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# What can university administrators do to increase the publication and citation scores of their faculty members?

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**Abstract** Studies on publication and citation scores tend to focus mostly on frequently published and cited scholars. This paper contributes to advancing knowledge by simultaneously looking into both high and low performing scholars, including non-publishing scholars, and by focusing on factors increasing or impeding scholarly performances. To this end, two complementary sources of data are used: (1) data from ISI web of science on publications and citations of scholars from 35 Canadian business schools and, and (2) survey data on factors explaining the productivity and impact performances of these scholars. The analysis of the data reveals five scholar profiles: (i) non-publishing scholars; (ii) low performing scholars; (iii) frequently publishing scholars; (iv) frequently cited scholars and; (v) high-impact frequently publishing scholars. Statistical modeling is then used to look into factors that explain why scholars are any of these performance configuration rather another. Two major results emerge: first, scholars in the low performing profile differ from those in the non-publishing profile only by being in top tier universities and by having high levels of funding from research councils. Second, scholars who publish frequently and are frequently cited differ from those in the low performing profile in many ways: they are full professors, they dedicate more time to their research activities, they receive all their research funding from research councils, and, finally, they are located in top tier universities. The last part of the paper discusses policy implications for the development of research skills by university managers willing to increase the publication and citation scores of their faculty members.

**Keywords** Publications · Citations · Fields · Time allocation · Academic rank · Survey

**JEL Classification** D2 · I29 · M10 · I21

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## Introduction

There is a large and ever growing body of studies on the productivity and impact of academic research (Brusa et al. 2010; Abramo et al. 2011; Kern 2011; Talukdar et al. 2011). In spite of the large difference in publications and citations performance among scholars, these studies tend to focus on frequently published and frequently cited scholars. By contrast, studies on scholars with poor publishing and citation scores are scanty (Lelièvre et al. 2011; Bosquet and Combes 2013). However, a better understanding of factors that improve performances of latter group of scholars may strengthen existing theories on "academic production". This may also help in designing policies to improve these scholars' performance. Providing such evidence is especially important in business administration schools where nearly one third of scholars have no publications reported in ISI Web of Science (and therefore no citations).

Assessments of productivity and impacts provide useful data at many levels. At the individual level, they provide insights into hiring, promotion and salary decisions. At the department and university levels, they provide information on organizational performances used to support accreditation and government funding decisions. However, productivity and impact assessments provide little information on factors to support sound policy interventions. The purpose of this paper is to investigate the determinants of the productivity and impact of scholars. More concretely, we aim to identify factors that may cause scholars to be in any given performance configuration rather than another. Such an approach to productivity and impact assessment is not only very insightful but may also be informative for university administrators and national policy-makers who, more often than not, tend to assume that no intervention is required to foster the professional development of scholars (Marginson and Van der Wende, 2007; Finkelstein et al. 2013). Indeed, the current implicit assumption seems to be that the development of the research skills of scholars is learned by osmosis (Hemmings and Kay 2010), in a gradual and partly unconscious process of absorption resulting from working in an environment that provides opportunities to interact with highly productive scholars whose publications are frequently cited. But given major productivity and impact performance differences among scholars, one has to assume that systematic policy interventions are required if this is to change in any meaningful way (Clarke 2005; Cohen et al. 2012; Reid et al. 2012).

This paper contributes to advancing knowledge by simultaneously looking into both high and low performing scholars, including non-publishing scholars, and by focusing on factors that may stimulate or impede scholarly performances. To this end, data from two complementary sources are used: (1) data from ISI web of science on publications and citations of scholars from 35 Canadian business schools and, (2) survey data on factors that explain the productivity and impact performances of these scholars. Such an approach will show that scholars who are in the low performing profile (low publication and citation scores) differ from those in the non-publishing profile (zero publication and zero citation) only by being in top-tier universities and by having high levels of funding from research councils. It will also be shown that scholars who publish frequently and are frequently cited (high-impact frequently publishing scholars profile) differ from those in the low performing profile in more ways: they are full professors; they dedicate more time to their research activities; they receive all their research funding from research councils; they are more involved in passive knowledge transfer activities and; finally, they are located in top-tier universities. How these factors may be used by university administrators to improve their faculty's research skills is discussed. Furthermore, it is shown that time dedicated to research activities explains the difference in performance between high and low

performers. However, it does not explain performance differences between low performers and non-publishing scholars. Finally, factors such as academic rank and university ranking embody many implicit dimensions worth investigating further in future studies.

The rest of the paper is organized as follows. Section "Review of prior studies" reviews prior studies on publication and citation scores, and factors increasing these scores. Section "Studied population and data collection" deals with methodological issues, including data collection and descriptive statistics. Sections "Analytical model and regression results" and "Results" introduce the analytical plan and the statistical results, respectively. Section "Discussion" discusses the results and their policy implications. The main results are summarized in the concluding section "Concluding remarks and future research" where both the limitations of the study and possible directions for further research are discussed.

## Review of prior studies

### Dependent variables

Measuring the productivity and the impact of scholarly production is a daunting task for university managers who want to figure out what they could do to increase the publication and citation scores of their faculty members. As pointed out by Costas and van Leeuwen (2010), to date, no reliable assessment methodology exists on which university managers can rely on to make decisions on such important issues as tenure, promotion and salaries of their faculty members.

Previous studies on the productivity and the impact of scholars' publications used separate performance indicators for each dimension. For example, Gonzalez-Brambila and Veloso (2007) explored the determinants of research output and impact, measured by publications and citations in the ISI Web of Science, for a sample of Mexican researchers who had been members of the Mexican National System of Researchers (SNI) for at least 1 year, for the period of 1991 to 2002. They used these two indicators as dependant variables in two Negative Binomial fixed effect model (Hausman et al. 1984). They distinguished two sets of independent variables namely, those variables that are stable across time but not across researchers, i.e. area of knowledge, gender, institution of affiliation, country of PhD; and variables that vary in both dimensions, i.e. age, stock of past publications, total number of researchers in the same area. Lissoni et al. (2011) looked into the determinants of quantity productivity measured by the number of articles published and quality productivity measured as the 5-year average impact per article for a panel of French and Italian physicists active in the 2004–2005 year. The independent variables used to explain these two productivity indicators are age; gender; cohort of entry; and researcher's past productivity. More recently, Ibáñez et al. (2013) analyzed the relationships between publications, citations, and collaboration (institutional, national, and international) for a sample of Spanish university professors between 2000 and 2009. Bosquet and Combes (2013) performed two OLS regressions to explain, respectively, individual publications and citations of French academics in economics, by gender, age, co-authorship patterns, and research fields. Finally, Parker et al. (2013) examined the publication and citation patterns of the 0.1 % most highly cited 'environmental scientists and ecologists' listed in the field of environmental science and ecology at *Thompson Scientific's* ISIHighlyCited.com.

Another emerging string of studies explores the productivity and impact of scholarly research using sophisticated methodological approaches that combine various bibliometric

indicators. As an example, Costas and van Leeuwen (2010) studied research performance of Spanish National Research Council (CSIC) scientists by building a bibliometric profile of each researcher and by categorizing researchers' performance into three dimensions: observed impact; journal quality; and production. This methodology led the authors to distinguish three classes of CSIC scientists: Top class performers; Medium class performers; and Low class performers. They, then compared these three classes according to research areas, professional categories and age. As for Turner and Mairesse (2002), they used data from the ISI Web of Science on publications, citations and impact factors for 497 French physicists over the 1980–1997 period to identify the determinants of their productivity according to three dimensions: the annual number of publications per researcher; the average annual impact factor of the journal of publication per scientists; and the yearly average number of citations scientists. These determinants were grouped into two categories: (1) individual determinants such as age, gender, education, and cohort; and (2) academic research determinants, i.e., the career trajectory or experience; the size and activity of the laboratories in which the scientist works. They then used these as explanatory variables in regression models.

In this study, we used an approach similar to Krampen (2008) to develop a classificatory scheme combining two outcome variables, namely publications and citations. The resulting dependent variable, in contrast to earlier studies, accounts for large variations in citations and publication performance which, when combined, allows for different performance configurations. More specifically, we developed outcome profiles comprised of two indicators: the lifetime number of publications and the lifetime number of citations. We then differentiated among three levels of performance: small, large and zero publications or citations. This leads to five outcome profiles:

Profile 1: *Non-publishing scholars*—(and non-cited scholars): no publications and no citations
Profile 2: *Low performing scholars*: few publications with few citations
Profile 3: *Frequently publishing scholars*: large number of publications with few citations
Profile 4: *Frequently cited scholars:* large number of citations with few publications
Profile 5: *High-impact publishing scholars*: large number of publications with large number of citations

Such a performance configuration carries three advantages. First, instead of focusing solely on the elite group of highly performing researchers, it accounts for lesser acknowledged scholars, namely, (i) those scholars who never or rarely publish; (ii) those who publish a lot but are rarely cited; (iii) those who barely publish but are frequently cited. Second, this configuration, by explicitly acknowledging the existence of scholars who do not perform well, provides some levers to university administrators to help them move from lower to higher performance levels. Third, our taxonomy carries practical implications in regard to the management of the professional development of scholars, by systematically comparing factors helping scholars to move from lower to higher productivity and impact performance configurations.

## Independent variables

There is an extensive literature on the determinants of scholars' publication and citation performance. Studies based on bibliometric data have focused on four categories of factors: journal characteristics; article characteristics; author characteristics; and institutional

characteristics, also referred to as the work environment characteristics. Mingers and Xu (2010) and Hemmings and Kay (2010) reviewed this literature in detail. In this study, we build on and extend this literature, by first adding independent variables based on survey data collected at the scholar level, and second, by emphasizing factors that are conducive to policy intervention by university administrators and policy-makers.

In order to explain why scholars engage in publishing their research outputs, we draw on the resource-based theory of the firm (Conner and Prahalad 1996; Grant 1996; Kogut and Zander 1992; Landry et al. 2010) by assuming that, like entrepreneurs, scholars and university managers control bundles of idiosyncratic resources and capabilities mobilized in generating research impact, notably through well-received publications.

### Time allocation

The allocation of time by faculty members among different activities is an important issue for three main reasons. First, time is a limited resource they can easily control and mobilize to increase the probability of success in their academic career. Second, it may be used by university administrators as a policy lever to enhance the research outputs of their faculty members. Finally, national policy-makers may invest more or less resources on the time dedicated to research as a means to influence faculty time allocation patterns with the goal of increasing the research outputs.

