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The globalization of research highlighted through the research networks of management education institutions: the case of French business schools

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Abstract. Research has become a key success factor for academic institutions in a growing and increasingly globalized market. In the past, many business schools appear to have had little involvement in research, but are now strategically positioned in international rankings. In this study, we investigate some of the mechanisms that appear to have helped these schools increase their faculty's research productivity in order to face strong competition. We investigate in some depth the case of French business schools, and explore their research networks, focusing on the relationships between academic institutions. We use bibliometric and clustering techniques. We find that, during the last decade or so, French business schools have significantly broadened their research network—at not only the national but also the international level, meaning they have participated in the globalization of research. Exploring the structure of the research networks of these business schools, we highlight two core structuring mechanisms: status and competition. First, the schools we investigated tend to link to other institutions depending on the latter's status—i.e., their level of prestige. Second, it appears that they tend to prefer to collaborate with foreign partners on the international scene rather than with other institutions with which they are in direct competition in their home country. The article discusses the strategies implemented by business schools to help and motivate their professors to enter some existing communities of established scientists (invisible colleges), and the consequences of these trends for the organization of business education.

Keywords: research networks, invisible colleges, status, competition, business schools

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INTRODUCTION

The press, national agencies, and accreditation bodies produce diverse evaluations and rankings of higher-education institutions; these fit into a broad trend of evaluating organizations' performance, aiming for transparency (Espeland & Sauder, 2007). The purpose of these numerous and constant evaluations is to objectivize the position of academic institutions within some kind of hierarchy (Wedlin, 2007) in order to provide reliable information to students and their families, to firms that hire graduates, and to other institutions and their faculty members (D'Aveni, 1996; Martins, 2005; Sauder & Espeland, 2009).

In many international rankings, such as the Shanghai Ranking, as well as in many national-level rankings of business schools, research tends to be one of the prime criteria for ranking universities or schools. This is why academic institutions, and thus their faculty, have been caught up in what Murphy and Zhu (2012: 916) term "the world championship of scholarship." To develop their research productivity and improve their scholarship, scholars must penetrate the social structures of research, and more specifically the "invisible colleges"—i.e., informal communities of established scientists who share some elements related to their research, be it a paradigm, a field of study, or a domain of research. These invisible colleges have been recognized as the prevalent social structure of research (Crane, 1969; de Solla Price, 1963): Invisible colleges link academics in close networks where they choose their partners/co-authors (Acedo, Barroso, Casanueva & Galán, 2006).

The invisible-college concept has been forged to capture networks of scholars across academic organizations (Crane, 1969; de Solla Price, 1963; Zupic & Čater, 2015). Rather than investigating invisible colleges, we explore in this article whether—and how—academic institutions are linked to each other in research networks. Our research question is whether co-authorships highlight regular patterns of relationships at the organizational level, thus leading to research networks of academic organizations. If so, our purpose is to understand these patterns and to investigate the core mechanisms that structure these networks.

To investigate this issue, we draw on the case of French business schools, and more specifically the 15 top-ranked French business schools: These schools evolved very fast in recent years, from being teaching-oriented and neglecting research to being highly concerned with the scholarly production of their faculty. They appear to have succeeded rather remarkably in this endeavor (Mangematin & Belkhouja, 2015). Under the pressure of accreditation and the necessity to obtain as good a place as possible in rankings, these schools successfully changed their organizational template (Lazuech, 1998), as their positions in international rankings demonstrate[1] . These schools were certainly not the only ones to begin to "play the game" with its new rules, but they did so quite successfully, despite the fact that most of them were not research-oriented originally. Hence, we chose to investigate French schools specifically.

We conducted an exploratory study, aiming first to identify possible research networks in which the top 15 French business schools are involved, and second to find possible explanatory lines to understand how these networks are structured. Our work allows us to highlight a phenomenon that is particularly acute in French top-tier business schools (but appears to reach far beyond the case of France). We name this the *globalization of research*, and it has been getting stronger since the turn of the century on the international scene. It is the development not only of research collaborations that link researchers in invisible colleges through co-authorships, but also of their academic institutions in research networks at the organizational level. We find that two main mechanisms appear to explain some patterns in these research networks: status homophily and competition. Our methodological approach—the study and mapping of co-authorship links between institutions with the help of bibliometric and clustering techniques—is original and little used in the management literature.

1. In the widely used FT European Business Schools 2016 ranking, France is the most represented country, with 25 schools (27.78%), followed by the U.K. with 20 (22.22%), and Germany with 7 (7.78%). French schools represented 15% of the schools in the 2004 ranking. Given that the number of ranked schools rose from 40 in 2004 to 90 in 2016, French schools are overrepresented among the institutions that entered the ranking.

The article is structured as follows. We begin by discussing the academic field as a status order, and the importance of research in shaping this order. We then describe our methodology, before detailing our results, which highlight the research networks of the schools we investigated. We next discuss these results, which have managerial implications for academic institutions, before concluding.

BUSINESS EDUCATION AS A STATUS ORDER

Rankings and accreditations organize business schools and universities into strata. This stratification of academic institutions is based on their prestige rather than, for instance, their capacity to generate revenue, thus leading to the concept of status, which has been approached in the literature from a sociological perspective (Weber, 1978) and, later, an economical perspective (Podolny, 1993). For Weber, status is linked to the degree of "social honor" or prestige held by an actor in a given social environment (Barbalet, 1980). Status is "an effective claim to social esteem in terms of positive or negative privileges" (Weber, 1978: 305); thus, it refers to a position in a hierarchy, which entails consensus. On the other hand, Podolny maintains that status is a signal about the quality of the products a firm sells, that is "the perceived quality of [a] producer's products in relation to the perceived quality of that producer's competitors' products" (Podolny, 1993: 830). Organizations are then ranked depending on the perceived quality of their products, in status order. The main argument developed by Podolny is that actors tend to link with others depending on their status, as a "tie" (by which Podolny means a link between two or more actors) to a high-status partner sends a positive signal about the quality of a producer's products that makes the producer rise in the status order. On the contrary, a tie to a low-ranked partner sends a negative signal that makes an actor move downward in the status order. It follows that high-status actors tend to choose other high-status actors to be their partners.

Recent research (Piazza & Castellucci, 2014) has bridged these two conceptions of status to define it as both a position in a hierarchy of prestige and a signal of quality. Podolny (1993)—followed by others researchers (D'Aveni, 1996; Martins, 2005; Sauder, et al., 2009)—highlighted that this may well apply to academic institutions. Indeed, the status-order concept describes well the field of academic institutions, because the first asset of universities is "their prestige […] which finds its most concrete expression in periodic ratings" (Bok, 2009: 159). Competitors thus act in structured interaction with one another, while looking for opportunities to move up in a hierarchy of prestige. Menger, Marchika & Hanet (2015), studying the field of French business schools, term this specific form of rivalry "positional competition." The position that a school holds is crucial, as not only its financial but also its symbolic resources depend on its position in the status order (Brint, Riddle & Hanneman, 2006). First, schools look for the best "student quality," which partly determines the quality of their "output"—definable as the performance of their former students on the labor market, often measured by the average salary commanded by their alumni. The position of a school also conditions its ability to attract the best faculty members (Bedeian, Cavazos, Hunt & Jauch, 2010; Burris, 2004) and funds from national bodies, and to establish relationships with other universities and with firms (Martins, 2005).

When actors cannot easily assess quality, they rely on specific devices to evaluate performance (Karpik, 2007). In the case of higher education in general, two indicators aim to summarize this information about quality objectively, not only to students and their families, but also to academics and firms: rankings and accreditations. Accreditations allow differentiation between those schools that have been accredited for a given period of time and other schools that have not. The most sought-after accreditations are the Association to Advance Collegiate Schools of Business (AACSB), the European Foundation for Management Development Quality Improvement System (EQUIS), and the Association of Masters of Business Administration (AMBA), known collectively as the "triple crown." Accreditations reinforce the status order as they widen the gap between accredited and non-accredited schools; similarly, rankings can turn a small difference into an "objectivized" gap, when two schools with similar results obtain different rankings.

THE IMPORTANCE OF RESEARCH IN THE STATUS ORDER

If the position of an academic institution in the status order is its most important asset, then the question becomes how to attain the best-possible position—or, for the best schools, how to maintain their high positions. Schools deploy many strategies to address these issues. We focus here on one specific strategy, which is research. Research productivity brings prestige to schools (Armstrong & Sperry, 1994). Publications in ranked and respected journals are evidence that a faculty's research satisfies the institutional norms of modern science (Rindova, Williamson, Petkova & Sever, 2005), and that schools as intellectual entities are able to feed managerial, economic, and social debates with new ideas. For instance, the schools that are highly ranked in the U.S. News & World Report are research-oriented rather than teaching-oriented, while maintaining both activities (Borokhovich, Bricker, Brunarski & Simkins, 1995). This is also confirmed by Menger, et al. (2015) on a small sample of French schools. Hence, there is a strong relationship between research production and press rankings (Menger, et al., 2015; Siemens, Burton, Jensen & Mendoza, 2005).

METHODOLOGY

In this section, we detail our data sampling and coding. Further information about these may be found in Appendices 1.1 to 1.6.

