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The Effect of Holding a Research Chair on Scientists' Research Impact

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ABSTRACT

This paper examines the effect of holding Canada Research Chair (CRC) on a scientist's number of citations as a measure of research impact, based on an econometric analysis with combined data on Quebec scientists' funding and journal publication. Using Generalized Least Square (GLS) method for regression analysis, the results show that holding either tier-1 or tier-2 of CRC significantly and positively results in conducting research with higher impact. This finding, however, does not necessarily imply that the others are the lesser scientists.

Keywords: Citation, Research Chair, Research Impact, Science Policy.

INTRODUCTION

Research impact is an important topic in science policy. The administrative bodies and policy makers want to get the maximum benefit of public budget, which tax-payers spend for the sake of knowledge production and contribution to the advancement of knowledge. Considering the standing of research impact in science policy issues, it is fruitful to investigate the determinants of citation count. Various factors have been mentioned in the literature that explain the number of citation: The size of research team or measure of research collaboration (Johnes, 1988; Melin, 1996), the research domain, the prestige of the journal, and the social network of authors (Bornmann et al., 2008), the scientist gender (Aksnes et al., 2011), the amount of research funding (Harman, 2000; Pavitt, 2000, 2001), and scientist visibility in academic community (Mirnezami et al., 2015).

Conducting an econometric analysis, this paper identifies the main determinant of citation count, specifically looking at the effect of 'holding a research chair' on citation count. The remainder of this article goes as follows: Section 2 reviews the related blocks in the literature; Section 3 introduces the data set and explains the research methodology; Section 4 presents the regression analyses; and finally, Section 5 discusses the results and concludes findings.

SECTION 1 - THEORETICAL FRAMEWORK

In order to situate the topic of this research, we review two related blocks of literature: 'prestigious academic affiliation' and 'the number of citation' as a measure of research impact.

An explanation for the covariation of ‘research quality’ and ‘the number of citation’ has been provided by Kostoff (1998) and similarly by Phelan (1999). Kostoff (1998) investigates the theory of citation and proposes that each citation has more or less two origins/components: the real component of intellectual heritage and random components of self-interest. The author argues that the random effect diminishes in the aggregation of citation counts and therefore the number of citation is a good indicator of the “research quality”.

In terms of prestige, Long et al. (1979) showed a positive and significant correlation between the prestige of the scientist alma matter/affiliation and the number of citations. Honors and awards can be also proxies for research prestige, if they are given/awarded based on competitive and pre-defined procedures, like what is called as ‘research chair program’ in Canada. Cantu et al. (2009) showed the research chair programs are capable of implementing knowledge-based development. Considering holding a chair as a measure of prestige, we examine the effect of being a ‘chair-holder’ on research impact. Our hypothesis therefore reads as:

Hypothesis: *Holding a chair increases a scientist’s research impact measured in terms of number of citations.*

There are some other factors mentioned in the literature as possible determinants of research impact. These can be used as control variables in regression analysis. The age of scientist may affect the scientific productivity (Kyvik, 1990; Kyvik and Olsen, 2008). Gender is also known as a significant determinant of scientific productivity in the literature (Long, 1990, 1992). Research funding can be another determinant (Salter and Martin, 2001).

Other factor which have been mentioned in the literature are the size of research team and department size (Buchmueller et al., 1999; Carayol and Matt, 2006; Heinze et al., 2009), the type of university governance and ownership (Golden and Carstensen, 1992; Jordan et al., 1989), attributions of each specific research field and scientific context, which may characterize the research impact (Baird, 1991; Blackburn et al., 1978), and scientist visibility in form of number of articles or average impact factor of journals in which scientists publish his/her articles (Feist, 1997; Merton, 1968; Stegmann and Grohmann, 2001).