University faculties face challenges in finding time to work on research activities because of competing scholarly activities on their time (Hemmings et al. 2007; Landry et al. 2010). Thus, our overall hypothesis is that time allocation to research, teaching, administration and professional consulting activities affects publication and citation performances. In practice, this overall hypothesis suggests that faculty members who dedicate more time to research activities at the expense of teaching, administration and consulting activities will achieve a better publication and citation score. More specifically,

**Hypothesis 1** There is a positive relationship between the time allotted to research activities and the number of publications and citations, and conversely, a negative relationship between the time allotted to teaching, administration and professional consulting activities and the number of publications and citations.

### Financial resources

Similar to time allotted to research, the amount of activities geared toward raising financial resources is under the control of scholars. While time allocation depends on the specific trade-offs that scholars make based on the type of career paths they aim to achieve, financial resources are raised through funding mechanisms where they compete with other scholars for the limited research resources made available by organizations such as research councils and companies. Prior studies showed that the publication record of scholars is influenced by the level and the sources of financial funding (Blumenthal et al. 1996; D'Este and Perkmann 2011; Landry et al. 2010; Amara and Landry 2012). Very often, the level and sources of financial resources controlled by scholars provide an indication on other resources such as equipment and personnel that scholars can mobilize to ensure the success of their research projects. Based on this rationale,

**Hypothesis 2** we hypothesize that there is a positive relationship between the level of financial resources raised by scholars and their number of publications and citations. Moreover, based on the findings of Blumenthal et al. (1996),

**Hypothesis 3** we hypothesize that there is a positive relationship between financial resources that scholars raise from research councils and their number of publications and citations.

Knowledge transfer activities

The transfer of knowledge from academia to organizations outside of universities plays an increasing role as a justification that policy-makers rely on to support universities. The issue of knowledge transfer is usually approached from the perspectives of patenting, licencing and spin-off creation activities. These activities are less common in business and management schools than in engineering and life sciences. Thus, in this paper, we look into the extent to which scholars in business and management are engaged in non-formalized contractual knowledge transfer activities to other companies. Informal knowledge transfer arrangements involve scholars providing technical information, expertise or technical support, without being paid, to help companies solve technical problems (Amara et al. 2013). In this study, we differentiate between informal passive and informal proactive knowledge transfer activities. The former is limited to making accessible or sending research results and technical reports to companies. By comparison, the latter is much more demanding as it involves presentation of research results to companies; participation in industry expert groups; and provision of expertise and technical support to companies without receiving any monetary compensation. In a resource-constrained environment, engagement in informal knowledge transfer activities comes at the expense of other scholarly activities such as publishing. Thus,

**Hypothesis 4** we hypothesize that there is a negative relationship between proactive knowledge transfer activities and the number of publications and citations, and no relationship between passive knowledge transfer activities and the number of publications and citations.

Linkages with companies

The abundant literature on social networks and scholarly activities suggests that forging relations with companies creates opportunities that influence the patterns of academic careers (Amara et al. 2013; Landry et al. 2010; Dietz and Bozeman 2005). One stream of the literature on this topic argues that, in a context of resource-scarcity, scholars who maintain strong and frequent linkages with companies have to make it at the expense of engagement in other scholarly activities such as publishing (Nelson 2001; Geuna and Nesta 2006). A second stream found a positive association between linkages with companies and publications (Gulbrandsen and Smeby 2005; Van Looy et al. 2004; Stephan et al. 2007). Finally, there is a third stream which found no significant association between linkages with companies and publications (Carayol and Matt 2006; Landry et al. 2010; D'Este et al. 2013). To sum up, the relation between linkages with companies and publications is a complex and unresolved issue. Based on this mixed evidence and on the resources-scarcity argument,

**Hypothesis 5** we hypothesize that there is no clear directional relationship between strong ties with companies and the number of publications and citations. Likewise, there is no clear directional relationship between frequent contacts with companies and the number of publications and citations.

Academic ranks

In contrast to the above variables, the promotion from one academic rank to another is a lever in the hands of university administrators. The relationship between academic rank and publications and citations is however more complex. In most Canadian universities, the number of publications and citations is the major criteria for promotion from lower to higher academic ranks. In contrast, services provided to the institution in administrative positions and the number of years of experience weigh little in decisions to promote scholars. In itself, the reliance on different promotion criteria by different universities suggests that academic rank actually embodies many dimensions that need to be made explicit in order to understand its relationship with publications and citations (Mishra and Smyth 2013; Sabharwal 2013; Abramo et al. 2011; Landry et al. 2010; Puuska 2010). Compared to scholars in lower academic ranks, scholars in higher academic ranks have more research experience, more research competence, more familiarity with a research topic, and a better capacity to raise tangible and intangible resources to support their research activities. These arguments suggest that, over a professional lifetime, scholars in higher academic ranks are expected to exhibit a higher number of publications and citations. Hence the following hypothesis

**Hypothesis 6** There is a positive relationship between academic rank and the number of publications and citations.

University ranking

Universities are complex organizations that differ significantly in the emphasis they place on their three missions, namely, (i) research in terms of knowledge creation; (ii) education in terms of training and knowledge transfer to students; and (iii) services provision in terms of knowledge transfer to society. For example, in Canada, the University of Toronto claims to be a global university with exceptional performance in all these three missions. Simon Fraser University claims to perform very well in both research and education while, Mount Allison University claims to provide an exceptional educational experience to its students. The University of Waterloo, on the other hand, claims to provide an exceptional incubating milieu for the transfer of knowledge to companies and the creation of successful spin-offs. As such claims have become commonplace, so have various types of university rankings ranging from (i) the Shanghai's ranking of world universities focusing mostly on the research mission of universities; (ii) the McLean's ranking of Canadian universities,[1] the Canadian equivalent of the Carnegie classification of institutions of higher education focusing on indicators of research, education and reputation[2]; and (iii) rankings based on university patenting, licensing and spin-offs creation activities as reported by the Association of University Technology Transfer Managers of the United States.

The methodologies of these rankings have been criticized over their ability to measure the "quality" of universities in all their complexities (van Raan 2005; Bowman and Bastedo 2011; Safón 2013; Chen and Liao 2012). Nevertheless, policy makers use them to develop investment policies for university research; university administrators use them to

[1] For details of how Maclean's ranks universities each year, see: http://www.macleans.ca/education/unirankings/measuring-excellence-2-2/. Retrieved December, 2014.

[2] Undergraduate and Comprehensive universities are ranked on 13 performance measures; Medical Doctoral universities are ranked on 14.

attract more funding, talented faculties, talented students and to create a feeling of pride and achievement among alumni, faculty, students and trustees (Safón 2013; Chen and Liao 2012). Furthermore, Chen and Liao (2012) showed that there is an increasing convergence in the results of several world rankings of universities. Thus, in deciding to investigate the levers at the disposal of university administrators to increase the publications and citations performance of their faculties, we used the Shanghai academic ranking of world universities.[3] This is because, as demonstrated by Docampo (2013), its results are reproducible. However, one of the limits of most rankings, including the Shanghai ranking, is that the coverage of social sciences is problematic. According to van Raan (2005), the strength of a university in social sciences contributes little, if at all, to the position of that university in the ranking. In a context where a third of Canadian faculty members in business administration do not publish in journals in the Web of Science (see Appendix 2), we can safely assume that their publications and citations contribute even less to the ranking of their university.

In this paper, we use the Shanghai ranking to create three categories of Canadian universities: (1) the top 5 universities included in the Shanghai ranking; (2) those in the top 500 ranking but not in the top five list; (3) those not included in the top 500 universities of the Shanghai ranking. This implies that: (i) universities in the first category are primarily research oriented exhibiting exceptional publications and citations performances at the world level; (ii) universities in the second category have significant levels of research funding with a large number of graduate programs and they exhibit very good research performances at the Canadian level without being global players; and, universities in the third category are primarily undergraduate universities whose impacts are mostly regional.

We further suggest that universities in the first category provide three series of incentives that are either not provided—or provided at a much lower level—in the second and third categories of universities. These are (i) material incentives under the form of better research facilities (laboratories, research space, time release for research, etc.) that generate higher research outputs (Carayol and Matt 2004; Landry et al. 2010); (ii) intellectual incentives embodied in work environments where close contacts with productive scholars provide access to expertise and ideas that foster higher productivity (Allison and Long 1990; Hemmings et al. 2007); and (iii) social incentives to help scholars to preserve their self-esteem among productive colleagues (Zukerman 1967; Hemmings et al. 2007). Thus, thanks to incentives offered by universities in the top tier category, members of their faculty enjoy a "halo effect" (Dey et al. 1997) which tends to increase their chances of getting published and obtaining more citations as compared to their counterparts in second and third tier universities (Johnson 1997; Mingers and Xu 2010; Long et al. 2009; Miller et al. 2013; Bergh et al. 2006; Safón 2013). Thus,

**Hypothesis 7** we hypothesize that a faculty member affiliated with a top five university benefits from incentives that increase the likelihood of getting higher publication and citation scores.

### Business disciplines

Literature shows that different disciplines exhibit different profiles in terms of publications and citations (Petersen et al. 2010; Leydesdorff and Shin 2011; Radicchi and Castellano

[3] For a complete explanation of the methodology, see: http://www.shanghairanking.com/ARWU-Methodology-2013.html. Retrieved December, 2014.

2012; Vieira and Teixeira 2010). Despite a growing literature on the relationship between natural sciences and engineering and publications and citations (Huang and Lin 2011; Young 2014), the literature on business disciplines shows mixed results (Saad 2006; Reis et al. 2011; Talukdar 2011; Merigó-Lindahl 2012; Mingers and Lipitakis 2014), suggesting that this is an open question to be resolved through further empirical investigation.

Publications, citations and performance configurations

In addition to the above, additional issues need to be addressed at this stage. First, what is the relationship between publications and citations? There is evidence that the number of publications is highly correlated with the number of citations (Parker et al. 2013; Bosquet et al. 2013; Basu 2006; Seglen 1992; Cole and Cole 1973), suggesting that factors that increase publications also augment citations. However, as previously shown, among the various performance configurations in business school, there are configurations where we need to identify factors that would explain why scholars would end up in frequently-cited profiles. The only likely factor is university ranking: scholars in higher-ranked universities are more likely than others to receive a higher number of citations for a given number of publications.

**Hypothesis 8** We hypothesize that there is a positive relationship between being in a higher-ranked university and the likelihood of being in a frequently-cited profile.