SAMPLING

The French higher-education system for business and management is split between university-based schools of management (e.g., Institut d'Aministration des Entreprises or IAE) and stand-alone business schools (e.g., HEC, Audencia). In this paper, we restricted our analysis to stand-alone business schools (hereafter Business Schools) because we could not built a coherent sample that would include both stand-alone business schools and university-based schools[2]. Our aim was to follow, over a period of years, a given set of academic institutions that had to turn quickly to research and succeeded in doing so. Our main purpose was to

2. There is no available ranking that includes both French universities and business schools. Moreover, the FT European Business Schools 2016 ranking includes only one French university (Aix-Marseille), and—while all top business schools are both EQUIS and AACSB accredited—only two French universities have obtained EQUIS accreditation (Aix-Marseille and Paris IX Dauphine), and none AACSB.

understand how their research networks are structured and whether they evolved over time.

We aimed at a sample of schools that was coherent but limited and manageable. There are more than 200 business schools in France, and approximately 40 are rated in rankings. We decided to limit our exploratory study to the top 15 schools, as these are the most likely to get involved in research: We saw in previous sections the links between research and rankings. The process used to identify the schools relevant for our sample is described in Appendix 1.1. The schools included in our sample were: INSEAD, HEC, ESSEC, ESCP Europe, EMLYON, EDHEC, GRENOBLE MANAGEMENT SCHOOL, AUDENCIA, SKEMA, KEDGE, TOULOUSE BUSINESS SCHOOL, IESEG, MONTPELLIER BUSINESS SCHOOL, NEOMA, and ESC RENNES.

In our investigations, we included publications in all journals listed by the *Centre National de Recherche Scientifiqu*e ("National Center for Scientific Research"— CNRS[3]) in the field of management and economics, and indexed in the Web of Science (WoS) database[4] . The process that describes the way we collected bibliometric data is described in Appendix 1.2.

We chose the CNRS list because journalists use it widely to evaluate schools; schools also use it to evaluate their own faculty members (Pontille & Torny, 2010). Journalists often translate the CNRS ranking categories from their numerical classification into stars: 5* or 4* for the best journals ranked 1e, 1g, or 1; 3* for journals ranked 2; 2* for those ranked 3; and 1* for the lowest, ranked-4 journals. We classified journals into two categories: 1*–2* and 3*–4*. For this study, we collected bibliometric data from WoS in March 2016 to record all articles published by scholars affiliated to French business schools over two periods: before 2000 and since 2000. We chose this threshold of the year 2000 because the majority of French business schools began to run for accreditation from the late 1990s (see the accreditation timeline of French business schools in Appendix 1.3), and because we also wished to investigate the possible influence of accreditation on the research production of the schools.

CODING

Before analysis, we had to recode the names of schools and universities, aiming to retain as much relevant information as possible. We built a thesaurus of several thousand lines (see some examples provided in Appendix 1.4). For schools that had changed name during the period studied, we recorded the most recent name of the school for all publications: For instance, publications under the name of "ESC Nantes" and "Audencia" were all coded as Audencia's, which is the new name of ESC Nantes. In the case of mergers, we recoded the name of the former school by adding the name of the merged school in brackets: For example, "ESC Lille" was coded as "esc lille (skema)." In the case of multiple affiliations, we highlighted the name of the school, with other affiliations in brackets: This meant that "ieseg cnrs" was recoded as "ieseg (cnrs)." Similarly, ESCP Europe hosts the RFID (radio frequency identification) laboratory, and so we coded "rfid" records as "rfid (escp)." We adopted the same approach for the EDHEC-Risk laboratory, coded as "edhec risk." Further information on the coding that we used is provided in Appendix 1.5.

3. CNRS is the most important government-run French research institution. The CNRS list of 830 journals is compiled by the economics and management section of the CNRS (section number 37), and ranks journals from 1g, 1e, or 1 (for the most selective journals) to 4 (for the least so), though all journals ranked by the CNRS are recognized as including only original contributions.

4. This database, developed by Thomson Reuters, compiles all articles published in over 25,000 scientific journals and conferences. WoS has recently started to collect bibliometric information from French journals, but it is not yet comprehensive, and some French journals are still not indexed. Similarly, WoS has increased its historical depth, and as previous research did not cover the pre-1990s period (Mangematin and Belkhouja, 2015), we thought it would be useful to include bibliographic records from before the 1990s that are now available, even though these data are sometimes less reliable, and require thorough and extensive data cleansing (which we did for the present study).

To help us code our data further and investigate the research networks, we used VOSviewer (Visualization of Similarities) software (van Eck & Waltman, 2009; Waltman, van Eck & Noyons, 2010). With the help of this, we created maps as visual representations of the co-authorship networks in which our sample of 15 French business schools are involved. To highlight better the possible evolution of these networks, we investigated them separately during an initial period of time before 2000[5] , and a second period from 2000 (inclusive) until February 2016 (inclusive). We chose these periods because they illustrate fairly closely pre- and post-accreditation periods (see Appendix 1.3), which we discuss further in the results section. The technical parameters we used when we ran the mappings in VOSviewer are detailed in Appendix 1.6.

Based on co-authorship indices, the software assigns institutions in the networks to clusters: Each institution is assigned to exactly one cluster. Each cluster has a different color and includes closely related institutions, represented by the nodes. As many node labels are displayed, priority is given to the most significant nodes in the various mappings we propose in the results section.

STATUS AND COMPETITION VARIABLES

In order to help us understand the mappings resulting from our work and the relative positions of schools in clusters, we used two variables—status and competition—that both rely on rankings.

Status

To account for the status of academic institutions, we used several rankings. Rankings provide a good proxy for status as both a position in a hierarchy and a signal for quality (Sauder, et al., 2009). This is why schools' stakeholders (students, firms, scholars, and national bodies) widely use rankings to assess the quality of schools and universities. We searched for a global ranking of business schools and not MBAs, because we consider institutions rather than programs, and because the core program of many business schools outside the U.S., especially in Europe, is the master in management rather than the MBA. First, we used the QS World Ranking (QSWR) 2016; this ranks 200 business academic institutions worldwide, using aggregated scales for institutions beyond the top 50 (51–100, 101–150, and 151–200). We noted the ranks of the schools in the QSWR column in the list of clusters (see Appendices 2, 3, 4, and 5). As many institutions from our clusters did not appear in the QSWR list, we also looked for regional rankings that would include more institutions; we thus added a regional ranking column to the list of clusters. We used the Financial Times (FT) European Business Schools 2016 ranking for Europe (highlighted in red in Appendices 3, 4, and 5), the News & World Report 2016 ranking for the U.S. (highlighted in blue in Appendices 3, 4, and 5), and the Eduniversal 2016 ranking for Canada (highlighted in green in Appendices 3, 4, and 5). We took into account rankings only for the 2000-2016 period, as most rankings did not exist before 2000.

5. The first article recorded in the Web of Science as having been published by a school in our sample in a CNRS-ranked outlet is dated 1933.

Competition

Using a status-based approach, D'Aveni (1996) notes that social stratification between schools is done through clustering: There are different groups organized into a hierarchy, with members of a given cluster being close to their "cluster-mates" with which they share some core features. The competition between institutions takes place within these groups, as top schools seem beyond the reach of lower-ranked schools: A small U.S. university would probably have difficulty competing with Harvard, just as a provincial school (such as Audencia or NEOMA) would with HEC. The relative position of schools in rankings thus provides a good indicator of the competition between schools: The closer they are in rankings, the fiercer the competition is.

RESULTS

In this section, we provide the results of our investigations: the increasing rate of publications and the networks of scholarly collaborations highlighted before and since 2000.

THE INCREASING RATE OF PUBLICATIONS

Only a few schools' faculties (mostly INSEAD and HEC, and to a lesser extent EMLYON, ESSEC, and ESCP Europe) produced academic research before 2000, while the other schools were just starting to show up on the academic stage. In contrast, since the 1990s, the number of research articles published by scholars affiliated to French business schools has been constantly rising both for 1*–2* and 3*–4* journals (see Figure 1). This trend coincides with the beginning of the accreditation process in French business schools. A first wave of accreditations, mostly by EQUIS, occurred during the 1998–2000 period (10 schools); a second wave (12 schools), mostly by AACSB, took place during the 2004–2011 period (see Appendix 1.3).

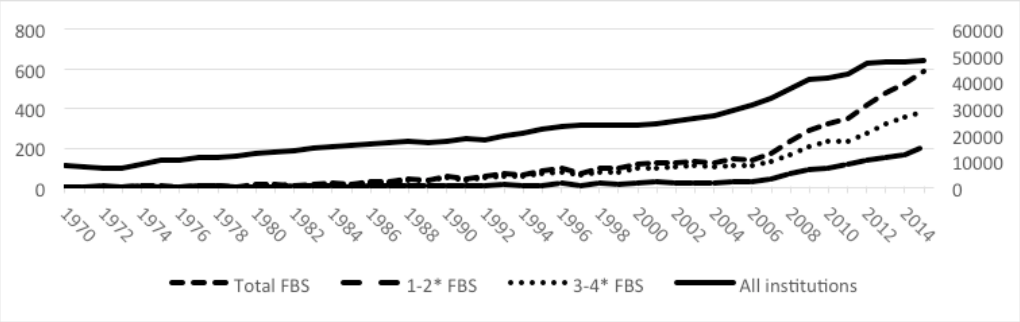


Figure 1[6] - Scholarly production of authors affiliated to the top 15 French business schools

1*–2* FBS (French business schools): publications by the top 15 French business schools in 1*–2* CNRS journals (the ordinate being read on the vertical axis on the left)

6. As there were very few relevant publications before 1970, we only included publications since 1970 in our graph.

3*–4* FBS: publications by the top 15 French business in 3*–4* CNRS journals (the ordinate being read on the vertical axis on the left)
Total FBS: all publications by the top 15 French business schools in CNRS journals (the ordinate being read on the vertical axis on the left)
All institutions: total number of publications in CNRS journals (the ordinate being read on the vertical axis on the right)

French business schools increased their research production at a higher rate than the average of other academic institutions: The top 15 French business schools accounted for 0.03% of all publications in the CNRS list of management journals in 1970, 0.52% in 2000, and 1.23% in 2015 (see Figure 2).