SECTION 2 - DATA AND METHODOLOGY

Methodology and econometrics model

Our regression analysis aims to explain the number of citation as the left-hand-side (LHS) variable based on the right-hand-side (RHS) variables, which are reviewed above. To measure the effect of ‘holding a research chair’ on a scientific research impact/quality, we use Generalized Least Squares (GLS) model. This is a technique for linear regression models, used when there is a certain degree of correlation between the residuals in a regression model. In other words, the variance matrix of dependent variable is no longer a scalar variance-covariance matrix. The following graph in Figure 1 shows that the standard deviation of citation count is not constant over ages. In such circumstances, OLS and WLS are statistically inefficient, which give misleading inferences. The command of *xtgls* in STATA fits GLS models on the panel data.

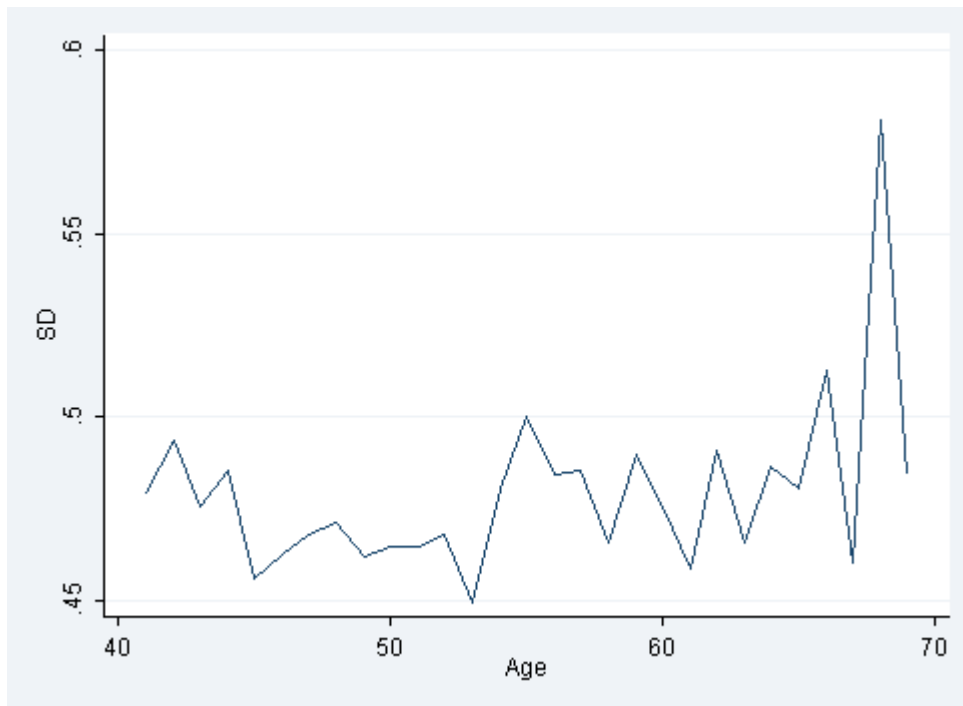


Figure 1 - The variation of citation count standard deviation over ages

In addition to CRC as the main independent variable, we also put some control variables in the model: the amount of funding as the scientists' operational capacity to conduct research, the number of articles and journal impact factor as measures of scientists past performance/visibility and his/her experience, the average number of authors in articles indicating the size of academic network, and the average of citation count for the first three years reflecting the initial condition of researcher. The use of initial condition to improve model efficiency has been verified in Blundell and Smith (1990). In addition, we put the gender of scientist in the left-hand-side to control some un-observed characteristics of them. Finally, dummy variables of universities and years are also put in the model to consider institutional effect on scientists' performance. Figure 2 shows the different average of scientists in universities justifying use of dummy variables in our model. Figure 3 justifies the use of year dummies in our model.