## Studied population and data collection

The individuals composing the population of this study are the faculty members of the Canadian business schools. We relied on five complementary approaches to identify this population. First, during the summer of 2009, two research assistants visited the web sites of all Canadian business schools affiliated with the *Association of Universities and Colleges of Canada*, and they independently identified the list of their faculty members. Second, after verification of academic ranks, these faculty members that were not assistant, associate or full professors were excluded from the population of the study (lecturers, visiting professors, emeritus professors, sessional instructors). These two complementary approaches allowed us to identify a population of 3,134 individuals affiliated with 35 business schools. Third, from the population of 3,134 individuals identified in the previous steps, a random sample of 1,286 scholars was extracted, using three criteria for representativeness: (1) the school; (2) the seniority of the scholar as measured by his/her academic rank (assistant, associate or full professor); and (3) his or her sub-discipline in management and business. Eight sub-disciplines were considered: (1) Management; (2) Human Resources Management; (3) Finance; (4) Marketing; (5) Information Management; (6) Accounting; (7) Operational Research; and (8) Economics. A web-based survey was used in combination with a telephone survey to collect data from these faculty members. The data were collected by a survey firm between December 2009 and March 2010. In a first stage, the respondents were contacted by email to answer a web-based survey. In order to improve the response rate, the survey was designed according to the principles formulated by Dillman (2000), Gaddis (*1998*). In a second stage, the survey firm contacted, by phone, faculty members who had not participated in the web-based survey, to request their participation in a phone-based survey version of the questionnaire. This two-stage procedure generated 807 usable questionnaires for a response rate of 62 %.

Fourth, between April and June 2010, two research assistants (RAs) collected independently, for each of the 3,134 faculty members composing the population of this study, the metrics compiled by the Social Sciences Citations Index (SSCI) of the Thomson ISI Web of Science (*WoS*) database (number of contributions, number of citations, Hirsch's h-index). Finally, for each of the 807 respondents to our survey, the two RAs used ''Harzing Publish or Perish'' software (Harzing 2007) to extract data from the GS database regarding the number of contributions, citations, and Hirsch's h-index.

In spite that the Thomson ISI Web of Science database (WoS) is increasingly criticized, notably because: (1) it excludes most research contributions published in non-listed journals, books, book chapters, conference proceedings, and most new Internet-based outlets; and (2) journal articles published in languages other than English (LOTE) are significantly underrepresented in the ISI-listed journals, which, admittedly, underestimates the scholars' contributions in some fields like business and management (Adler and Harzing 2009; Mingers and Lipitakis 2010; Bartneck and Kokkelmans 2011), it still is a reliable and a widely used database in academia (Costas and van Leeuwen 2010; Lissoni et al. 2011; Lortie et al. 2013; Abramo and D'Angelo 2014).

In this study we rely on this database for two main reasons: (1) *WoS* offers more options to refine the search of scholars' metrics than Google Scholar; and (2) as can be seen in Appendix 1, the correlations between each pair of performance indicators (number of contributions measured by ISI and by GS, citations measured by ISI and by GS, and h-index measured by ISI and by GS), are very high (.793 for contributions, .819 for citations, and .815 for h-index). These high correlations suggest that scholars who exhibit the highest performances when assessed in reference to articles published in high-impact factor journals also exhibit the highest performances when assessed in reference to the additional forms of the less research-oriented outputs included in the Google Scholar database.

More specifically, the "author finder" option was used to review all the publications associated with each individual in our population. This option allows the refinement of the search as we can specify the scholar's institution of affiliation, his/her main research topics, his/her country. This option also allows the production of a citation report that compiles many metrics as the number of articles published, number of citations, and h-index. Moreover, to refine the research procedure and to confirm that the right metrics were associated with the right scholars, the two RAs verified each of the contribution associated with each author. This verification enabled them to merge redundant contributions, control for name variation. Finally, to control for changes on the affiliation, they also tried, whenever possible, to cross-check the list of contributions of each scholar and his/her more recent available online CV. Although this task might at first sight appear immense, it was in practice easily manageable due to the fact that almost 75 % of the respondents had no more than 5 contributions captured in *WoS*, and that more than 94 % had 20 contributions or less (see Appendix 2 for details). Furthermore, the two principal investigators held many meetings with the two RAs to confront their data extraction results. Overall, the convergence between the results obtained by the two RAs was very high. When a consensus was not found regarding the metrics corresponding to particular scholars, the two principal investigators replicated the data extraction procedure used by the RAs, and consensus meetings were organized to ensure that the right metrics for the right scholars had been collected.

To assess the representativeness of the Final Sample (FS) used in this study, we compared the faculty members that compose this FS with their colleagues in the Rest of the population (ROP) that served in the initial sampling procedure. More specifically, we

compared the faculty members in the two samples with regard to three variables, namely, the total number of published papers, the total number of citations, and the distribution of the faculty members in each sample according to their academic rank. For the first two variables, we used the metrics compiled by the Social Sciences Citations Index (SSCI) of the Thomson ISI Web of Science (*WoS*) database. Appendices 3 and 4 show the comparison of rank means of these two variables for faculty members in the FS and the ROP samples. The results of these independent-sample *T* tests indicate that, on average, faculty members in the FS do not differ from their colleagues in the ROP sample, according to the total number of published papers and the total number of citations. Likewise, for the third variable of comparison, academic rank, the results of the Chi-square test reported in Appendix 5 indicate academic rank of faculty members, and faculty member's being in the FS or in the ROP sample, are two independent variables. Thus, we can conclude that on the basis of these three key variables, the faculty members in the FS are similar to their colleagues in the ROP sample.

### Operationalization of the dependent variable performance

The dependent variable performance was operationalized by crossing two indicators: (1) the scholar's number of publications measured as his/her lifetime number of scientific contributions; and (2) the scholar's number of citations measured as the lifetime number of citations. These two metrics were compiled from the Social Sciences Citations Index (SSCI) of the Thomson ISI Web of Science (*WoS*) database (see Fig. 1). Therefore, the construction of the dependent variable used in this study was based on these two variables and was derived in a three-step process. First, we selected from the database the subsample of scholars that have no publications, and consequently no citations. This group of scholars forms the first profile (Profile 1) that we called "non-publishing scholars". Second, for the remaining subsample, the medians of the two variables were calculated. As can be seen in Table 1, the medians are equal to 4 and 13 for the publications indicator and the citations indicator, respectively. Third, the four other profiles were characterized by combining the two indicators in the following manner (Table 1):

- *Low performing scholars (Profile 2)*: (Low publication record and Low citation record): Number of publications $\leq$4 and Number of citations $\leq$13.
- *Frequently publishing scholars (Profile 3)*: (High publication record and Low citation record): Number of publications >4 and Number of citations $\leq$13.
- *Highly-cited scholars (Profile 4)*: (Low publication record and High citation record): Number of publications $\leq$4 and Number of citations >13.
- *High-impact publishing scholars (Profile 5)*: (High publication record and High citation record): Number of publications >4 and Number of citations >13.

The distribution of scholars across these profiles is presented in Fig. 1.

## Analytical model and regression results

The following model was developed to establish the determinants of the various scholars' profiles resulting from the combination of their publication and citation records as compiled by *WoS* database, and to ascertain what factors explain the likelihood to be in one profile rather than another. Therefore, ten binary logistic regressions were estimated for all pairs of profile combination.

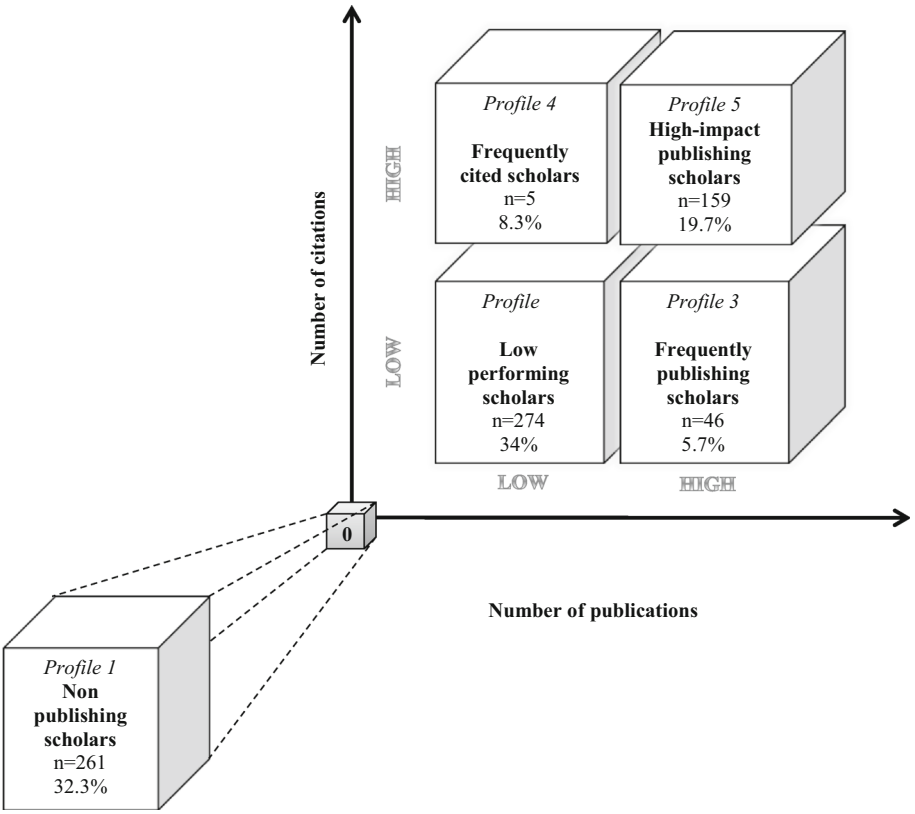


**Fig. 1** The distribution of scholars across the five profiles

$$\begin{aligned}\mathrm{Log}(P_i/1-P_i) = {} & \beta_0 + \beta_1 RESEAR + \beta_2 ASSIST + \beta_3 ASSOC + \beta_4 LOW\_FUND \\ & + \beta_5 MOD\_FUND + \beta_6 NO\_PFUND + \beta_7 PAR\_PFUND + \beta_8 OUT\_LIST \\ & + \beta_9 IN\_LIST + \beta_{10} TEACH + \beta_{11} SrADM + \beta_{12} SrCONS + \beta_{13} SrPASS\_KT \\ & + \beta_{14} PROAC\_KT + \beta_{15} TIES + \beta_{16} CONTACT + \beta_{17} HRM + \beta_{18} FINAN \\ & + \beta_{19} MARK + \beta_{20} INFOR + \beta_{21} ACCOUNT + \beta_{22} OPER + \beta_{23} CON + \varepsilon\end{aligned}$$

where, $\beta_i$ ($i = 0,\ldots,23$) are the coefficients, and $\varepsilon$ is the error term. Log ($P_i/1 - P_i$) is the logarithm of the ratio of the probability that a scholar has a more productive profile rather than a less productive one (Fig. 2).