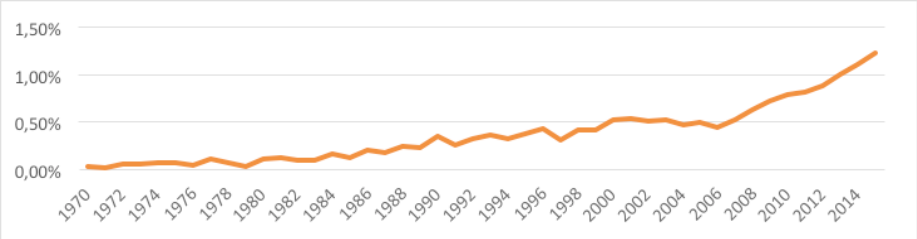


Figure 2 - Percentage of publications of the top 15 French business schools in journals on the CNRS list

RANKINGS AND RESEARCH

Our study also gave us the opportunity to assess the relationship between research and rankings, even when research does not appear to directly account for much in rankings criteria, as in the FT ranking[7] . In the case of French business schools, we found a very strong correlation between their researchers' productivity and their FT ranking (R2=67.74% with Prob>F=0.0003; coef=–0.3387 with p>ltl=0.000) over the 2013–2015 period[8]. This confirms the findings that Menger, et al. (2015) obtained on a smaller sample: Research has a greater influence on schools' positions in rankings than would be expected given its weight in rankings

THE RESEARCH NETWORKS

One of our queries was whether the fierce competition, and the increasing influence of rankings and accreditations, had led French business-school scholars to enter networks of scholarly collaborations. The pre-2000 networks are graphically represented in Figure 3 and summarized in Appendix 2. These networks includes 313 organizations, but only 42 of these meet the threshold of having at least five publications; all 42 were taken into account (see Appendix 2).

7. The FT European Business Schools ranking does not directly include research in its criteria. It combines several rankings from other FT rankings (the MBA, masters in management, and executive MBA rankings account for 25% each, and the two executive-education rankings count for 12.5% each). Two of these rankings (MBA and executive MBA) take research into account, the research criterion being weighed at 10% (assessed through publications in the FT journals list).
8. Our calculation was based on 14 schools only, as ESC Rennes did not appear in the FT European Business Schools 2013, 2014, and 2015 rankings. However, it was ranked 63rd in the latest (2016) ranking.

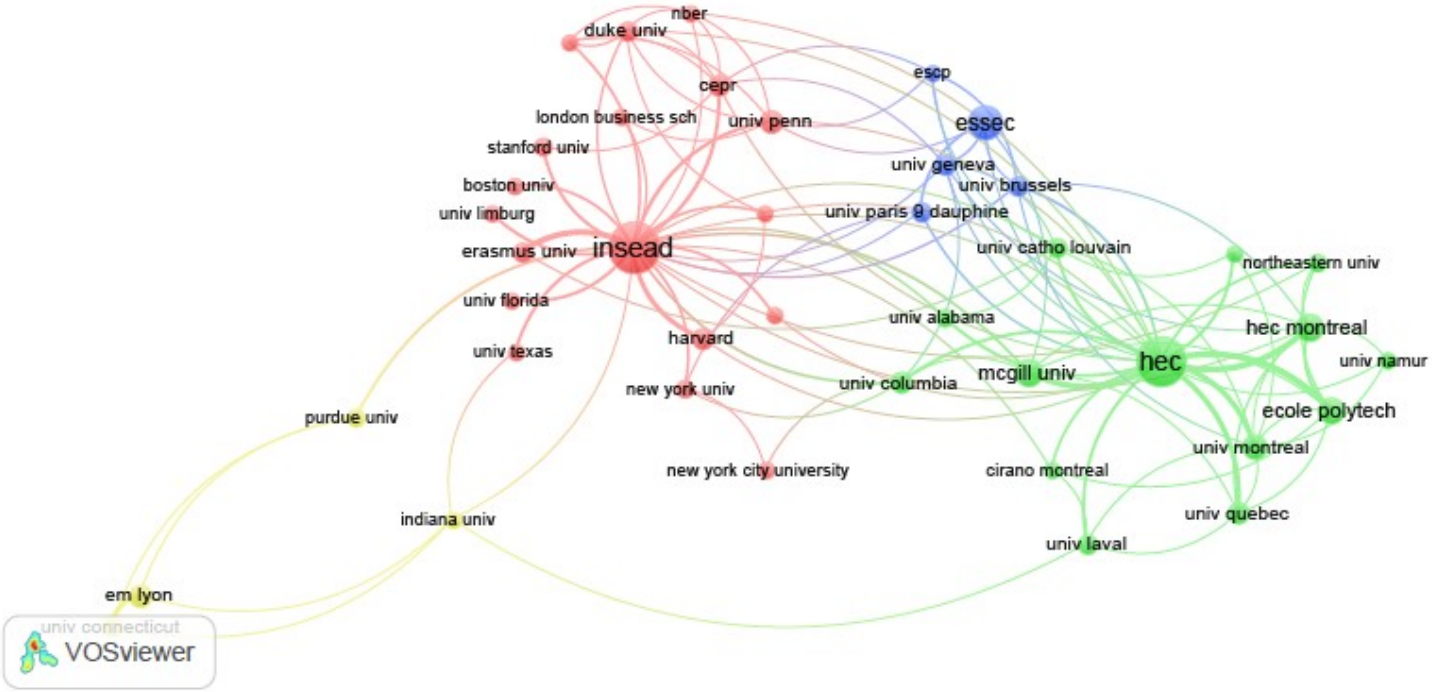


Figure 3 - The research networks before 2000

The 2000–2016 networks are graphically represented in Figure 4 and summarized in Appendix 3. They include 1,679 organizations, of which 368 meet the threshold of having at least five publications. For clarity and readability of the resultant mapping, we retained the 100 institutions with the highest number of co-authorship links; only the 200 most significant of these links are displayed in the mapping.

Before 2000, only the long-standing top-ranked schools appear on the map within networks of collaborations. On the other hand, we found that all schools in our sample were on the 2000-2016 map (see Figure 4). This important result allowed us to emphasize the extent to which French schools' scholars have developed collaborations with colleagues from universities and research-driven institutions (e.g., CNRS) in order to meet new academic requirements.