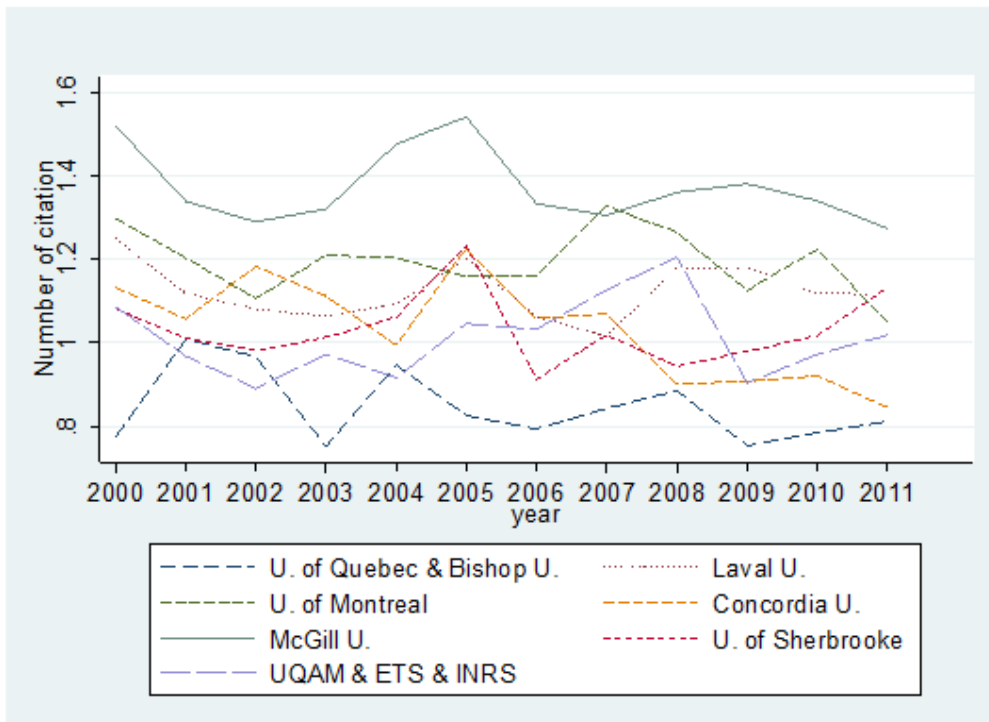


Figure 2 - Discipline-normalized citation rates of papers from Quebec universities



Figure 3 - Average of Discipline-normalized citation rates of Quebec papers, by year

Considering the mentioned explanatory variables, the resulting model is given by

$$\ln(\text{nbCitation}) = f \left(\begin{array}{l} \text{Tier 1, Tier 2, Citavg 3, } \ln(\text{PublicfundingO}), \ln(\text{PublicfundingI}) \\ \ln(\text{PrivatefundingO}), \ln(\text{NFPfund ingO}), \ln(\text{nbArticle}), \\ \ln(\text{nbAuthor}), \ln(\text{Impactfactor}), d\text{Female}, \text{Age}, d\text{Univ} \end{array} \right)$$

Data and variables

The data set used in this article integrates information about funding and publication of scientists in the province of Quebec. Funding information of scientists comes from the Quebec University Research Information System (*Système d'information sur la recherche universitaire* or SIRU) of the Ministry of Education, Leisure and Sports (MELS). This database reports funding information including research grants and industrial contracts of all Quebec academics, on a yearly basis during the period 1985-2012. We have access to Thomson Reuters Web of Science database on scientific articles (2000-2012), which includes information about date of publication, journal name, authors, affiliations, and the number of citation each article receives. To identify chair holders, we got information of all chair holders from Canada Research Chair office¹.

SECTION 3 - RESULT AND DISCUSSION:

The result of regression analysis in Table 1, Table 2, and Table 3 show that, *ceteris paribus*, both tiers of CRC have significant and positive effect on research impact. No matter which tier of CRC a scientist has, such chair holding is a kind of proxy for latent variables indicating the inherent capabilities in conducting research. To justify this finding, we can argue that CRC is a prestigious research sign in Canada, which grants more visibility to the chair-holders. As a result, chair holders are almost successful in academic networking and attracting accomplished and promising minds in academia. In addition, non-chair holders may also have more willingness to conduct collaborative research with the CRC holders as they have well-equipped laboratories and talented research staff. Regarding the effect of initial condition, the results show that the average of citation counts for the first three years positively affect the number of citation in future. As mentioned in previous section, it is a technique to increase the efficiency of our dynamic panel model.