We used the same explanatory variables for all regressions. Appendix 6 provides an overview of the operationalization of the independent variables as well as some descriptive statistics of these variables. As for the two indices based on multiple-item scales, namely passive knowledge transfer activities (SrPASS_KT) and proactive knowledge transfer activities (PROACT_KT), we conducted a principal components factor analysis (PCFA) to assess their unidimensionality. We also tested their reliability. The results indicate that these two multiple-item scale independent variables satisfy the unidimensionality criterion. Moreover, as it can be seen in the last column of Appendix 6, the values of Cronbach's $\propto$ indicate that the items forming each index are reliable (.694 and .811 respectively).

**Table 1** Publications and citations of the faculty members of the Canadian business schools as compiled by the Thomson ISI Web of Science Database

| Number of publication | Measured as the lifetime number of scholar's scientific contributions |
|---|---|
| Number of cases | 546 |
| Median | 4 |
| Mean | 7.51 |
| SD | 10.36 |
| Minimum | 1 |
| Maximum | 94 |
| **Number of citations** | **Measured as the lifetime number of scholar's citations** |
| Median | 13 |
| Mean | 75.16 |
| Std | 215.95 |
| Minimum | 0 |
| Maximum | 2,986 |

Moreover, the checking of the tolerance statistic values for the predictors used in the regression models indicates that all the tolerance statistic values are much higher than .2 (last column of Appendix 6). This ensures that there is no multicollinearity concern (Field 2009; Menard 1995).

Finally, we used the probability plots to determine whether the distribution of each of the six independent continuous variables included in the model matches a normal distribution. For three among them, namely time dedicated to administration activities, time dedicated to professional consultation, and passive knowledge transfer activities, we used a

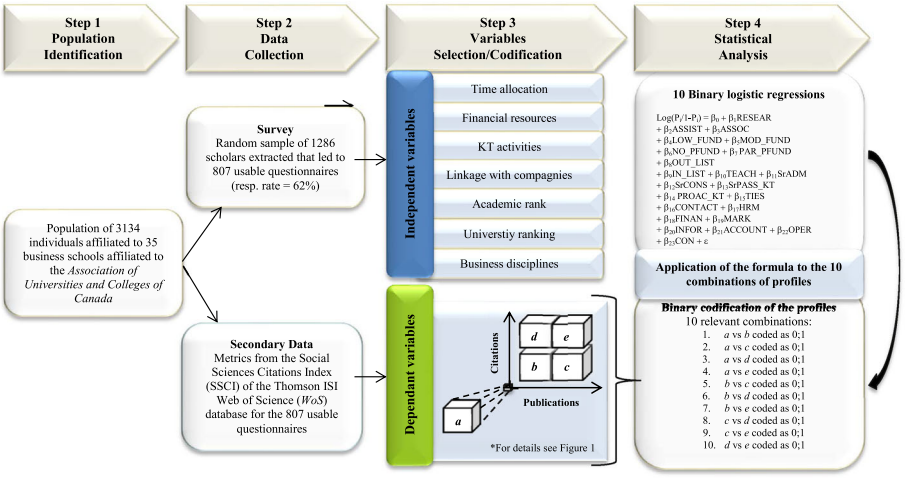


**Fig. 2** Data collection and data analysis processes

square root transformation; the probability plots for the transformed values indicated that the transformed variables did not differ significantly from a normal distribution.

## Results

The descriptive statistics of the independent variables used in this study are reported in Appendix 6. The regression results of the Logit models that corresponded respectively to the ten configuration situations of BS scholars' performance are summarized in Table 2. The computed value of the Chi-square statistics for each of the ten Logit regressions was greater than its critical value (i.e., 41.64) with 23 degrees of freedom at the 1 % level. The explanatory power of the models, as indicated by the percentages of correct predictions, was also very good. It varied between 68.0 % for the configuration corresponding to the likelihood that scholars have no publication nor citation rather than a low publication record and a low citation record, and 90.2 % for the configuration corresponding to the likelihood that scholars have no publication nor citation rather than high publication and low citations records.

Finally, the Nagelkerke pseudo $R^2$ was quite acceptable for models with qualitative dependent variables. It varied between .185 for the configuration corresponding to the probability that scholars have low publication and low citation records rather than low publication and high citation records, and .657 for the configuration corresponding to the probability that scholars have no publication nor citation rather than high publication and high citation records.

The estimation results that identified the factors affecting the likelihood that scholars be in a more productive profile rather than in a less productive one for the ten configurations are reported in Table 2. Let us first consider the capacity of the independent variables to explain the likelihood of being in more productive profiles rather than in less productive ones.

With regard to the independent variables that may increase or hamper scholars' publication and citation propensities, the results reported in Table 2 show that, anywhere from four to fourteen variables are significant to explain the likelihood of being in more productive profiles rather than in less productive ones at levels varying from 1 to 10 % in each of the ten equations corresponding to the different configurations considered in this study. More precisely, two variables, namely being a full professor rather than an assistant professor, and being a scholar totally funded by research councils rather than a scholar non-funded by research councils, are significant and exert a positive impact in eight of the ten equations considered in this study. Three other variables are f significant and have a positive impact in seven of the ten equations: being a full professor rather than an associate professor, and being affiliated to a top-5 university rather than to a second or third-tier university.

One variable, namely time dedicated to professional consultation, had a significant and positive impact in four configurations, and a significant and negative impact in one configuration. Conversely, having moderate research funding rather than large research funding, and having partial public research funding rather than total public research funding, had no significant impact on the likelihood of being in a better performing profile rather than in a lower performing one. Moreover, time dedicated to administration activities had a negative and significant impact for only one configuration among the ten considered in this study. Time dedicated to teaching activities and proactive knowledge

**Table 2** Estimated logit models of factors affecting the performance of scholars in business administration

| | Configuration # 1 | Configuration # 2 | Configuration # 3 | Configuration # 4 | Configuration # 5 |
|---|---|---|---|---|---|
| Dependent variables | Non-publishing profile/ low performing profile | Non-publishing profile/ frequently publishing profile | Non-publishing profile/ frequently cited scholars profile | Non-publishing profile/ high-impact publishing profile | Low performing profile/ frequently publishing profile |
| Independent variables | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] |
| Constant | 1.717 | −2.193 | −1.793 | −.628 | −5.299 |
| Time allocation | | | | | |
| Time dedicated to research activities (RESEAR) | .006 | .024 | .025* | .039** | .042** |
| Time dedicated to teaching activities (TEACH) | −.005 | .001 | −.004 | .004 | .024 |
| Time dedicated to administration activities (Sr_ADM)[a] | .063 | .009 | .265 | −.282** | .093 |
| Time dedicated to professional consultation activities (Sr_CONS)[a] | .108 | .280** | .153* | .194* | .257** |
| Financial resources | | | | | |
| Research Funds | | | | | |
| Low research funding (LOW_FUND) | −.808** | .638 | .248 | −.602 | −1.121** |
| Moderate research funding (MOD_FUND) | −.360 | −.718 | .650 | −.427 | −.168 |
| High research funding (HIGH_FUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Public sources of research funding | | | | | |
| No public research funding (NO_PFUND) | −.557** | −1.930*** | −.247 | −1.132*** | −1.328*** |

**Table 2** continued

| | Configuration # 1 | Configuration # 2 | Configuration # 3 | Configuration # 4 | Configuration # 5 |
|---|---|---|---|---|---|
| Partial public research funding (PAR_PFUND) | −.037 | −.450 | .074 | −.376 | −.016 |
| Total public research funding (TOT_PFUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Knowledge transfer activities | | | | | |
| Passive knowledge transfer activities (Sr_PASS_KT)[a] | .451 | 1.496* | .306 | 1.817*** | 1.050 |
| Proactive knowledge transfer activities (PROACT_KT) | −.142 | .428 | −.057 | −.074 | −.085 |
| Linkages with companies | | | | | |
| Strength of ties with companies (TIES) | −.299 | −.562 | −.303 | −.630* | −.070 |
| Frequency of contacts with companies (CONTACT) | .180 | −.830* | .178 | −.542* | −.388 |
| Academic rank | | | | | |
| Assistant professor (ASSIST) | −.331 | −2.524*** | −1.784*** | −3.645*** | −2.366*** |
| Associate professor (ASSOC) | −.157 | −.479 | −.976*** | −1.480*** | −.586* |
| Full professor (FULL) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| University ranking | | | | | |
| Not in the top-500 AWRU list (OUT_LIST) | −1.512*** | −2.452** | −2.032*** | −3.412*** | −.176 |
| In the top-500 AWRU but not in the top-5 (IN_LIST) | −1.249*** | −1.870** | −1.021* | −2.644*** | −.189 |
| Top-5 Canadian Universities (TOP_5) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Control variable | | | | | |
| Business disciplines | | | | | |
| Human Resources Management (HRM) | .481 | .609 | .105 | .493 | .285 |
| Finance (FINAN) | .152 | .928* | .253 | .075 | .339 |
| Marketing (MARK) | −.204 | −1.617* | .317 | .296 | −1.507* |
| Information Management (INFORM) | .507 | 1.762*** | 1.649*** | .857* | 1.510*** |
| Accounting (ACCOUNT) | −1.160*** | −1.942** | −1.066** | −2.015*** | −.409 |
| Operational Research (OPERES) | .382 | .712 | −.167 | 1.079** | .741 |
| Economics (ECONO) | 1.134*** | 1.453** | −.234 | .944 | .370 |
| Management (MNG) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |

**Table 2** continued

| | Configuration # 1 | Configuration # 2 | Configuration # 3 | Configuration # 4 | Configuration # 5 |
|---|---|---|---|---|---|
| Number of cases | 261/274 | 261/46 | 261/67 | 261/159 | 274/46 |
| Chi-square (df): Critical Chi-square (23) at 1 % level = 41.64 | 102.70 (23) | 101.54 (23) | 63.20 (23) | 276.91 (23) | 53.64 (23) |
| Nagelkerke $R^2$ (Pseudo $R^2$) | .233 | .494 | .275 | .657 | .275 |
| Percentage of correct predictions | 68.0 % | 90.2 % | 79.3 % | 85.2 % | 85.0 % |
| | Configuration # 6 | Configuration # 7 | Configuration # 8 | Configuration # 9 | Configuration # 10 |
| Dependent variables | Low performing profile/frequently cited scholars profile | Low performing profile/ high-impact publishing profile | Frequently publishing profile/frequently cited scholars profile | Frequently publishing profile/high-impact publishing profile | Frequently cited profile/high-impact publishing profile |
| Independent variables | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] | Coeff. ($\beta$)[b] |
| Constant | −1.927 | −1.531 | 7.485 | 4.768 | 1.606 |
| Time allocation | | | | | |
| Time dedicated to research activities (RESEAR) | −.003 | .029** | −.073 | −.010 | .024 |
| Time dedicated to teaching activities (TEACH) | −.003 | .003 | −.050** | −.042** | .004 |
| Time dedicated to administration activities (Sr_ADM)[a] | .091 | .149 | .015 | .002 | −.108 |
| Time dedicated to professional consultation activities (Sr_CONS)[a] | .028 | .092 | −.151 | −.317** | .019 |
| Financial resources | | | | | |
| Research Funds | | | | | |
| Low research funding (LOW_FUND) | .783 | .520 | −1.998** | −1.470** | .148 |
| Moderate research funding (MOD_FUND) | .855 | .493 | .018 | .598 | −.078 |
| High research funding (HIGH_FUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |

**Table 2** continued

| | Configuration # 6 | Configuration # 7 | Configuration # 8 | Configuration # 9 | Configuration # 10 |
|---|---|---|---|---|---|
| Public sources of research funding | | | | | |
| No public research funding (NO_PFUND) | .256 | −1.016*** | −2.730*** | −1.673*** | −1.425*** |
| Partial public research funding (PAR_PFUND) | .423 | −.142 | .255 | −.375 | −.403 |
| Total public research funding (TOT_PFUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Knowledge transfer activities | | | | | |
| Passive knowledge transfer activities (Sr_PASS_KT)[a] | −.013 | 1.245*** | −1.367 | 1.110 | 1.260* |
| Proactive knowledge transfer activities (PROACT_KT) | −.067 | −.124 | −.867* | −.463* | .212 |
| Linkages with companies | | | | | |
| Strength of ties with companies (TIES) | −.070 | −.395 | −.199 | −.202 | −.463 |
| Frequency of contacts with companies (CONTACT) | −.169 | −.380 | .855 | .207 | −.920** |
| Academic rank | | | | | |
| Assistant professor (ASSIST) | −1.704*** | −4.192*** | .878 | −2.721*** | −2.135*** |
| Associate professor (ASSOC) | −.928*** | −1.554*** | .202 | −.926** | −1.104*** |
| Full professor (FULL) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| University ranking | | | | | |
| Not in the top-500 AWRU list (OUT_LIST) | −.385 | −1.949*** | −.559 | −1.778*** | −1.830*** |
| In the top-500 AWRU but not in the top-5 (IN_LIST) | .309 | −1.357*** | .680 | −1.374** | −1.850*** |
| Top-5 Canadian Universities (TOP_5) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Control variable | | | | | |
| Business disciplines | | | | | |

**Table 2** continued

| | Configuration # 6 | Configuration # 7 | Configuration # 8 | Configuration # 9 | Configuration # 10 |
|---|---|---|---|---|---|
| Human Resources Management (HRM) | −.347 | .175 | −.225 | −.277 | .280 |
| Finance (FINAN) | .115 | −.235 | −.191 | −1.030* | −.724 |
| Marketing (MARK) | .875** | 1.003*** | 2.990** | 2.498** | −.009 |
| Information Management (INFORM) | 1.485*** | 1.087** | −.645 | −.867* | −.566 |
| Accounting (ACCOUNT) | .315 | −.672 | 1.718 | −.260 | −2.237*** |
| Operational Research (OPERES) | −.068 | 1.476*** | .125 | 1.531** | .766 |
| Economics (ECONO) | −.935 | .154 | −1.401 | −1.079* | 1.099 |
| Management (MNG) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Number of cases | 274/67 | 274/159 | 46/67 | 46/159 | 67/159 |
| Chi-square (df): Critical Chi-square (23) at 1 % level = 41.64 | 42.26 (23) | 184.35 (23) | 53.89 (23) | 55.47 (23) | 75.93 (23) |
| Nagelkerke $R^2$ (Pseudo $R^2$) | .185 | .474 | .512 | .362 | .406 |
| Percentage of correct predictions | 81.2 % | 79.2 | 84.1 | 84.4 | 81.0 % |

[a] Sr indicates a square root transformation

*, **, *** That variable is significant at 10, 5 and 1 % level respectively

transfer activities were found to have a significant and negative impact for two configurations among the ten considered in this study.

With regard to business disciplines, the results show that, overall, scholars in management are more likely to be in better performing profiles than their colleagues in accounting. Moreover, being a scholar in marketing rather than in management had a significant impact in six configurations among the ten considered in this study. Finally, being a scholar in finance rather than in management had a significant impact for two configurations, whereas no significant differences were found between scholars in human resources management and those in management.

Let us now look more carefully at each of the ten configurations in turn:

- *Configuration 1: From the non-publishing profile to the low performing profile* (0 Publication and 0 Citation/Low publication score and Low citation score): in this configuration, being a scholar with a high level of research funding rather than a scholar with a low level of research funding, being a scholar totally funded by research councils rather than a scholar non-funded by research councils, being in a top-5 university rather than in a second or third-tier university, and being a scholar in management rather than in accounting, increase the probability that scholars be in the low performing profile rather than in the non- publishing profile. Moreover, being a scholar in economics rather than in management decreases this probability.
- *Configuration 2: From the non-publishing profile to the frequently publishing profile (0 Publication and 0 Citation/high Publication score and low Citation score)*: in this configuration, being a full professor rather than an assistant professor, being a scholar with a high level of research funding rather than a scholar with a low level of research funding, being affiliated with a top-5 university rather than with a second or third-tier university, having a low frequency of contacts with companies, and being a scholar in management rather than accounting or in marketing, increase the likelihood that scholars be in the frequently publishing profile rather than in the non-publishing profile. Moreover, time dedicated to professional consultation, passive knowledge transfer activities, and being a scholar in finance, in information management or in economics rather than in management, decrease this likelihood.
- *Configuration 3: From non-publishing profile to frequently cited profile (0 Publication and 0 Citation/Low publication score and High citation score)*: in this third configuration, seniority and university ranking were found exerting a significant impact on the likelihood that scholars be in the frequently cited profile rather than in the non-publishing profile. More specifically, being a full professor rather than an assistant or associate professor, and being affiliated with a top-5 university rather than with a second or third-tier university, and being a scholar in management rather than in accounting, increase this likelihood. Moreover, time dedicated to research activities, time dedicated to professional consultation, and being a scholar in information management rather than in management, increase this likelihood.
- *Configuration 4: From non-publishing profile to high-impact publishing profile (0 Publication and 0 Citation/High publication score and High citation score)*: for this fourth configuration, a decrease in time dedicated to administration activities, weak ties with companies, a low frequency of contacts with companies, being a full professor rather than an assistant or associate professor, being a scholar totally funded by research councils rather than a scholar non-funded by research councils, being affiliated with a top-5 university rather than with a second or third-tier university, and being a scholar in management rather than in accounting, an increase in time dedicated to

research activities, an increase in time dedicated to professional consultation, passive knowledge transfer activities, and being a scholar in information management or in economics rather than in management, increase the likelihood that scholars be in a high-impact publishing profile instead of a non-publishing profile.

- *Configuration 5: From low performing profile to frequently publishing profile (Low publication score and Low citation score/High publication score and Low citation score)*: in this configuration, an increase in time dedicated to research activities and in time dedicated to professional consultation, being a full professor rather than an assistant or associate professor, being a scholar with a high level of research funding rather than a scholar with a low level of research funding, being a scholar totally funded by research councils rather than a scholar non-funded by research councils, being a scholar in management rather than in marketing, and being a scholar in information management rather than in management, increase the probability that he will be in the frequently publishing profile rather than in the low performing profile.
- *Configuration 6: From low performing profile to frequently cited profile (Low publication score and Low citation score/Low publication score and High citation score)*: in this configuration, being a full professor rather than an assistant professor or associate professor, and being a scholar in marketing or in information management rather than in management, increase the probability that he will be in the frequently cited profile rather than in the low performing profile.
- *Configuration 7: From low performing profile to high-impact publishing profile (Low publication score and Low citation score/High publication score and High citation score)*: in this configuration, the probability that scholars be in the high-impact publishing profile rather than in the low performing profile is increased by an increase in time dedicated to research activities, an increase in the index of passive knowledge transfer activities, being a scholar in marketing, in information management or in operational research rather than in management, being a full professor rather than an assistant professor or associate professor, being a scholar totally funded by research councils rather than a scholar non-funded by research councils, and being affiliated with a top-5 university rather than with a second or third-tier university.
- *Configuration 8: From frequently publishing profile to frequently cited profile (High publication score and Low citation score/Low publication score and High citation score)*: in this configuration, five variables were found significant and exerting a positive impact on the likelihood that scholars be in the frequently cited profile rather than in the frequently publishing profile, namely a decrease in time dedicated to teaching activities and in the index of proactive knowledge transfer activities, being a scholar with a high level of research funding rather than a scholar with a low level of research funding, being a scholar totally funded by research councils rather than a scholar non-funded by research councils, and being a scholar in marketing rather than in management.
- *Configuration 9: From frequently publishing profile to high-impact publishing profile (High publication score and Low citation score/High publication score and High citation score)*: for this configuration, being a full professor rather than an assistant professor or associate professor, being a scholar with a high level of research funding rather than a scholar with a low level of research funding, being a scholar totally funded by research councils rather than a scholar non-funded by research councils, being affiliated with a top-5 university rather than with a second or third-tier university, a decrease in time dedicated to administration activities and in time spent in professional consultation activities, a decrease in the index of proactive knowledge

transfer activities, and being a scholar in management rather than in finance, in information management or in economics, increase the probability that a scholar be in the high-impact publishing profile rather than in the frequently publishing profile.

- *Configuration 10: From frequently-cited scholars profile to high-impact publishing profile (Low publications and High citations/High publications and High citations)*: for this last configuration, eight predictors were positively related to the likelihood that scholars be in the high-impact publishing profile rather than in the frequently cited profile: a decrease in passive knowledge transfer activities index, a low frequency of contacts with companies, being a full professor rather than an assistant or an associate professor, being a scholar totally funded by research councils rather than a scholar non-funded by research councils, being affiliated with a top-5 university rather with a second or third-tier university, and being a scholar in management rather than in accounting.

Table 3 summarizes the previous findings regarding the determinants of BS scholars' different profiles.

## Discussion

First, we will review to what extent the hypotheses derived from the literature were confirmed and their policy implications. Second, we will discuss what it takes to move up from a non-publication profile to a low performing profile, and from a low performing profile to a higher performing profiles.

We hypothesized a positive relation between time dedicated to research, and publication and citation scores. Interestingly, with the exception of configuration 2, we found a positive association for these configurations involving radical changes in performances, but no association for these configurations involving incremental changes in performances. For instance, time dedicated to research activities is not significantly associated with being in a low performing profile rather than in a non-publishing profile (configuration 1). However, time dedicated to research is positively associated with performance for these configurations involving more radical changes like in the case of configuration 3 where we consider the situation of scholars being in a frequently cited profile rather than in a non-publishing profile. These results suggest that university administrators may want to devise policies regarding time release for research activities only for these cases where they aim to generate radical changes in publication and citation scores. These results also suggest that incremental changes in scholarly performances do not require special attention from university administrators.