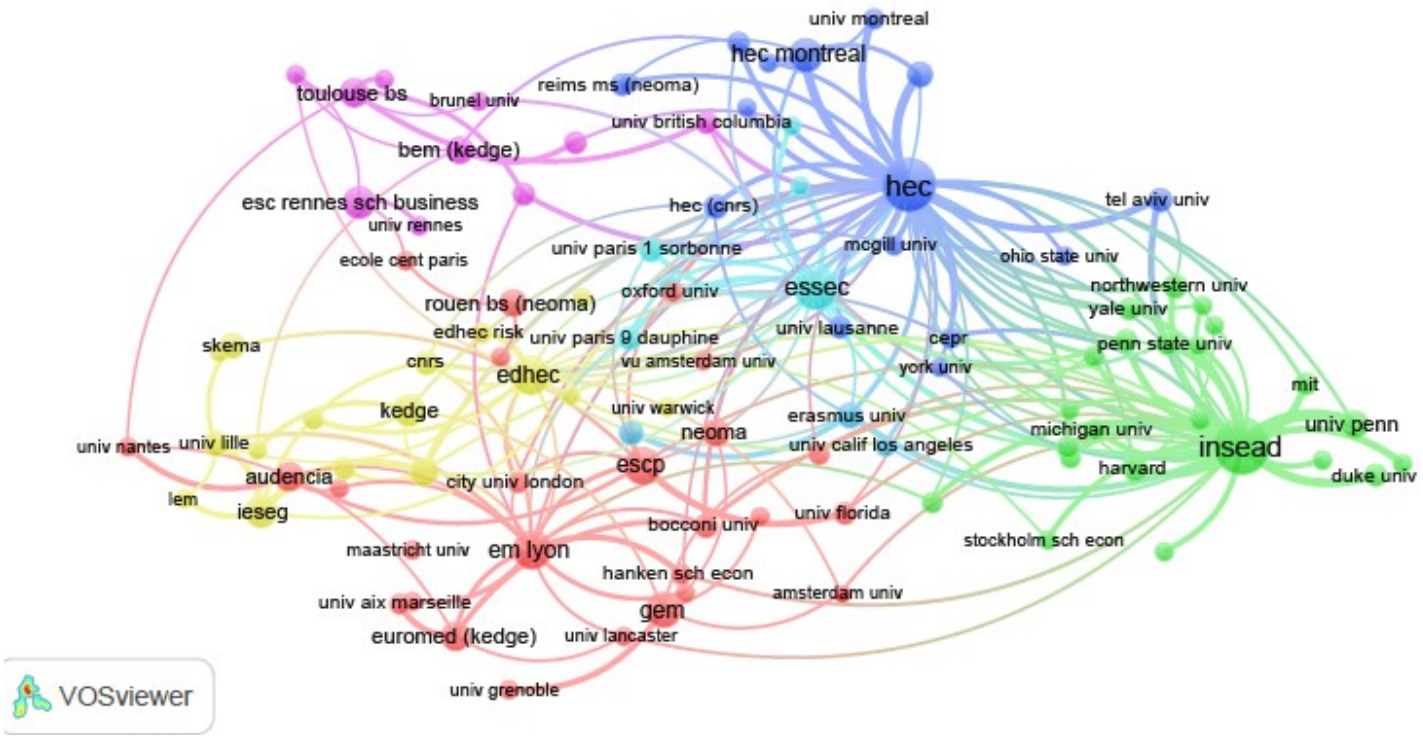


Figure 4 - The 2000-2016 research networks

THE 2000–2016 PERIOD

We now focus more specifically on the composition of scholarly networks in the 2000-2016 period, graphically represented in Figure 4. We look at the relationships between institutions through the co-authorship networks of their scholars. Appendix 3 details the composition of the clusters of institutions based on their publications for all CNRS-ranked journals indexed in WoS; it includes the regional and international rankings of academic institutions toward the assessment of their status.

INSEAD (cluster 2—green) operates clearly within a tight network of top U.S.-based institutions (including the University of Pennsylvania, Harvard, and MIT), ranked in the top ten of both the U.S. ranking and the QSWR[9]. All institutions in INSEAD's network are ranked by the QSWR . The network is predominantly American but also global, with highly ranked Asian and European institutions (e.g., the National University of Singapore, ranked 12th in the QSWR; and London Business School, ranked 2nd in the QSWR). In contrast, HEC's network (cluster 3—blue) involves predominantly Canadian institutions (HEC Montréal, McGill University, and Concordia University). These Canadian institutions rank high in regional rankings (1, 2, 7, and 8). HEC has a close link to Ecole Polytechnique, a world-famous French engineering school (thus not included in our rankings, but ranked first among French engineering schools, and 51–100 in the 2016 QSWR of engineering schools); this school hosts a management department.

9. With the exception of "nber" (National Bureau of Economic Research), which is not a ranked academic institution.

ESSEC's network (turquoise cluster 6) is predominantly French, with two of the most respected universities in the field of management (Paris 1 Sorbonne and Paris 9 Dauphine, the only two French universities ranked in the QSWR). Cluster 1 (red) associates a range of French schools, led by EMLYON, ESCP Europe, and Grenoble Management School ("gem"). This cluster includes only one non-European institution. Eleven schools in cluster 1 rank 20–60 in the FT ranking. Cluster 1 also includes a few institutions that are top-ranked (at the European and international levels), such as Bocconi, Oxford, and Cambridge. The lower-ranked French schools in this cluster—Audencia and NEOMA—receive smaller w scores than the top-ranked schools.

Cluster 4 (yellow cluster) also gathers a range of French schools, originally geographically located around the Lille region (EDHEC, SKEMA, and IESEG—and also Louvain Catholic University and Brussels Free University), suggesting a result that may also be witnessed in other clusters: Geographic proximity seems to facilitate collaboration between institutions, perhaps in response to strong regional concerns and policies. EMLYON is linked to the University of Lyon, Toulouse Business School to the University of Toulouse, and ESC Rennes to the University of Rennes. Only one institution in cluster 4 is ranked by the QSWR. The French schools leading this network (EDHEC, IESEG, and KEDGE) are ranked lower than those in cluster 2 (led by INSEAD), cluster 3 (led by HEC), and cluster 1 (led by ESCP Europe). This is also the case for clusters 5 (pink—ESC Rennes and Toulouse Business School) and 7 (Montpellier Business School). We find few ranked schools in cluster 5, with only one QSWR-ranked school and two FT-ranked schools. In contrast, Montpellier Business School's network (cluster 7)[10] includes only two institutions, but both are highly ranked. Nonetheless, this is the only cluster that is not led by its French representative, Montpellier also having weaker w scores. A possible explanation may be that Montpellier rose recently in the rankings, whether French or European.

Another result is that top French schools appear not to collaborate much among themselves, each belonging to—and remaining within—a specific network. Each of the top three schools (INSEAD, HEC, and ESSEC) leads its own network of co-authorships, having the heaviest weight of co-authorship within its respective cluster. On the other hand, as noted, we find several French middle- or lower-ranked schools in the same clusters (clusters 1 and 4).

To obtain a finer reading, we investigated the 2000-2016 research networks, drawn separately for 1*–2* (Figure 4) and 3*–4* publications (Figure 5). The 1*–2* networks include 851 organizations, but only 107 of these meet the threshold of having at least five publications, and all were taken into account (see Appendix 4 for the detailed composition of clusters).

10. This cluster can be visualized on the mappings only by zooming in on it in the software. Hence, it does not appear in the mapping in Figure 3, but is detailed in the appendix.

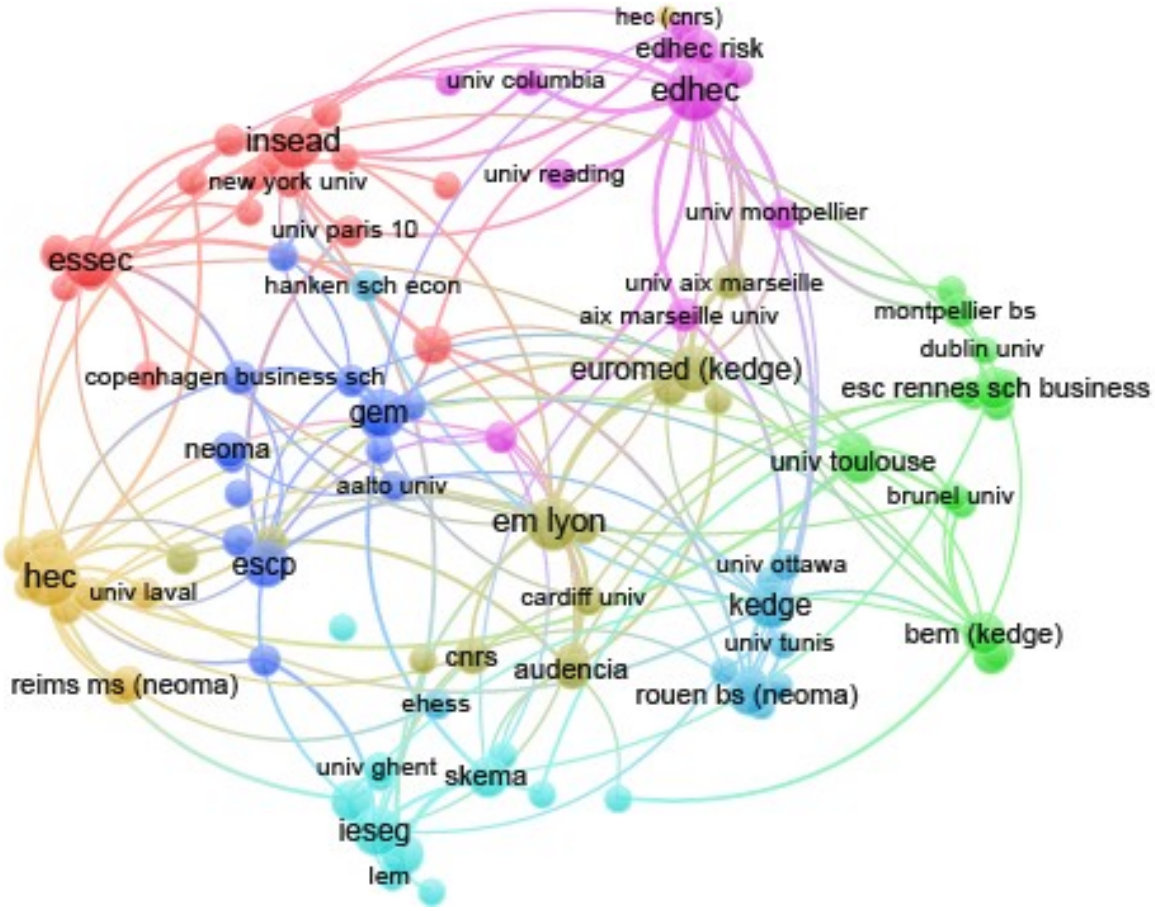


Figure 5 - The 2000-2016 research networks
Publications in 1*–2* journals

The 3*–4* networks (see Figure 6) include 1,340 organizations, but only 274 of these meet the publication threshold (see Appendix 5 for the detailed composition of clusters). To improve the readability of the mapping, and the clarity of the analyses, we retained the 100 institutions with the highest number of co-authorship links (and only the 200 strongest co-authorship links are illustrated in the diagrams).