Beside the effect of chair holding, there are some significant effect of control variables. The variable of [*dFemale*] is significant with a negative effect on the number of citations. However, when we consider the interactive effect of gender with the amount of public funding and with the number of articles, the results suggest that female with low amount of funding or few articles are being cited more than male while other female scientists are cited less than male. This finding can be related to Aksnes et al. (2011) and Larivière et al (2013) showing the underperformance of women.

¹ Tier 1 and Tier 2 CRC holders receive annual amount of \$200,000 and \$100,000 respectively.

Table 1 – GLS regression results to investigate the effect of tier-1 CRC on citation count

<i>Dep var: ln(nbCitation)_{it}</i>	<i>Reg1</i>	<i>Reg2</i>	<i>Reg3</i>	<i>Reg4</i>	<i>Reg5</i>	<i>Reg6</i>	<i>Reg7</i>
<i>Citavg3</i>	0.0903*** 0.0020	0.0854*** 0.0025	0.0888*** 0.0021	0.0921*** 0.0020	0.0868*** 0.0023	0.0902*** 0.0021	0.0902*** 0.0021
<i>Tier1_{it}</i>	0.0528*** 0.0085	0.0498*** 0.0084	0.0495*** 0.0084	0.0538*** 0.0085	0.0511*** 0.0085	0.0385 0.0580	0.0382*** 0.0119
<i>Tier1_{it}*ln(PublicfundingO)_{it}</i>						0.0012 0.0047	
<i>Tier1_{it}*ln(PrivatefundingO)_{it}</i>							0.0028* 0.0016
<i>dFemale</i>	-0.0098*** 0.0017	0.0167*** 0.0048	0.0224*** 0.0078	-0.0102*** 0.0018	-0.0068*** 0.0020	-0.0096*** 0.0017	-0.0096*** 0.0017
<i>ln(PublicfundingO)_{it}</i>	-0.0014*** 0.0003	-0.0020*** 0.0002	-0.0013*** 0.0002	-0.0014*** 0.0003	-0.0016*** 0.0003	-0.0015*** 0.0003	-0.0015*** 0.0003
<i>ln(PrivatefundingO)_{it}</i>	-0.0001 0.0002	0.0001 0.0002	-0.0005** 0.0002	-0.0002 0.0003	0.0002 0.0003	-0.0001 0.0002	-0.0002 0.0002
<i>ln(NFPfundingO)_{it}</i>	-0.0013*** 0.0002	-0.0015*** 0.0002	-0.0010*** 0.0002	-0.0013*** 0.0002	-0.0011*** 0.0002	-0.0013*** 0.0002	-0.0013*** 0.0002
<i>ln(nbArticle)_{it}</i>	0.0643*** 0.0020	0.0750*** 0.0024	0.0676*** 0.0020	0.0637*** 0.0020	0.0564*** 0.0023	0.0644*** 0.0020	0.0643*** 0.0020
<i>ln(Impactfactor)_{it}</i>	0.3530*** 0.0013	0.3495*** 0.0013	0.3534*** 0.0013	0.3525*** 0.0014	0.3290*** 0.0019	0.3528*** 0.0013	0.3528*** 0.0013
<i>ln(nb.Author)_{it}</i>	0.1080*** 0.0012	0.1115*** 0.0015	0.1071*** 0.0012	0.1081*** 0.0014	0.1060*** 0.0016	0.1079*** 0.0012	0.1079*** 0.0012
<i>dFemale*ln(nbArticle)_{it}</i>		-0.0214*** 0.0043					
<i>dFemale*ln(PublicfundingO)_{it}</i>			-0.0033*** 0.0008				
<i>dFemale*ln(PrivatefundingO)_{it}</i>				0.0005 0.0006			
<i>ln(Impactfactor)_{it}*ln(nbArticle)_{it}</i>					0.0126*** 0.0010		
<i>Constant</i>	0.3135*** 0.0039	0.3031*** 0.0045	0.3121*** 0.0036	0.3109*** 0.0042	0.3156*** 0.0044	0.3131*** 0.0039	0.3134*** 0.0039
<i>Number of observation</i>	35332	35332	35332	35332	35332	35332	35332
<i>Number of scientists</i>	7315	7315	7315	7315	7315	7315	7315
<i>χ²</i>	3345076	1033287	2978141	2452072	635693	3757878	2376291