We also hypothesized a negative relationship between time dedicated to teaching, administration and professional consulting activities, and publication and citation scores. Overall, these variables are not significantly related to performances. Time dedicated to teaching is negatively associated with the case of scholars being in a frequently cited profile and in a high impact profile rather than in a frequently published profile (see configurations 8 and 9). As for the time dedicated to administration activities it has a negative relation only for the case of a radical change involving scholars in the high-impact publishing profile rather than in the non-publishing profile (configuration 4). Finally, professional consultation is positively related to publication and citation scores in three configurations involving radical changes (configurations 2, 3 and 4), and in a configuration involving incremental changes (configuration 5). However, this variable is negatively

**Table 3** Estimated Logit models of factors affecting the performance of BS scholars

| | Configuration # 1 | Configuration # 2 | Configuration # 3 | Configuration # 4 | Configuration # 5 |
|---|---|---|---|---|---|
| Dependent variables | Non-publishing profile/Low performing profile | Non-publishing profile/Prolific profile | Non-publishing profile/ Efficient profile | Non-publishing profile/Elite profile | Low performing profile/Prolific profile |
| Independent variables | Coeff. ($\beta$) | Coeff. ($\beta$) | Coeff. ($\beta$) | Coeff. ($\beta$) | Coeff. ($\beta$) |
| Time allocation | | | | | |
| Time dedicated to research activities (RESEAR) | NS | NS | + | + | + |
| Time dedicated to teaching activities (TEACH) | NS | NS | NS | NS | NS |
| Time dedicated to administration activities (Sr_ADM)[a] | NS | NS | NS | − | NS |
| Time dedicated to professional consultation activities (Sr_CONS)[a] | NS | + | + | + | + |
| Financial resources | | | | | |
| Research Funds | | | | | |
| Low research funding (LOW_FUND) | − | NS | NS | NS | − |
| Moderate research funding (MOD_FUND) | NS | NS | NS | NS | NS |
| High research funding (HIGH_FUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Public sources of research funding | | | | | |
| No public research funding (NO_PFUND) | − | − | NS | − | − |
| Partial public research funding (PAR_PFUND) | NS | NS | NS | NS | NS |
| Total public research funding (TOT_PFUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Knowledge transfer activities | | | | | |

**Table 3** continued

| | Configuration # 1 | Configuration # 2 | Configuration # 3 | Configuration # 4 | Configuration # 5 |
|---|---|---|---|---|---|
| Passive knowledge transfer activities (Sr_PASS_KT)[a] | NS | + | NS | + | NS |
| Proactive knowledge transfer activities (PROACT_KT) | NS | NS | NS | NS | NS |
| Linkages with companies | | | | | |
| Strength of ties with companies (TIES) | NS | NS | NS | − | NS |
| Frequency of contacts with companies (CONTACT) | NS | − | NS | − | NS |
| Academic rank | | | | | |
| Assistant professor (ASSIST) | NS | − | − | − | − |
| Associate professor (ASSOC) | NS | NS | − | − | − |
| Full professor (FULL) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| University ranking | | | | | |
| Not in the top-500 AWRU list (OUT_LIST) | − | − | − | − | NS |
| In the top-500 AWRU but not in the top-5 (IN_LIST) | − | − | − | − | NS |
| Top-5 Canadian Universities (TOP_5) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Control variables | | | | | |
| Business disciplines | | | | | |
| Human Resources Management (HRM) | NS | NS | NS | NS | NS |
| Finance (FINAN) | NS | + | NS | NS | NS |
| Marketing (MARK) | NS | − | NS | NS | − |
| Information Management (INFORM) | NS | + | + | + | + |
| Accounting (ACCOUNT) | − | − | − | − | NS |
| Operational Research (OPERES) | NS | NS | NS | + | NS |

**Table 3** continued

| | Configuration # 1 | Configuration # 2 | Configuration # 3 | Configuration # 4 | Configuration # 5 |
|---|---|---|---|---|---|
| Economics (ECONO) | + | + | NS | NS | NS |
| Management (MNG) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |

| | Configuration # 6 | Configuration # 7 | Configuration # 8 | Configuration # 9 | Configuration # 10 |
|---|---|---|---|---|---|
| Dependent variables | Low performing profile/ Efficient profile | Low performing profile/ Elite profile | Prolific profile/ Efficient profile | Prolific profile/ Elite profile | Efficient profile/ Elite profile |
| Independent variables | Coeff. ($\beta$) | Coeff. ($\beta$) | Coeff. ($\beta$) | Coeff. ($\beta$) | Coeff. ($\beta$) |
| Time allocation | | | | | |
| Time dedicated to research activities (RESEAR) | NS | + | NS | NS | NS |
| Time dedicated to teaching activities (TEACH) | NS | NS | − | − | NS |
| Time dedicated to administration activities (Sr_ADM)[a] | NS | NS | NS | NS | NS |
| Time dedicated to professional consultation activities (Sr_CONS)[a] | NS | NS | NS | − | NS |
| Financial resources | | | | | |
| Research Funds | | | | | |
| Low research funding (LOW_FUND) | NS | NS | − | − | NS |
| Moderate research funding (MOD_FUND) | NS | NS | NS | NS | NS |
| High research funding (HIGH_FUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Public sources of research funding | | | | | |
| No public research funding (NO_PFUND) | NS | − | − | − | − |

**Table 3** continued

| | Configuration # 6 | Configuration # 7 | Configuration # 8 | Configuration # 9 | Configuration # 10 |
|---|---|---|---|---|---|
| Partial public research funding (PAR_PFUND) | NS | NS | NS | NS | NS |
| Total public research funding (TOT_PFUND) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Knowledge transfer activities | | | | | |
| Passive knowledge transfer activities (Sr_PASS_KT)[a] | NS | + | NS | NS | + |
| Proactive knowledge transfer activities (PROACT_KT) | NS | NS | − | − | NS |
| Linkages with companies | | | | | |
| Strength of ties with companies (TIES) | NS | NS | NS | NS | NS |
| Frequency of contacts with companies (CONTACT) | NS | NS | NS | NS | − |
| Academic rank | | | | | |
| Assistant professor (ASSIST) | − | − | NS | − | − |
| Associate professor (ASSOC) | − | − | NS | − | − |
| Full professor (FULL) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| University ranking | | | | | |
| Not in the top-500 AWRU list (OUT_LIST) | NS | − | NS | − | − |
| In the top-500 AWRU but not in the top-5 (IN_LIST) | NS | − | NS | − | − |
| Top-5 Canadian Universities (TOP_5) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |
| Control variables | | | | | |
| Business disciplines | | | | | |

**Table 3** continued

| | Configuration # 6 | Configuration # 7 | Configuration # 8 | Configuration # 9 | Configuration # 10 |
|---|---|---|---|---|---|
| Human Resources Management (HRM) | NS | NS | NS | NS | NS |
| Finance (FINAN) | NS | NS | NS | − | NS |
| Marketing (MARK) | + | + | + | + | NS |
| Information Management (INFORM) | + | + | NS | − | NS |
| Accounting (ACCOUNT) | NS | NS | NS | NS | − |
| Operational Research (OPERES) | NS | + | NS | + | NS |
| Economics (ECONO) | NS | NS | NS | − | NS |
| Management (MNG) | Benchmark | Benchmark | Benchmark | Benchmark | Benchmark |

[a] Sr indicates a square root transformation

*, **, *** That variable is significant at 10, 5 and 1 % level respectively

related to performance in a case of incremental change regarding the case of scholars being in a high-impact publishing profile rather than in a frequently publishing profile (configuration 9). Overall, time allocation is a weak policy lever. Thus, the frequent claim that low publication and citation scores by excessive time dedicated to teaching and professional consultation combined with lack of time dedicated to research activities is not supported by the evidence collected for this study. Indeed, Landry et al. (2010) have found that complementarity effects between academic activities are much more prevalent than substitution effects. Their findings suggest that the outputs of many academic activities can be used as inputs for the undertaking of other academic activities.

Hypotheses 2 and 3 regarding financial resources are largely confirmed. Overall, we found a positive association between high research funding, and publication and citation scores, as well as between the fact of being totally supported by research councils (public support) and publication and citation performances. Interestingly, having a moderate level of research funding or only partial research funding was not associated with publication and citation scores. These results suggest that the publication and citation scores are associated with a high concentration of financial resources. Based on a very large data set, Larivière et al. (2010) have uncovered similar findings. Such results suggest that an efficient use of public financial support for research should be concentrated rather than diffused across the whole scholarly community. Such a policy recommendation may not be welcomed in the scholarly community.

Third, we hypothesized that passive knowledge transfer to companies had no impact on publications and citations, while proactive knowledge transfer was assumed to be negatively related to publication and citation scores. These hypotheses are only partly supported. Proactive knowledge transfer has no relationship with scholarly performance in all cases, except for configurations 8 and 9 where it is negatively associated with being in either a frequently cited profile or a high impact publishing profile rather than in a frequently publishing profile. In other words, being involved in proactive knowledge transfer has a negative influence on getting to the highest of citation scores. As for passive knowledge transfer, it has no relationship with publication and citation scores in six configurations and a positive relation either involving marginal changes in citation scores (configurations 8 and 10) or radical changes in publication scores (configuration 2) and in citation scores (configuration 4). Such results do not provide sufficiently strong evidence to devise effective policies that would contribute to increase either publications or citations.

Fourth, we hypothesized that there is no clear directional relationship between either the strength of ties or the frequency of contact with companies, and the number of publications and citations. These hypotheses are partly confirmed by our results. Many previous studies have also arrived at similar results. These results counter the myth that publication and citation performances of business schools' scholars are hampered by the strength of ties and the frequency of contact they have with industry. Given that most business schools develop initiatives to forge stronger linkages with industry, these findings suggest that such linkages do not impact negatively on publications and citations.

Fifth, we hypothesized that higher academic ranks are positively related to higher publication and citation scores. With the exception of two configurations, this hypothesis is largely supported by tour results. They suggest that there is no statistically significant relation between the fact of being in a frequently cited profile rather than in a frequently publishing profile (configuration 8). The case of configuration 1 is more puzzling because it suggests that the academic rank is not associated with the fact of having a small number of publications and citations by comparison of having no publication at all. This is commented on in more detailed below.