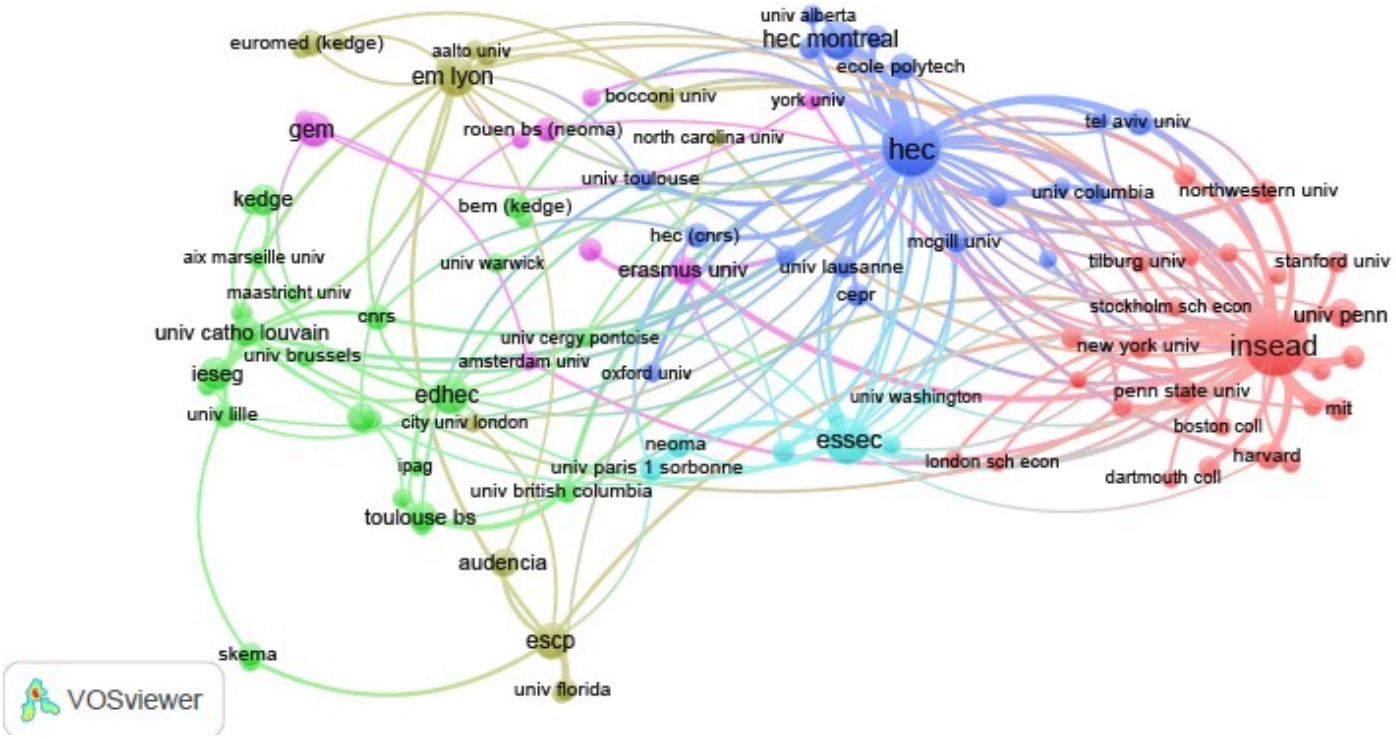


Figure 6 - The 2000-2016 research networks
Publications in 3*–4* journals

Indeed, the two maps (Figures 5 and 6) differ, showing that the two networks are far from fully overlapping. The 3*–4* map is much denser than its 1*–2* counterpart, particularly in the HEC and INSEAD scholarly networks. In other words, schools are not involved in the same networks when their scholars publish in top-tier journals and in lower-ranked ones. All INSEAD's partners in its 3*–4* network are QSWR-ranked, and we find in 3*–4* clusters the most prestigious universities. But if we look at its 1*–2* cluster, a little over half of INSEAD's partners are QSWR-ranked. INSEAD's prestigious U.S.-based network relates to publications in top-tier journals, whereas it is linked to other French institutions (ESSEC, Paris 9 Dauphine, and Paris 1 Sorbonne) for publications in 1*–2* journals. Similarly, in 3*–4* networks, EMLYON is linked to French schools/ universities that are more prestigious than in 1*–2* ones. We also find lower-ranked, less-prestigious schools leading 1*–2* research networks (KEDGE and Rouen Business School (NEOMA) in cluster 7); this does not seem to happen in scholarly networks related to top-tier journals.

DISCUSSION

In this section, we discuss three related issues that emerge from our work: i) the development of French business-school research at a global level through research networks; ii) the structured composition of these research networks, highlighting linkages between institutions, around two core mechanisms—status and competition; iii) the strategies developed by French business schools to boost their research power, including supporting the development of relationships between their faculty and other researchers through co-authorship.

THE GLOBALIZATION OF RESEARCH IN FRENCH BUSINESS SCHOOLS

Our bibliometric data confirms that French business schools were not originally research-oriented (Courtault, Hayek, Rimbaux & Zhu, 2010; Mangematin, et al., 2015), but that they have now embraced the scholarly model as highlighted by previous research (Mangematin, et al., 2015; Menger, et al., 2015). The turn to research is obvious in all schools (not only the top ones) in our sample, just as it is obvious that research productivity of schools' faculties is highly skewed, the most prolific faculties being those of the most prestigious, highly ranked schools.

When it became necessary for business schools to maintain their status following the introduction of accreditations and rankings, schools and their faculties turned to academic institutions more engaged in research than they were, such as universities and the CNRS, especially when targeting top-tier journals. These partners are often non-French institutions: The 2000-2016 networks (all journals included) involve 83 countries (the U.S., Canada, and the U.K. coming first, but also European countries, and Japan, China, Turkey, and Brazil); among the 100 institutions with the highest number of co-authorship links in this network, 58 are foreign and 42 French. Most French business schools produced hardly any research at all 20 years ago; they now appear to participate, through their faculty, in global research networks: The French case suggests that standing out on the research scene appears to be facilitated by a global approach.

INVISIBLE COLLEGES OF SCHOLARS, AND RESEARCH NETWORKS OF ACADEMIC INSTITUTIONS

Looking at the social structure of academia, de Solla Price (1963) was the first to theorize the notion of invisible college, shortly followed by Crane (1969; 1972). The invisible-college hypothesis states that academic fields share a common social structure made up of formal and informal networks, with a closely linked group of highly productive academics responsible for most of the academic production. The invisible-college theory deals with networks of scholars, including co-authorship networks (Evans, Lambiotte & Panzarasa, 2011). However, we find that co-authorship networks—when investigated at the organizational level (as in our study)—also reveal structured clusters of institutions: Our results evidence very strong links between some institutions. This leads us to investigate why we observe such regular patterns of linkages between schools. In the following sections, we discuss two core principles that may contribute to structuring co-authorship networks at the organizational level: status homophily and competition.

STATUS HOMOPHILY

Status research argues that actors tend to tie with similar status partners (Podolny, 1993), and this is what we also find to some extent. One explanation is certainly that the most productive scholars tend to work in the best reputed institutions (Bedeian, et al., 2010). In turn, scholars from top-ranked schools tend to co-author publications with peers who offer them the best chances of success—i.e., those working in top-ranked institutions (Acedo, et al., 2006). The two leading schools (INSEAD and HEC) are linked to institutions from North America, whereas the other French schools are instead involved in European clusters. North America dominates the field of management research (Murphy, et al., 2012), and working with U.S. universities is critical to achieving high rankings (Macdonald & Kam, 2011). However, the fact that scholars are free to choose their co-authors certainly helps explain why, on a few occasions, we find high-status and lower-status schools in the same cluster. Indeed, scholars from a top-tier school (such as ESSEC) have collaborated with colleagues from lower-ranked ones (e.g., NEOMA) for 3*–4* publications. In the same way, ESCP Europe is linked to NEOMA and AUDENCIA. These elements lead us to question Podolny's (1993) somewhat mechanistic assumption that, by tying to a lower-status partner, high-status actors endanger their level of prestige.

Research networks result first and foremost from scholars' collaborations. Accordingly, schools developed strategies to boost the production of research published under their banner. Schools implemented policies to motivate and drive their faculty to produce research, including contractual research objectives, publication bonuses, and career promotion. This has certainly encouraged their scholars to search for external collaborations, as it is one of the best ways to be research-productive (Acedo, et al., 2006). Another policy adopted by some French schools, often encouraged by accreditation bodies, is to hire international faculty members and/or faculty trained abroad: International faculty members can help develop research projects with colleagues from their home countries and former institutions, and thus enlarge their new school's research network. This type of policy may be applied in a systematic manner, and it has been so in some schools. For instance, 90% of the ESC Rennes faculty is made up of international scholars, as stated on the school's website.

Some schools have also established close and more formal co-operations with research-productive institutions. These linkages are based on high-status, highly ranked institutions that tend to establish partnerships with others of similar status. Guided by the results of our mappings, and to give just a few examples, we found that INSEAD entered a strategic partnership with Wharton Business School of Pennsylvania University, a leading U.S. business school. Also, HEC hosts a joint research laboratory with the CNRS, and is part of the Paris-Saclay University project, which aims to build a broad academic organization close to Paris, along with the Ecole Polytechnique. EMLYON leads a strategic alliance with another well-established European school, the Hanken School of Economics (in Finland), including a joint degree and the exchange of visiting professors. All these partnerships appear to support research collaborations between faculties and are highlighted in our mappings of existing research networks: They may not otherwise have been obvious to observers outside these schools. Other schools (NEOMA, KEDGE, and ICN) have—in the past—launched joint doctoral programs, which are currently being dismantled. They too are of similar status, and have long used the same

entrance examination. However, this strategy seems less productive in terms of shared research outputs, as we did not find linkages between these schools in the mappings that were drawn.

