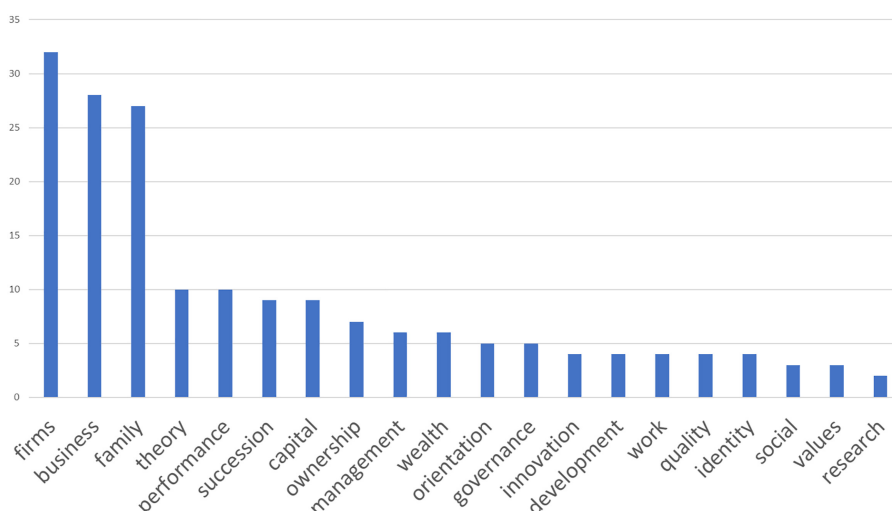


Figure 8.
Most common
keywords 2009–2014

also appears that economics-related disciplines have smaller cores and that they have a slower pace of integration than other subjects. Ortega (2014) looked at the structural coauthorship networks and showed that social sciences, mathematics, economics and business presented sparse and small networks. On the other hand, science subjects had the opposite result.

Overall, researchers in experimental fields produce a larger number of collaborative papers than those in theoretical disciplines. While coauthorship is more common in the natural sciences than in the social sciences, it has been substantially increasing across all fields, as we also observed in our network with family business. Furthermore, with respect to the other characteristics of social network analysis, the clustering coefficient, diameter and shortest path in our network have evolved in manners similar to other disciplines. The centralities were not much different either, as we observed the same impact with other fields, where the star nodes play a substantial role in the evolution of the networks.

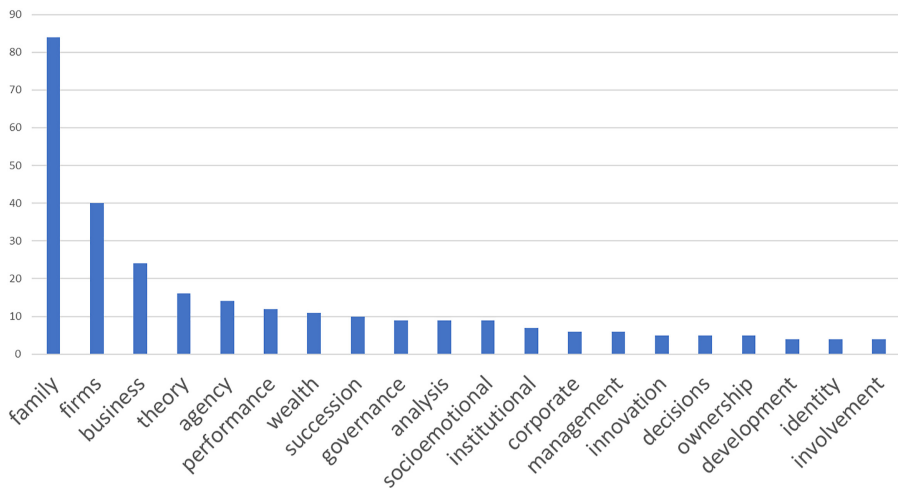


Figure 9.
Most common
keywords 2015–2020

6. Conclusions

The rise in the number of coauthorships has been linked with augmented productivity in terms of research. The need for quality science and management of academic departments has always been a trending issue for research. Previous studies have looked at the subject, and substantial research interest has been visible when it comes to similar topics. However, the work that has been carried out in the past either focuses on elements of only a partial interaction between authors or examines specific aspects of coauthorship itself. This study takes a slightly different route by performing network analysis, producing productivity rankings to estimate how coauthorship can be quantified and examining the elements prevalent throughout collaboration. We also demonstrate how coauthorship networks have developed and evolved. Lastly, we analyzed the most common and “hot-issue” keywords in family business and simultaneously, by whom these topics are been published.

We examined authors’ collaboration in the field of family business. We presented the most prolific authors, institutions and countries for a period of more than 30 years (1989–2020). We discovered the centrality and most key nodes or “actors” in all the networks. In addition, we found that all the network categories portray small-world properties, a condition in which networks verify that collaboration within authors becomes integrated in conjunction with time. The evidence shows that collaboration networks are not only integrated but that they are getting bigger and evolving. Giant components demonstrate significant changes in size over time as they occupy more space in the networks, they have a large number of ties and small distances and their actors have a tendency to produce more neighbors (degrees). We also observed that keywords like firms, business, family, theory and performance have dominated interest in both five-year periods in the family business field. Also, the results show that 65 and 74 out of 100 most common keywords are published by the 10 and 20 most prolific authors. The first ten most prolific authors of all time seem to dominate not only the output but also the hot topics and the most common keywords per period. Lastly, these authors are also the most central to a percentage of convergence that reaches 60%. This means that these prolific authors also relate to central authors, since for the most part (60%), they are the same persons. The analysis performed in this study not only detects evidence of increasing collaboration in coauthorship but also provides significant information about the structure of coauthorship and the mechanisms of academic networks in publishing papers.

To the best of our knowledge, this study is one of a few to examine coauthorship in the area of family business. The evidence presented in this paper can be of aid to educational institutes that are trying to organize their productivity in terms of science, given that authors look at the resources they can set aside for research. Studies in the future can look at providing an understanding of these networks at an integrated level. A study that produces richer data by virtue of larger networks or parameters can help create evidence that is easier to generalize because it is more representative of how networks change and grow with time, and how their systems respond to collaboration trends and patterns. It is our assumption that if the time parameter is reduced between authors, then strong evidence to augment the academic network structure is gained.

Notes

1. For the area of family business, we consider three elite journal fields: *Family business Review*, *Journal of family business strategy* and *Journal of family business management*.
2. *Journal of Family Business Strategy* and *Journal of Family Business Management* are introduced in 2010 and 2011, respectively, while *Family Business Review* in 1989.
3. We did not use any database (such as Scopus) to extract the data. Dataset was manually collected. With this approach, we increase the possibility to have a better collected sample, cleaned from any errors and typos in the names of the authors, institutions and countries. However, the drawback is that it is a time-consuming and meticulous work.
4. Cytoscape is an open-source software platform for visualizing complex networks and integrating these with any type of attribute data. A lot of apps are available for various kinds of problem domains, including bioinformatics, social network analysis and semantic web. Cytoscape project is supported by the US National Institute of General Medical Sciences of the National Institutes of Health.
5. Our database consists of 100 responses, but due to dimensionality reasons, we present here the top 20.

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