Notes: *, **, and *** show the significance level at 0.1, 0.05, and 0.01 respectively - Year dummies, and university dummies are significant. The minimum year activity, average year activity, and maximum year activity are 1, 4.8, and 9 respectively.

Table 2 – GLS regression results to investigate the effect of tier-2 CRC on citation count

<i>Dep var: ln(nbCitation)_{it}</i>	<i>Reg8</i>	<i>Reg9</i>	<i>Reg10</i>	<i>Reg11</i>	<i>Reg12</i>	<i>Reg13</i>	<i>Reg14</i>
<i>Citavg3</i>	0.0896*** 0.0022	0.0887*** 0.0026	0.0904*** 0.0023	0.0915*** 0.0021	0.0893*** 0.0024	0.0903*** 0.0022	0.0899*** 0.0023
<i>Tier2_{it}</i>	0.0493*** 0.0090	0.0523*** 0.0090	0.0482*** 0.0090	0.0508*** 0.0090	0.0479*** 0.0091	0.1643*** 0.0588	0.0528*** 0.0111
<i>Tier2_{it}*ln(PublicfundingO)_{it}</i>						-0.0102** 0.0051	
<i>Tier2_{it}*ln(PrivatefundingO)_{it}</i>							-0.0015 0.0020
<i>dFemale</i>	-0.0082*** 0.0019	0.0211*** 0.0049	0.0230*** 0.0079	-0.0077*** 0.0020	-0.0069*** 0.0020	-0.0084*** 0.0019	-0.0080*** 0.0019
<i>ln(PublicfundingO)_{it}</i>	-0.0017*** 0.0003	-0.0024*** 0.0002	-0.0014*** 0.0003	-0.0018*** 0.0003	-0.0015*** 0.0003	-0.0017*** 0.0003	-0.0018*** 0.0003
<i>ln(PrivatefundingO)_{it}</i>	0.0000 0.0002	0.0004** 0.0002	-0.0004* 0.0002	0.0000 0.0003	0.0005** 0.0002	-0.0001 0.0002	0.0000 0.0002
<i>ln(NFPfundingO)_{it}</i>	-0.0013*** 0.0002	-0.0014*** 0.0002	-0.0009*** 0.0002	-0.0012*** 0.0002	-0.0013*** 0.0002	-0.0012*** 0.0002	-0.0012*** 0.0002
<i>ln(nbArticle)_{it}</i>	0.0701*** 0.0021	0.0770*** 0.0024	0.0716*** 0.0021	0.0690*** 0.0020	0.0600*** 0.0023	0.0704*** 0.0021	0.0701*** 0.0021
<i>ln(Impactfactor)_{it}</i>	0.3509*** 0.0014	0.3494*** 0.0013	0.3514*** 0.0014	0.3504*** 0.0015	0.3267*** 0.0020	0.3508*** 0.0014	0.3509*** 0.0014
<i>ln(nb.Author)_{it}</i>	0.1066*** 0.0013	0.1098*** 0.0015	0.1065*** 0.0012	0.1064*** 0.0014	0.1068*** 0.0016	0.1063*** 0.0013	0.1063*** 0.0013
<i>dFemale*ln(nbArticle)_{it}</i>		-0.0264*** 0.0045					
<i>dFemale*ln(PublicfundingO)_{it}</i>			-0.0033*** 0.0008				
<i>dFemale*ln(PrivatefundingO)_{it}</i>				-0.0002 0.0006			
<i>ln(Impactfactor)_{it}*ln(nbArticle)_{it}</i>					0.0127*** 0.0010		
<i>Constant</i>	0.3092*** 0.0039	0.3022*** 0.0046	0.3052*** 0.0040	0.3083*** 0.0041	0.3048*** 0.0046	0.3091*** 0.0039	0.3093*** 0.0039
<i>Number of observation</i>	35332	35332	35332	35332	35332	35332	35332
<i>Number of scientists</i>	7315	7315	7315	7315	7315	7315	7315
<i>χ²</i>	2398663	430020	8692326	703639	415534	1877470	2307896