COMPETITION

Status theory would have led us to expect scholars from the French top-tier schools to collaborate in the same way as those from middle- or lower-ranked schools. But French top-tier schools do not cluster with each other—i.e., few of their scholars co-author publications. INSEAD's scholars have very few collaborations with other French schools, with the exception of ESSEC for 1*–2* journals; neither INSEAD nor the three Parisian schools known to provide the most prestigious French master's degrees in management (HEC, ESSEC, and ESCP Europe) belong to the same cluster. Hence, our results suggest that close competition may also shape status mechanisms, as these top schools (with the exception of INSEAD) operate within the same competitive environment and recruit their students from the same "breeding" ground of preparatory classes, which is less the case for lower-ranked ones (Menger & Marchika, 2014).

This result is suggestive, and less easy to interpret, as researchers remain free to choose their co-authors. However, as we noted, schools can encourage their faculty to seek out collaborations with targeted (and often foreign) partners through more- or less-formalized relationships with foreign institutions, or through the recruitment of non-French scholars. Scholars can also assimilate their schools' strategies to privilege relationships with institutions other than their direct national competitors. However, while our article provides insights to approach this question, our data do not allow us to answer it definitively.

In the context of a fast-changing environment that is urging less-prestigious schools to increase their research productivity, they operate more within French and/or European research networks comprising not only universities but also similarly ranked business schools. This involves both competition and collaboration, which Brandenburger & Nalebuff (2011) term "co-opetition." Our results suggest that for a school to reach top-tier level in international and local rankings implies not only that it is research-prolific, but also that it is part of an international research network comprising prestigious foreign institutions; this type of network is different from those of close competitors, including for schools specializing in executive education (such as INSEAD)[11].

LIMITATIONS AND FUTURE RESEARCH

One possible limitation of this study is methodological. We could have used one of two databases as sources for our data: WoS and Scopus. We first started our work with Scopus, as this database includes more research outlets than WoS. We quickly found that the affiliation field in Scopus did not include information that was sufficiently reliable. Therefore, we had to use WoS as its information on authors' affiliation appeared more reliable[12] but included a smaller number of indexed outlets. This imposed choice means there are journals that we did not take into account, simply because they are not indexed in WoS—particularly some French ones. However, most of the main significant international research outlets in economics and management science that are widely

11. INSEAD's network is the most prestigious of all French schools. If we compare INSEAD to HEC, which houses the leading French master's in management, INSEAD's faculty has published 1,397 articles in 3*–4* journals since 1970 versus 997 for HEC.

12. The error rate of WoS has considerably improved in recent years, but it still ranges from 6% to 12%, depending on samples (Olensky, Schmidt & Eck, 2015).

recognized on the international academic scene are indexed in WoS; our results may therefore be considered robust. This issue should be further investigated in future research.

In this paper, we have focused on organizations and have investigated research networks at the organizational level. As research networks are first made up of researchers, it would be interesting to complete our study with the analysis of scholars' invisible colleges, and to investigate how researchers choose their co-authors.

Furthermore, we focused on French business schools because they provide a relevant case with results that may well extend to other academic institutions in the world. We showed that French business schools' key asset is status, which is expressed through rankings and which somewhat contributes to explaining the structure of their research networks. It has been shown that many academic institutions build their position on status, as is the case for U.S. business schools (D'Aveni, 1996; Martins, 2005) and law schools (Espeland, et al., 2007). The general attention paid to rankings across the academic field (and beyond management) also tends to demonstrate this. However, future research should verify our findings in other, broader settings. Our paper provides some methodological guidance to lead such investigations; to do so, we highlight the possibility of using some recently developed, relevant, and freely available software.

CONCLUSION

The present article shows that research-collaboration networks highlight linkages not only between scholars but also between academic institutions. These linkages are not random, but appear to be linked to social mechanisms and organizational strategies. Sometimes, these collaborations turn into more-enduring ties (as witnessed very recently in the case of EMLYON and Grenoble Ecole de Management, which have recently formalized their partnership and appeared as previously linked through research co-authorships in our maps). Thus, our results may have managerial implications for schools' deans who are looking to boost the research productivity of their faculty. This suggests that research not only is an individual effort but also may be profitably supported by institutions, which may well play a significant role in shaping the social structure of research.

APPENDIX 1 - METHODOLOGY

Appendix 1.1. Selection process for our sample

We used the rankings published in four of the most popular journals in the French national press (*Le Figaro*, *Le Point*, *Le Parisien*, and *Challenges*), which we averaged over the years 2013, 2014, and 2015. However, these rankings do not include INSEAD, as this school's teaching focuses only on executive education. Since INSEAD is the most prominent French school for research production (Courtault, et al., 2010; Mangematin, et al., 2015), we considered it was useful to add it to our sample, which also included the 14 highest-ranked French business schools (see the table below, which details our sample).

School	Average national-press ranking	Rank
INSEAD	N/A	N/A
HEC	1	1
ESSEC	2.27	2
ESCP EUROPE	3.09	3
EMLYON	3.55	4
EDHEC	4.82	5
GRENOBLE MANAGEMENT SCHOOL	6.64	6
AUDENCIA	8.55	7
SKEMA	8.82	8
KEDGE	9.45	9
TOULOUSE BUSINESS SCHOOL	10	10
IESEG	10.71	11
MONTPELLIER BUSINESS SCHOOL	10.82	12
NEOMA	11	13
ESC RENNES	14.73	14

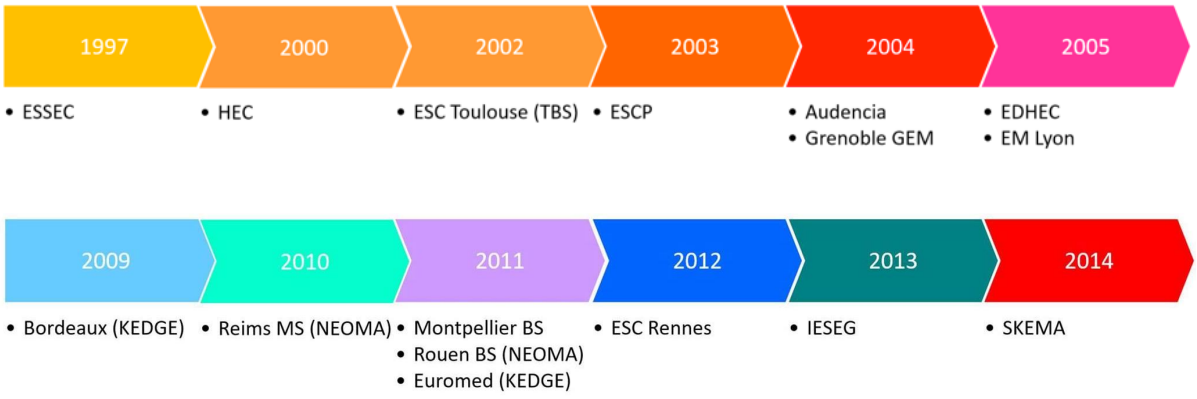
The French business schools in our sample

Appendix 1.2. Collection and coding of bibliometric data

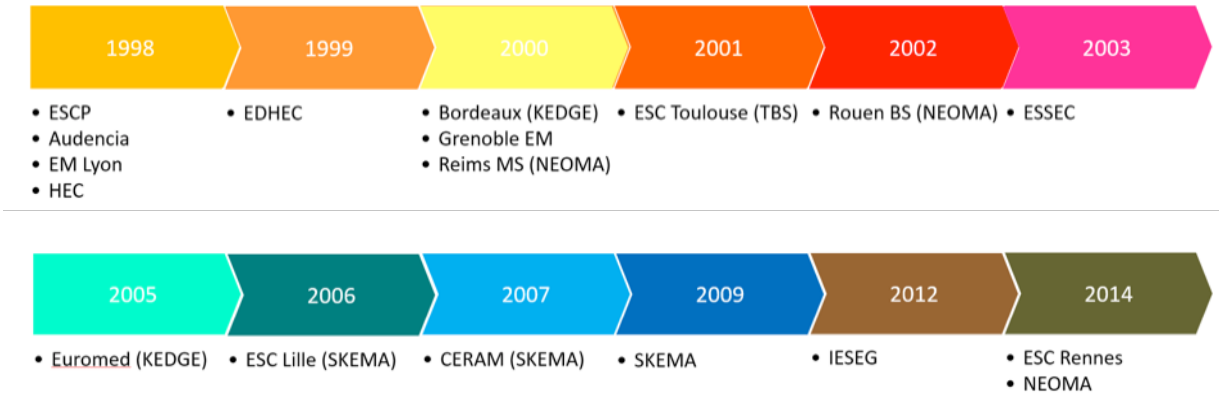
We first searched for all publications for which at least one author was affiliated to a French institution. For each publication, we recorded authors' and co-authors' names and affiliations, as well as the year of publication and the category of the research outlet (1*–2* or 3*–4*). The main issue during the data-collection process was that the data about schools were not aggregated in WoS: The same school can appear under a number of different names—sometimes because its name has changed (due to merger and/or change of governance); or sometimes because the database records names as given by journals (and authors), and these names may vary widely. For instance, we found publications by authors affiliated to "ESC Rennes," "ESC Rennes School of Business," "Ecole Supérieure de Commerce de Rennes," and other more unusual or misspelled names. Affiliations can also mention other details—for instance,

IESEG is associated with a CNRS laboratory (Lille Economie Management: LEM), and we found "IESEG LEM" affiliations in WoS. We also had to keep track of the various mergers: for instance, Rouen Business School and Reims Management School, which merged to become NEOMA; ESC Lille and CERAM, which became SKEMA; Bordeaux Management School and Euromed, which formed KEDGE; and (earlier) EAP, which was merged into ESCP Europe. We selected all possible labels that had been used to designate the schools included in our sample. We then ran new queries that included all these labels individually in order to obtain a set of reliable and comprehensive data involving 5,376 documents.