Finally, we hypothesized a positive relationship between university ranking, and publication and citation scores. This hypothesis was supported by the evidence for seven out of the ten configurations investigated in this study. Being a scholar located in the top 5 Canadian universities rather than in a second and third-tier university tends to be associated with higher publication and citation scores. In a complementary manner, we hypothesized that scholars in higher-ranked universities benefit from a citation premium. More specifically, we hypothesized that scholars in higher-ranked universities are also more likely to be in frequently cited profiles than their colleagues in lower-ranked universities. This latter hypothesis is not supported by the evidence provided by configurations 6 and 8, while it is supported by the results found in configurations 3, 4 and 7. Overall, these results strongly suggest that university ranking matters. Administrators of higher-ranked universities likely provide material, intellectual and social incentives that are more conducive to fostering academic productivity than their counterparts in lower-ranked universities. University administrators of lower-ranked universities may want to learn more about how these incentives could be adapted to their institutions in order to increase the publication and citation scores of their faculty members. With respect to the relationships between business disciplines and publication/citation scores, we found no clear trends with two exceptions, the first showing that information management tended to perform better than management, and second, that accounting tended to perform below the scores of management.

From the above, two questions emerge: (1) what it takes to get started in the academic career? and (2) what it takes to move up the ladder of the academic career?

What does it take to get started in the academic career?

First, we will consider configuration 1 about scholars in the non- publishing profile representing 32 % of the respondents and scholars in the low performing profile who make up 34 % of the respondents of this study. The econometric results show that scholars in a low performing profile (low publication and citation scores) differ from those in a non-publishing profile (zero publication) only by being located in a top-tier university and having a high level of funding from research councils. Factors such as the academic rank, time allocation, involvement in knowledge transfer to companies and linkages with companies do not explain the differences between these two profiles of scholars. These results suggest that university administrators of top tier universities make better decisions at the recruitment stage by selecting more scholars with research potential that turns out to be realized under the form of publications and citations. Thus, recruitment policies matter. Therefore, second and third tier universities may improve their recruitment policies by paying more attention to the research potential of the candidates who apply for tenured positions. We are aware that this is a difficult challenge in the case of regional universities where university administrators cannot provide these incentives.

Furthermore, getting large amount of funding from research councils was also found to be related to a low-performing profile rather than to a non-publishing profile. Fortunately, the Canadian federal and provincial research councils have devised policies targeting scholars of less than 5 years of experience by using evaluation criteria that give more weight to the quality of the research projects than to the publication and citation records of the applicants. Such policies may be especially advantageous for top tier universities which provide material, intellectual and social incentives that are more efficient than those of the second and third-tier universities at helping their faculty members compete successfully for the research grants provided by research councils. If this interpretation is correct, it

suggests that administrators of second and third-tier universities should adopt some of these incentives used in the top-tier universities. Finally, results of role of the level of research funding in explaining the difference between being in the low performing profile rather than in the non-publishing profile suggest that research councils should concentrate their resources on the best research projects instead of spreading their research funds among a large proportion of the scholars who are part of the non-publishing profile.

Last but not least, the results show that the academic rank, time allocation, involvement in knowledge transfer to companies, and linkages with companies do not explain the differences between the low performing profile and the non-publishing profile. Such results suggest that university administrators and government policy-makers should refrain from using these levers because they have no impact on helping scholars to get started in their academic careers. Many Canadian business schools use release teaching time policies to induce their new faculty members to dedicate more time to research activities. The results of this study suggest that it may be more productive to provide expert advice and assistance that would help new faculty members to become more successful at getting research grants from research councils.

## Moving up the ladder of the academic career

We will now consider the differences between these scholars that have accumulated a small number of publications and citations (low performing profile) and these scholars who publish frequently but are rarely cited (frequently publishing-profile), are frequently cited but have a small number of publications (frequently cited profile), or are frequently publishing and frequently cited (high-impact frequently publishing profile). The results show that the academic rank is the only difference between scholars who are low performers and those who are frequently publishing or frequently cited, or frequently-publishing and frequently cited. Full professors who are low performers are more likely to be frequently publishing and/or cited than their colleagues who are associate or assistant professors. These results suggest that academic rank captures very important differences between scholars with respect to their capabilities to transform their research ideas into publications and citations. The results of this study support the idea that scholars in higher academic ranks achieve higher publication and citation scores than their colleagues in lower academic ranks because academic rank is associated with more research experience, more research competence, more familiarity with a research topic, and a better capacity to raise tangible and intangible resources to support research activities. The association between academic rank and research productivity also suggests that university administrators generally give more weight to the research performance of their faculty members when comes time to consider applications for promotion to higher academic ranks.

The results suggest that the academic rank is the only difference between scholars who are in the frequently cited profile and those who are in the low performing profile (low publication and citation scores). There are more differences between scholars who are in the frequently publishing profile and those who are in the low-performance profile. In fact, scholars who are in the frequently-publishing profile rather than in the low performing profile differ in five ways: the former are full professors, they dedicate more time to research and consulting, and they are more likely to have significant levels of funding from research councils than assistant professors. Scholars who are in the high-impact frequently publishing profile rather than in the low performing profile also differ in five but slightly different ways: they are also full professors, they dedicate more time to their research activities, they receive all their research funding from research councils, they are more

involved in passive knowledge transfer activities and, finally, they are located in top-tier universities.

Overall, these three sets of results suggest that academic rank of full professorship embodies resources that may be sufficient to explain the likelihood of being in a frequently cited profile rather than in a low performing profile. But, once scholars have a small number of publications and citations may require additional resources, especially more time for research activities and public research funding. Finally, the results suggest that scholars in top-tier universities may benefit from material, intellectual and social incentives that increase their likelihood of being in a high-impact frequently publishing profile (high publication and citation scores) rather than in a low performing profile (low publication and citation scores).

What do such results imply for university administrators and national policy-makers? The fact that academic rank matters suggest that the development of academic careers should not be based on implicit policies which assume that the development of research skills of scholars can rest only on a process of learning by osmosis. The results of this study suggest that university administrators may need to develop and implement explicit career development policies that aim to improve the research skills of their faculty members by using a diversified set of incentives. First, university administrators may consider improving the material incentives they provide to their faculty members. For instance, they may create or consolidate their research offices by hiring personnel that would provide expert advice and assistance to help scholars prepare applications for research grants. Training sessions and seminars on how to prepare applications for research grants could also be offered by the university research offices. The systematic implementation of such simple policies will likely contribute to improving the success rate in competing for research grants from research councils. Second, university administrators need to use more systematically the intellectual incentives that are embodied in the work environments of their universities by creating more opportunities where faculty members have close contacts with productive scholars. Developing such opportunities will likely provide access to expertise and ideas to improve the productivity of less productive scholars. Third, university administrators need to rely more heavily on social incentives that create and preserve self-esteem among productive faculty members. Such social incentives may induce faculty members to do what they would not do otherwise: to try harder to publish and to publish more while hoping to be cited and be cited more frequently. University administrators of second and third tier universities may also get ideas for intervention by looking at the material, intellectual and social incentives used by top-tier universities. Overall, the results of our study suggest that recruitment, career development (of research skills) and promotion policies are likely the most efficient policies that university administrators can use to increase the publication and citation scores of their faculty members.

## Concluding remarks and future research

Overall, although we found that many factors influence publication and citation scores, two sets of major results emerge from this study: first, scholars who are in the low performing profile (low publication and citation scores) differ from those in the non-publishing profile (zero publication and zero citation) only by being in top-tier universities and by having high levels of funding from research councils; second, scholars who publish frequently and are frequently cited (high-impact frequently publishing profile) differ from those in the low performing profile in many ways: they are full professors, they dedicate more time to their

research activities, they receive all their research funding from research councils, they are more involved in passive knowledge transfer activities, and finally, they are located in top-tier universities.

Such results carry important implications for university administrators and national policy-makers. First, the results showing that scholars in top tier universities are more likely to be in a low performing profile than in a non-publishing profile suggest that the second and third-tier universities may improve their recruitment policies as well as their career development policies by adopting material, intellectual and social incentives used by top-tier universities to improve the research skills of their faculty members. Furthermore, they should provide more assistance and better expert advice to help their faculty members prepare applications for research grants. Second, the results regarding the factors explaining why some scholars are in the high-impact frequently publishing profile rather than in the low performing profile suggest that university administrators should realize that implicit career development policies of relying on learning research skills by osmosis is not working and, as a consequence, explicit career development policies are required. University administrators could learn from the material, intellectual and social incentives developed in top-tier universities in order to find these incentives that could be adapted for their own institutions.

The results of this study have limitations that inform the interpretation of its results and suggest further research. Although the results of this study show the importance of academic rank as an explanatory factor of publication and citation scores, further research should investigate these various implicit and insufficiently documented dimensions of this factor. Second, the importance of academic rank is also linked to how career development of faculty members is managed by university administrators: further research is needed on how faculty members learn the research skills required to be able to publish papers worth being cited by others. Third, further research is also required on the issue of time allocation among the different academic activities: we found that time dedicated to research had a positive impact when explaining the difference between scholars in the low performing profile and those in the high-impact frequently publishing profile, while it had no impact on the difference between scholars in the non-publishing profile and those in the low performing profile. Such counterintuitive results suggest that further research is needed to better understand the situations in which substitution and complementarity effects between the different academic activities operate.

Finally, the results of this study are based on data on faculty members from Canadian business schools. Although our study deals with incentives and issues found in most other countries and other fields, the results potentially reflect peculiarities of the field of business administration that should be compensated in further research by multi-country and multi-field studies.

These limitations notwithstanding, we believe that our results contribute to establishing that policies developed and implemented by university administrators matter, and that further research will be required to better understand how to nurture faculty members in order to improve their publication and citation scores.

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## Appendix 1

See Table 4.

**Table 4** Non-parametric correlations[a] between the *GS* and *WoS* databases regarding the contributions, citations and h-index of B scholars

| | Contributions record according to *WoS* | Citations record according to *WoS* | h-index according to *WoS* |
|---|---|---|---|
| Contributions record according to *GS* | .793*** | | |
| Citations record according to *GS* | | .819*** | |
| h-index according to *GS* | | | .815*** |

[a] We used non-parametric Spearman's rho coefficient to perform correlation tests between the three pairs of indicators because the six variables are not normally distributed. Moreover, Spearman's correlation is more robust to outliers than Pearson's correlation

*, **, *** That we can reject the null hypothesis (no correlation between the two variables), at 10, 5 and 1 % levels, respectively

## Appendix 2

See Table 5.

**Table 5** Distribution of faculty members regarding their total number of contributions in *WoS*

| | Number of faculty members | % |
|---|---|---|
| 0 contributions | 261 | 32.3 |
| Between 1 and 5 contributions | 341 | 42.3 |
| Between 6 and 20 contributions | 159 | 19.7 |
| Between 21 and 50 contributions | 41 | 5.1 |
| Between 51 and 100 contributions | 5 | 0.6 |
| Total | 807 | 100.0 |

## Appendix 3

See Table 6.