Notes: *, **, and *** show the significance level at 0.1, 0.05, and 0.01 respectively - Year dummies, and university dummies are significant. The minimum year activity, average year activity, and maximum year activity are 1, 4.8, and 9 respectively.

Table 3 – GLS regression results to investigate the effect of tier-1 and tier-2 CRC on citation count

<i>Dep var: ln(nbCitation)_{it}</i>	<i>Reg15</i>	<i>Reg16</i>	<i>Reg17</i>	<i>Reg18</i>	<i>Reg19</i>	<i>Reg20</i>	<i>Reg21</i>
<i>Citavg3</i>	0.0865*** 0.0023	0.0865*** 0.0026	0.0878*** 0.0024	0.0875*** 0.0022	0.0882*** 0.0025	0.0870*** 0.0023	0.0868*** 0.0023
<i>Tier1_{it}</i>	0.0576*** 0.0085	0.0541*** 0.0084	0.0549*** 0.0085	0.0579*** 0.0085	0.0544*** 0.0085	0.0451 0.0580	0.0445*** 0.0120
<i>Tier2_{it}</i>	0.0542*** 0.0090	0.0561*** 0.0090	0.0535*** 0.0090	0.0550*** 0.0090	0.0521*** 0.0091	0.1654*** 0.0589	0.0573*** 0.0112
<i>Tier1_{it}*ln(PublicfundingO)_{it}</i>						0.0010 0.0047	
<i>Tier1_{it}*ln(PrivatefundingO)_{it}</i>							0.0026* 0.0016
<i>Tier2_{it}*ln(PublicfundingO)_{it}</i>						-0.0099** 0.0051	
<i>Tier2_{it}*ln(PrivatefundingO)_{it}</i>							-0.0012 0.0020
<i>dFemale</i>	-0.0051*** 0.0019	0.0197*** 0.0050	0.0219*** 0.0079	-0.0044** 0.0020	-0.0049** 0.0021	-0.0054*** 0.0020	-0.0048** 0.0020
<i>ln(PublicfundingO)_{it}</i>	-0.0018*** 0.0003	-0.0022*** 0.0002	-0.0016*** 0.0003	-0.0019*** 0.0003	-0.0019*** 0.0003	-0.0018*** 0.0003	-0.0019*** 0.0003
<i>ln(PrivatefundingO)_{it}</i>	0.0001 0.0002	0.0007*** 0.0002	-0.0001 0.0002	0.0001 0.0003	0.0006** 0.0002	0.0000 0.0002	0.0001 0.0002
<i>ln(NFPfundingO)_{it}</i>	-0.0012*** 0.0002	-0.0015*** 0.0002	-0.0009*** 0.0002	-0.0012*** 0.0002	-0.0009*** 0.0002	-0.0011*** 0.0002	-0.0012*** 0.0002
<i>ln(nbArticle)_{it}</i>	0.0645*** 0.0022	0.0733*** 0.0024	0.0666*** 0.0022	0.0647*** 0.0022	0.0554*** 0.0024	0.0648*** 0.0022	0.0646*** 0.0022
<i>ln(Impactfactor)_{it}</i>	0.3519*** 0.0014	0.3484*** 0.0013	0.3512*** 0.0015	0.3511*** 0.0015	0.3285*** 0.0020	0.3514*** 0.0014	0.3513*** 0.0014
<i>ln(nbAuthor)_{it}</i>	0.1082*** 0.0013	0.1115*** 0.0015	0.1071*** 0.0012	0.1084*** 0.0015	0.1074*** 0.0016	0.1081*** 0.0014	0.1083*** 0.0013
<i>dFemale*ln(nbArticle)_{it}</i>		-0.0240*** 0.0045					
<i>dFemale*ln(PublicfundingO)_{it}</i>			-0.0029*** 0.0008				
<i>dFemale*ln(PrivatefundingO)_{it}</i>				-0.0004 0.0006			
<i>ln(Impactfactor)_{it}*ln(nbArticle)_{it}</i>					0.0123*** 0.0010		
<i>Constant</i>	0.3097*** 0.0040	0.3010*** 0.0048	0.3068*** 0.0041	0.3078*** 0.0042	0.3099*** 0.0047	0.3081*** 0.0041	0.3095*** 0.0041
<i>Number of observation</i>	35332	35332	35332	35332	35332	35332	35332
<i>Number of scientists</i>	7315	7315	7315	7315	7315	7315	7315
<i>χ²</i>	774094	307409	533071	1044830	239834	643384	595455