Appendix 1.3. Accreditation timeline in French management education (Adapted from Schmidkontz, 2016)



AACSB



EQUIS

Appendix 1.4. Thesaurus (excerpt)

Standardized label	Labels found in bibliographic databases to be standardized								
lab automat besancon	lab automat besancon 25								
lancashire univ	lancashire business sch								
lehman bros	lehman brothers								
lem	cnrs lem	cnrs lem umr 8179	cnrs lem umr 81791	lem cnrs	lem cnrs 8179	lem cnrs umr 9221	lem res ctr	lille econ & management cnrs	sch management lem cnrs
linkoping univ	linkoping inst technol								
lombard odier	lombard odier internat portfolio management ltd								
london business sch	london grad sch business studies								
london metropolitan univ	london metropolitan business sch								
london sch econ	london sch econ & polit sci	london sch econ & political sci	london sch econ financial markets grp	lse	lse alumni assoc				

Appendix 1.5. Further elements related to our coding of bibliometric data

Beyond the 15 schools that were the focus of our investigations, we also faced the same type of issues for other institutions with faculty who co-authored documents with academics from the 15 schools; this meant further significant recoding to make sure that records were accurate, at least as far as WoS allowed. We recorded French universities from the same city under the single name of their city (or region)—e.g., "univ bordeaux." As for business schools, the current trend for French universities is to merge—e.g., Bordeaux 1, 2, and 4 merged to become the single University of Bordeaux; and, in the Lorraine region, Nancy 1 and 2, the University of Metz, and INPL (an engineering school) merged to form the University of Lorraine. Note that, in most cases, the original split of universities belonging to the same city referred to different disciplines, as in the case of Bordeaux, where Bordeaux 1 was devoted to science and technology, and Bordeaux 4 to law, social science, and management. Paris universities were coded differently because, although disciplines were divided between universities, this split was far from systematic; this was evident in our data. Indeed, it is not by chance that Parisian-university-affiliated scholars invariably provide some detail when mentioning their home university (Paris 9 Dauphine, Paris 1 Sorbonne, Paris 2 Panthéon-Assas, etc.): We had no occurrences of "Paris University," as we had for provincial universities. Hence, we retained the differentiation between Parisian universities in our records. When an article was co-authored by two or more authors, it was registered for each of their home institutions, as well as for the co-authorship link between the two.

Appendix 1.6. Parameters used to map the research networks with VOSviewer

The minimum number of documents to be included in the calculation and visualization must be specified in the software: Once all data were collected and cleaned, and the co-authorship networks were constituted, we retained for the analyses only those institutions that had at least five publications, in order to avoid statistical noise and blrring of the resulting mappings. The networks we highlight and graphically map include nodes and edges. The nodes are institutions (business schools, universities, and research laboratories). The sizes of nodes are proportional to the co-authorship indices of the institution they represent. The distance between nodes, and the thickness of the edges, indicate the strengths of co-authorship relations between institutions. To calculate co-authorship indices and to address the issue of assigning co-authored publications to individual institutions, we applied fractional counting (Aksnes, Schneider & Gunnarsson, 2012; Waltman & van Eck, 2015). For instance, if a publication was co-authored by three authors affiliated to three different institutions, the publication was assigned to each institution with a fractional weight of one-third. This appeared the soundest counting method because, in this instance, the total weight of the co-authorship links that an institution obtained for one publication equaled one; hence, this total weight of one was distributed equally over the individual co-authorship links. The software allowed us to map results based on their unnormalized or normalized link strength. We chose the Lin/Log normalization as it provided easily readable maps.

APPENDIX 2 - CLUSTER DETAILS, BEFORE 2000

Cluster	Label	Weight documents	Weight co-authorships	Cluster	Label	Weight documents	Weight co-authorships
1	insead	260	81	2	univ catho louvain	9	8
1	univ penn	17	11	2	univ laval	9	8
1	cepr	14	11	2	northeastern univ	7	7
1	harvard	13	8	2	univ alabama	7	6
1	duke univ	11	8	2	univ toulouse	6	5
1	erasmus univ	11	11	2	cirano montreal	5	5
1	new york univ	8	4	2	univ namur	5	3
1	stanford univ	8	4	2	univ columbia	12	9
1	london business sch	6	3	2	univ catho louvain	9	8
1	northwestern univ	6	5	2	univ laval	9	8
1	stockholm sch econ	6	6	2	northeastern univ	7	7
1	univ texas	6	4	2	univ alabama	7	6
1	boston univ	5	3	2	univ toulouse	6	5
1	hong kong univ sci & technol	5	4	2	cirano montreal	5	5
1	nber	5	5	2	univ namur	5	3
1	new york city university	5	1	3	essec	61	9
1	univ florida	5	4	3	univ brussels	9	9
1	univ limburg	5	4	3	univ geneva	9	8
2	hec	235	92	3	univ paris 9 dauphine	9	7
2	mcgill univ	30	19	3	escp europe	6	5
2	hec montreal	29	24	4	emlyon	18	11
2	ecole polytech	23	21	4	univ connecticut	12	10
2	univ montreal	20	14	4	purdue univ	7	5
2	univ quebec	13	13	4	indiana univ	6	5
2	univ columbia	12	9				

APPENDIX 3 - CLUSTER DETAILS, 2000-2016

Cluster	Label	Weight documents	Weight co-authorships	Regional ranking	QS World Ranking	Cluster	Label	Weight documents	Weight co-authorships	Regional ranking	QS World Ranking
1	emlyon	275	144	20		2	insead	1021	472	3	3
1	escp europe	213	98	12	101–150	2	univ penn	75	75	4	5
1	gem	197	70	17		2	harvard	54	54	1	1
1	audencia	99	49	60		2	northwestern univ	44	44	5	22
1	euromed (kedge)	98	56	33		2	new york univ	42	42	20	19
1	rouen bs (neoma)	83	35	50		2	penn state univ	41	40	41	51–100
1	neoma	73	27	50		2	duke univ	38	38	12	40
1	bocconi univ	52	51	6	10	2	yale univ	38	38	8	16
1	univ florida	36	31	37	151–200	2	mit	36	36	5	6
1	hanken sch econ	33	33	81		2	natl univ singapore	36	36		12
1	univ aix marseille	31	31	67		2	tilburg univ	33	32	23	51–100
1	city univ london	28	28	26	51–100	2	univ columbia	30	28	10	22
1	oxford univ	28	28	11	8	2	london business sch	29	29	1	2
1	copenhagen business sch	26	26	35	13	2	michigan univ	29	29	12	27
1	aalto univ	25	25	31	51–100	2	stanford univ	27	26	2	4
1	univ lancaster	22	22	48	51–100	2	stockholm sch econ	25	25	28	51–100
1	vu amsterdam univ	22	22		51–100	2	univ toronto	24	24	3	35
1	bath univ	21	21	58	51–100	2	berkeley univ	21	19	7	11
1	cambridge univ	21	21	13	7	2	cornell univ	21	21	14	41
1	univ grenoble	21	21			2	georgia inst technol	21	21	34	51–100
1	univ lyon	21	20			2	hong kong univ sci & technol	20	20		18
1	maastricht univ	20	20	60	151–200	2	univ illinois	20	20	39	51–100
1	univ nantes	20	20			2	nber	19	19		
1	aston univ	19	19		101–150						
1	ecole cent paris	19	19								
1	amsterdam univ	18	18		51–100						
3	hec	758	448	2	14	4	sciences po	25	24		
3	hec montreal	156	99	2		4	lem	24	23		
3	ecole polytech	61	60			4	univ brussels	24	23	56	
3	tel aviv univ	52	52			4	univ paris 10	21	21		
3	hec (cnrs)	44	35	2	14	4	univ warwick	21	20	22	25
3	univ lausanne	41	32	45	151–200	5	esc rennes sch business	125	38		
3	univ laval	36	36	12		5	toulouse bs	99	51	47	
3	reims ms (neoma)	35	19	50		5	bem (kedge)	80	44	33	
3	mcgill univ	33	31	1	45	5	univ toulouse	42	41		
3	univ montreal	33	33		51–100	5	univ geneva	37	33		
3	cepr	32	31			5	univ british columbia	35	35	5	38
3	concordia univ	25	25	8		5	univ orleans	25	25		
3	ohio state univ	23	23	27	101–150	5	univ rennes	23	23		
3	univ alberta	23	22	10	101–150	5	brunel univ	20	20		
3	york univ	20	20	7	101–150	5	toulouse sch econ (toulouse univ)	19	19		
3	univ quebec	19	19			6	essec	400	197	18	51–100
4	edhec	262	129	14		6	univ paris 1 sorbonne	48	46		101–150
4	ieseg	147	86	59		6	univ paris 9 dauphine	48	47		151–200
4	kedge	134	62	33		6	univ cergy pontoise	22	20		
4	univ catho louvain	86	83	65	151–200	6	univ paris 13	20	20		
4	skema	68	42	57		6	bar ilan univ	19	19		
4	univ lille	57	55			7	erasmus univ	61	61	10	21
4	cnrs	55	55			7	montpellier bs	46	25	67	
4	ieseg (lem)	36	23	59		7	univ calif los angeles	26	25	15	17
4	aix marseille univ	29	29	67							
4	edhec risk	28	16	14							
4	cardiff univ	25	25								