**Table 6** Comparison of means of total number of papers published between faculty members in the FS and those in the ROP sample (independent-samples *T* test on ranked data)

| Total number of papers published according to WoS | FS | ROP | *t* test for equality of means |
|---|---|---|---|
| Number of cases | 807 | 2,327 | |
| Means | 1,596.2 | 1,557.5 | 1.089 |
| Standard deviation | 848.6 | 875.9 | |
| *P* value for the Levene test of equality of variances | .039** | | |

The *T* test was performed on ranked data. Therefore, numbers in the row *Means* are mean rank

*, **, *** That the test is significant at 10, 5 and 1 %, respectively

## Appendix 4

See Table 7.

**Table 7** Comparison of means of total number of citations between faculty members in the FS and in the ROP sample (independent-samples *T* test on ranked data)

| Total number of citations according to WoS | FS | ROP | *t* test for equality of means |
|---|---|---|---|
| Number of cases | 807 | 2,327 | |
| Means | 1,573.7 | 1,565.3 | .244 |
| Standard deviation | 848.6 | 875.9 | |
| *P* value for the Levene test of equality of variances | .334 | | |

The *T* test was performed on ranked data. Therefore, numbers in the row *Means* are mean rank

*, **, *** That the test is significant at 10, 5 and 1 %, respectively

## Appendix 5

See Table 8.

**Table 8** Distribution of samples (FS vs ROP) of faculty members according to academic rank (Chi-square test)

| Academic rank | All faculty members | | FS | | ROP | | Pearson Chi-square |
|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | |
| Full professor | 1,169 | 37.3 | 289 | 35.8 | 880 | 37.8 | |
| Associate professor | 1,167 | 37.2 | 315 | 39.0 | 852 | 36.6 | *1.629* |
| Assistant professor | 798 | 25.5 | 203 | 25.2 | 595 | 25.6 | |
| Total | 3,134 | 100.0 | 807 | 100.0 | 2,327 | 100.0 | |

The Chi-square tests the independency between the variable indicating the academic rank of the scholar and the variable indicating if the scholar is from final sample, or ROP sample

*, **, *** That we can reject the null hypothesis (independency between the variable indicating the academic rank of the faculty members and the samples, FS or ROP), at 10, 5 and 1 % levels, respectively

## Appendix 6

See Table 9.

**Table 9** Definitions of independent variables and descriptive statistics

| | Measure | Sub-items | Mean (SD) | Percentage (number) | Tolerance[a] (Cronbach's α) |
|---|---|---|---|---|---|
| Factors increasing publications and citations propensity | | | | | |
| Time dedicated to research activities (RESEAR) | Measured as the percentage of scholar's time dedicated to research activities | | 35.30 % (16.02 %) | | .375 |
| Seniority | The level of seniority in the academic ranks was measured as follows: | | | | |
| | | *Assistant professor* (ASSIST) is a binary variable coded 1 if the scholar is an assistant professor, and coded 0 otherwise; | | 25.2 % (203) | .665 |
| | | *Associate professor* (ASSOC) is a binary variable coded 1 if the scholar is an associate professor, and coded 0 otherwise; | | 39.0 % (315) | .730 |
| | | *Full professor* (FULL) is a binary variable coded 1 if the scholar is a full professor, and coded 0 otherwise. This last category of scholars was used as the reference category | | 35.8 % (289) | Benchmark |
| Research funds | The total research funding (for research projects and infrastructure) of all scholar's research projects during the past 12 months was measured by the three following binary variables: | | | 41.4 % (334) | .276 |
| | | *Low research funding* (LOW_FUND) is a binary variable coded 1 if the scholar's total research funding over the past 12 months was less than $10,000, and coded 0 otherwise; | | | |
| | | *Moderate research funding* (MOD_FUND) is a binary variable coded 1 if the scholar's total research funding over the past 12 months was between $10,000 and $100,000, and coded 0 otherwise; | | 44.4 % (358) | .376 |
| | | *High research funding* (HIGH_FUND) is a binary variable coded 1 if the scholar's total research funding over the past 12 months was more than $100,000, and coded 0 otherwise. This last category was used as the reference category | | 14.2 % (115) | Benchmark |

**Table 9** continued

| | Measure | Sub-items | Mean (SD) | Percentage (number) | Tolerance[a] (Cronbach's α) |
|---|---|---|---|---|---|
| Public sources of research funding | The level of scholar's total research budget funded during the 12 past months by provincial and federal research councils was measured by the three following binary variables: | | | | |
| | *Non-funded by research Councils* (NO_PFUND) is a binary variable coded 1 if the scholar's was not funded over the past 12 months by provincial nor federal research councils, and coded 0 otherwise; | | | 50.8 % (410) | .473 |
| | *Partially funded by research Councils* (PAR_PFUND) is a binary variable coded 1 if the percentage of scholar's total research funding over the past 12 months funded by provincial and federal research councils range between 1 and 99 %, and coded 0 otherwise; | | | 27.1 % (219) | .567 |
| | *Totally funded by research Councils* (TOT_PFUND) is a binary variable coded 1 if, over the past 12 months, the funding from provincial and federal research councils represented 100 % of scholar's total research funding, and coded 0 otherwise. This last category was used as the reference category | | | 22.1 % (178) | Benchmark |
| World ranking of scholars' universities of affiliation | The academic ranking of scholars' universities of affiliation is based on the 2010 Academic Ranking of World Universities (ARWU). ARWU is one of most popular and employed ranking tables (Lukman et al. 2010).Three types of universities was distinguished by the three following binary variables: | | | | |
| | *Third tier Universities* (*OUT_LIST*) is a binary variable coded 1 if the scholar's university of affiliation was not in the ARWU top-500 ranking for the year 2010, and coded 0 if his university was in the top-500 ranking for the year 2010; | | | 22.8 % (184) | .365 |
| | *Second tier Universities* (IN_LIST) is a binary variable coded 1 if the scholar's university of affiliation was in the ARWU top-500 ranking but not in the Canadian top-5 in this list for the year 2010, and coded 0 otherwise; | | | 66.4 % (536) | .364 |
| | *Top-5 Universities* (TOP_5) is a binary variable coded 1 if the scholar's university of affiliation was in the Canadian top-5 ARWU ranking for the year 2010, and coded 0 otherwise.<br>This last category was used as the reference category. | | | 10.8 % (87) | Benchmark |

**Table 9** continued

| | Measure | Sub-items | Mean (SD) | Percentage (number) | Tolerance[a] (Cronbach's α) |
|---|---|---|---|---|---|
| Factors hampering publications and citations propensity | | | | | |
| Time dedicated to teaching activities (TEACH) | Measured as the percentage of scholar's time dedicated to teaching activities | | 35.22 % (13.96 %) | | .458 |
| Time dedicated to administration activities (SrADM) | Measured as the percentage of scholar's time dedicated to administration activities. This variable was matched with the normal distribution using a square root transformation | | 17.41 % (15.72 %) | | .414 |
| Time dedicated to professional consultation activities (SrCONS) | Measured as the percentage of scholar's time dedicated to professional consultation activities. This variable was matched with the normal distribution using a square root transformation | | 5.17 % (7.30 %) | | .675 |
| Passive knowledge transfer activities (SrPASS_KT) | Measured as a weighted index on a Likert scale of frequency ranging from 1 = *Never* to 5 = *Very often* of the engagement of the scholar, over the last three years preceding the survey, in the following four activities related to his/her research field for people in companies. This variable was matched with the normal distribution using a square root transformation | Posted research results on a website<br>Sent version of research results to the media<br>Sent research results through a newsletter to target people in companies<br>Mailed or emailed technical reports to target people in companies | 1.96 (.83) | | .533 (.694) |

**Table 9** continued

| | Measure | Sub-items | Mean (SD) | Percentage (number) | Tolerance[a] (Cronbach's α) |
|---|---|---|---|---|---|
| Proactive knowledge transfer activities (PROACT_KT) | Measured as a weighted index on a Likert scale of frequency ranging from 1 = *Never* to 5 = *Very often* of the engagement of the scholar, over the last 3 years preceding the survey, in the following five activities related to his/her research field for people in companies | Gave presentations in a technical seminar organized by companies<br>Presented research results to companies who could make direct use of them<br>Participated in industry expert groups or expert committees that were involved in efforts to directly apply new knowledge, including research in my field<br>Provided expertise or technical support to companies, without being paid, to help solve technical problems<br>Provided, without being paid, information or technical support to my former students who worked in companies | 2.17 (.86) | | .433 (.811) |
| Strength of ties with companies (TIES) | Dichotomous variable:<br>coded '1' (Strong ties), if the scholar described his working relationship with managers/ employees in companies in the past three years as very close (practically like being in the same work group), or somewhat close (like discussing and solving issues together), and 0 otherwise (weak ties) (somewhat distant, like with people that you do not know well; distant, like a working group with which you can only have a quick exchange of information; or very distant, practically like with people that you do not know at all) | | | | .617 |
| | Strong ties | | | 59.9 % (483) | |
| | Weak ties | | | 40.1 % (324) | |

**Table 9** continued

| | Measure | Sub-items | Mean (SD) | Percentage (number) | Tolerance[a] (Cronbach's α) |
|---|---|---|---|---|---|
| Frequency of contacts with companies (CONTACT) | Dichotomous variable: coded '1', (Frequent contact) if the scholar has had Very often or Often person-to-person contact with managers and/or employees in companies in the past 3 years, and 0 otherwise (Never, Rarely, or Sometimes) | | | | .635 |
| | Very often and Often | | | 38.7 % (312) | |
| | Never, Rarely, and Sometimes | | | 61.3 % (495) | |
| Control variable | | | | | |
| Business disciplines | A series of eight dichotomous variables indicating the scholars' business disciplines: | | | | |
| | Human Resources Management (HRM) | | | 14.4 % (116) | .754 |
| | Finance (FINAN) | | | 9.7 % (78) | .787 |
| | Marketing (MARK) | | | 14.7 % (119) | .755 |
| | Information Management (INFOR) | | | 7.9 % (64) | .809 |
| | Accounting (ACCOUNT) | | | 12.8 % (103) | .722 |
| | Operational Research (OPER) | | | 5.9 % (48) | .827 |
| | Economics (ECON) | | | 7.2 % (58) | .786 |
| | The reference category is Management (MNG) | | | 27.4 % (221) | Benchmark |

[a] It can be seen that all the tolerance statistic values are much higher than 0.2. This ensures that there is no multicollinearity concern (Field 2009; Menard 1995)

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