Notes: *, **, and *** show the significance level at 0.1, 0.05, and 0.01 respectively - Year dummies, and university dummies are significant. The minimum year activity, average year activity, and maximum year activity are 1, 4.8, and 9 respectively.

The number of articles [$\ln(nbArticle)$], journal impact factor [$\ln(Impactfactor)$], and interaction between them have all has a significant and positive effect on citation count. This implies that greater visibility of scientists can results in receiving more citations by them. It also shows that more articles in high impact factor journals results in more citations than the same number of articles in a less prestigious journal. Interestingly, the positive effect of visibility is smaller for female as shown in Figure 4. Related to our finding, there are some evidence in literature (Calderini and Franzoni, 2004; Stegmann and Grohmann, 2001) supporting the point that journal impact factor of past publication can be a proxy for research quality and visibility. However, one may criticize that journal impact factor is not a perfect proxy for research quality and research impact as citation count in journal has a significant variation with skewed distribution, which means that journal impact factor is based on few highly-cited items.

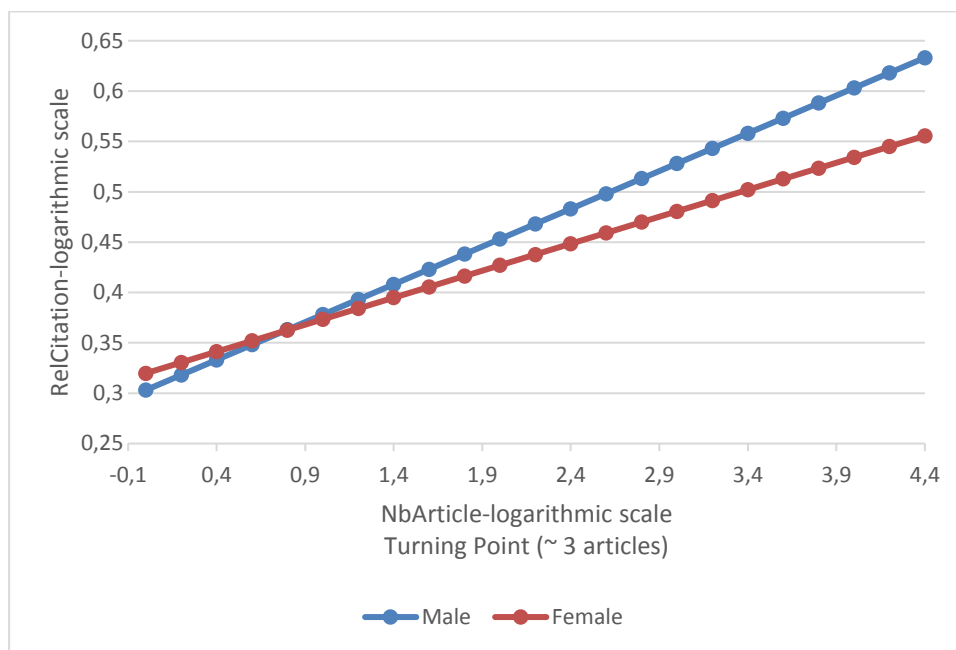


Figure 4 - Interactive effect of gender and number of articles

In terms of research team size, our results show that collaborative works with more authors [$\ln(nbAuthor)$] are more likely to be cited. The main reason for this finding is that collaborative nature of research work leads in higher quality, which is also supported by some articles (Johnes, 1988; Melin, 1996). This is mainly because tasks are broken down efficiently and research activities are being conducted in a collective way. On top of that, some sort of knowledge spillover or tacit knowledge transfer are possible by-product of such research collaboration, which improves their capability in conducting high impact research in future. For the effect of funding, we got some mixed signals from our