APPENDIX 4 - CLUSTER DETAILS, 1*–2*, 2000-2016

Cluster	Label	Weight documents	Weight co-authorships	Regional ranking	QS World Ranking
1	insead	131	47	3	3
1	essec	103	43	18	51–100
1	univ paris 9 dauphine	16	16		151–200
1	univ paris 1 sorbonne	13	11		101–150
1	natl univ singapore	9	9		12
1	univ paris 10	9	9		
1	mit	7	7	5	6
1	new york univ	7	7	20	19
1	stockholm sch econ	7	7	28	51–100
1	vu amsterdam univ	7	7		
1	univ cergy pontoise	6	6		
1	univ lancaster	6	6	48	51–100
1	univ lausanne	7	6	45	
1	univ sydney	6	6		
1	bar ilan univ	5	5		
1	penn state univ	5	5	41	51–100
1	univ waterloo	5	5		
1	wu vienna	5	5	43	45
2	bem (kedge)	30	22	33	
2	esc rennes sch business	51	21		
2	univ toulouse	17	17		
2	toulouse bs	33	14	47	
2	univ geneva	13	13		
2	montpellier bs	18	10	67	
2	univ aberdeen	9	9		
2	univ bordeaux	9	9		
2	brunel univ	7	7		
2	erasmus univ	7	7	10	21
2	univ orleans	7	7		
2	univ rennes	6	6		
2	dublin univ	5	5		101–150
2	la rochelle business school	5	5	76	
2	northwestern univ	5	5	5	22
3	gem	83	84	17	
3	escp europe	84	83	12	101–150
3	neoma	31	31	50	
3	copenhagen business sch	11	11	35	13
3	oxford univ	9	9	11	8
3	cambridge univ	8	8	13	7
3	tilburg univ	8	8	23	51–100
3	aalto univ	7	7	31	51–100
3	harvard	7	7	1	1
3	univ british columbia	6	7	5	38
3	univ otago	6	6		51–100
3	univ catho lille	5	6		
3	univ grenoble	5	5		
3	univ roma la sapienza	7	5		
4	emlyon	93	43	20	
4	euromed (kedge)	49	28	33	
4	audencia	40	14	60	
4	bocconi univ	14	14	6	10
4	cnrs	12	12		
4	univ aix marseille	11	11	67	
4	bath univ	9	9	58	51–100
4	univ lyon	9	9		
4	aston univ	8	8		101–150
4	cardiff univ	8	8		101–150
4	univ london	8	8		
4	univ nantes	6	6		
4	univ nice	5	5		
5	edhec	107	61	14	
5	edhec risk	19	15	14	
5	aix marseille univ	11	11	67	
5	city univ london	9	9	26	51–100
5	athens univ	8	8		
5	univ montpellier	8	8		
5	suny stony brook	7	7		
5	univ columbia	7	7	10	22
5	univ reading	7	7		
5	karlsruhe inst technol	6	6		
5	yale univ	6	6	8	
5	georgetown univ	5	5	22	
6	ieseg	55	36	59	
6	univ lille	21	19		
6	skema	32	21	57	
6	univ catho louvain	17	17	65	151–200
6	univ ghent	9	5		
6	lem	6	9		
6	norwegian business sch	6	5	35	51–100
6	univ autonoma barcelona	6	6		
6	univ hull	6	6		
6	esc lille (skema)	8	6	57	
6	ieseg (lem)	10	6	59	
6	maastricht univ	5	5	60	151–200
7	kedge	53	29	33	
7	rouen bs (neoma)	45	22	50	
7	middlesex univ	10	9		
7	univ ottawa	9	9	11	
7	hanken sch econ	8	8	81	
7	ehess	7	7		
7	univ tunis	6	6		
7	cranfield univ	6	5	30	
7	mcgill univ	5	5	1	45
7	univ naples parthenope	5	5		
7	univ southampton	5	4		
7	audencia (univ lunam)	6	1	63	
8	hec	130	61	2	14
8	hec montreal	14	13	2	
8	reims ms (neoma)	17	14	50	
8	ecole polytech	12	12		
8	concordia univ	11	11	8	
8	univ quebec	11	11	13	
8	univ laval	8	8	12	
8	univ paris 12	8	8		
8	univ montreal	5	2		51–100
8	hec (cnrs)	6	5	2	14

APPENDIX 5 - CLUSTER DETAILS 3*–4*, 200-2016

Cluster	Label	Weight documents	Weight co-authorships	Regional ranking	QS World Ranking	Cluster	Label	Weight documents	Weight co-authorships	Regional ranking	QS World Ranking
1	insead	890	447	3	3	2	edhec	155	89	14	
1	univ penn	71	71	4	5	2	ieseg	92	53	59	
1	harvard	47	47	1	1	2	kedge	81	41	33	
1	northwestern univ	39	39	5	22	2	esc rennes sch business	74	23		
1	penn state univ	36	35	41	51–100	2	univ catho louvain	69	65	65	
1	new york univ	35	35	20	19	2	toulouse bs	66	36	47	
1	duke univ	34	34	12	40	2	bem (kedge)	50	29	33	
1	yale univ	32	32	8	16	2	cnrs	43	42		
1	mit	29	29	5	6	2	skema	36	28	57	
1	michigan univ	27	27	12	27	2	univ lille	36	35		
1	natl univ singapore	27	27		12	2	univ british columbia	29	29	5	38
1	stanford univ	26	25	2	4	2	ieseg (lem)	26	18	59	
1	london business sch	25	25	1	2	2	sciences po	23	22		
1	tilburg univ	25	25	23	51–100	2	univ brussels	22	22	56	
1	univ toronto	21	21	3	35	2	aix marseille univ	18	18	67	
1	berkeley univ	20	18	7	11	2	lem	18	18		
1	cornell univ	20	20	14	41	2	univ orleans	18	18		
1	georgia inst technol	20	20	34	51–100	2	univ warwick	18	18	22	25
1	hong kong univ sci & technol	18	18		18	2	cardiff univ	17	17		
1	stockholm sch econ	18	18	24	51–100	2	toulouse sch econ (toulouse univ)	17	17		
1	boston coll	17	17	50	101–150	2	univ rennes	17	17		
1	nber	17	17			2	univ cergy pontoise	16	14		
1	dartmouth coll	16	16	8	51–100	2	univ groningen	16	15		
1	copenhagen business sch	15	15	38	13	2	maastricht univ	15	15	60	
1	london sch econ	14	14		9	2	ipag	14	14		
1	univ maryland	14	14	41	101–150						

3	hec	628	391	2	14	4	hanken sch econ	25	25	81	
3	hec montreal	142	82	2		4	univ aix marseille	20	20	67	
3	tel aviv univ	51	51			4	city univ london	19	19	26	51–100
3	ecole polytech	49	47			4	aalto univ	18	18	31	51–100
3	hec (cnrs)	38	33	2	14	4	rfid (escp)	17	17	12	101–150
3	univ lausanne	34	25	45	151–200	4	univ connecticut	16	16	68	
3	cepr	29	28			4	univ lancaster	16	16	48	51–100
3	mcgill univ	28	27	1	45	4	north carolina univ	15	15	16	51–100
3	univ laval	28	28	12		5	gem	114	41	17	
3	univ montreal	28	27		51–100	5	erasmus univ	54	54	10	21
3	univ toulouse	25	24			5	rouen bs (neoma)	38	17	50	
3	univ geneva	24	20			5	montpellier bs	28	17	67	
3	univ columbia	23	22	10	22	5	york univ	18	18	7	101–150
3	univ calif los angeles	22	21	15	17	5	ecole cent paris	16	16		
3	ohio state univ	21	21	27	101–150	5	univ grenoble	16	16		
3	univ alberta	21	19	10	101–150	5	amsterdam univ	15	15		51–100
3	oxford univ	19	18	11	8	5	vu amsterdam univ	15	15		
3	univ illinois	16	16	39	51–100	6	essec	297	148	18	51–100
3	arizona state univ	15	15	35	101–150	6	neoma	42	16	50	
4	emlyon	182	112	20		6	univ paris 1 sorbonne	35	35		51–100
4	escp europe	129	71	12	101–150	6	univ paris 9 dauphine	32	31		51–100
4	audencia	59	24	60		6	indiana univ	17	17	22	51–100
4	euromed (kedge)	49	29	33		6	univ paris 13	16	16		
4	bocconi univ	38	37	6	10	6	univ washington	15	15	21	101–150
4	univ florida	32	32	37	151–200						

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