results. Although all of them show significant effect of funding on the citation count but only private funding [$\ln(PrivatefundingO)$] has some positive effect while funding from public sector [$\ln(PublicfundingO)$] or funding from non-profit organizations [$\ln(NFPfundingO)$] always have negative effect. The interactive effect of funding and gender is illustrated in Figure 5 - interactive effect of funding and genderFigure 5 showing that female has more negative effect of funding. Our previous empirical study on this database (Mirnezami and Beaudry, 2016) along with other evidences from literature (Arundel and Geuna, 2004; Harman, 2000; Pavitt, 2000, 2001), support the positive effect of funding on publication and scientific productivity of

scientists, but the results of this paper imply that higher funding does not necessarily results in publications which are more cited.

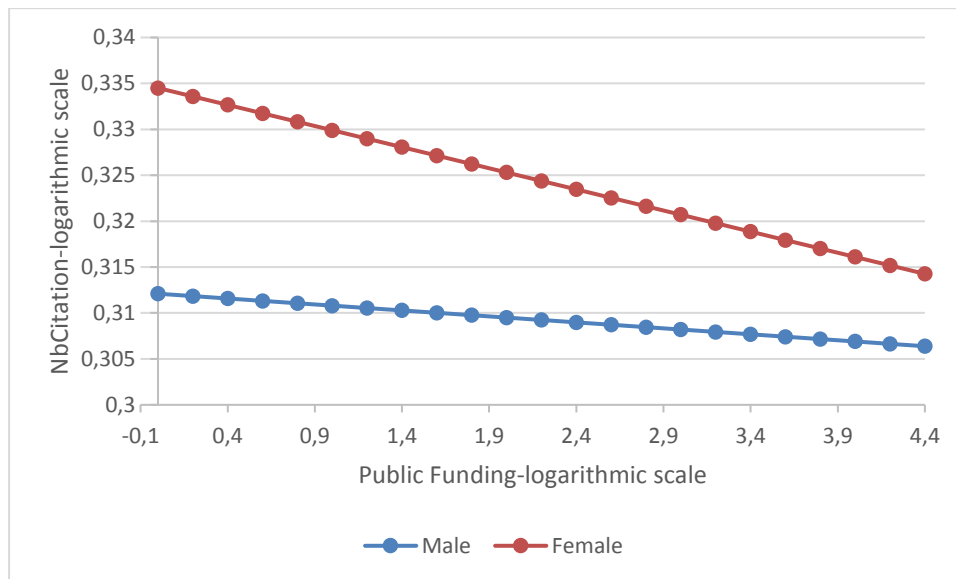


Figure 5 - interactive effect of funding and gender

CONCLUSION

The paper investigates the effect of holding CRC on citation count as a measure of research impact, which has been verified for both tier-1 and tier-2 of CRC. In addition, the positive effect of research team size, positive effect of number of articles and journal impact factor, and negative effect of being female have been validated based on our regression analysis. For funding effect, we both positive and negative effect depending on source of fund. We have also seen significant effect of year dummies and universities dummies, indicating the control of some un-observed institutional dimensions of research performance.

As a limitation to our mentioned interpretations, we only studied Quebec scientists and some data entries are missing in the original dataset. In addition to using more comprehensive and complete data set for future studies, one can conduct a deep investigation on citation concept and disentangle self-citation, citation based on quality, and citation related to research impact or literature review. In addition, future research can look for time-variation and discipline-dependency of our result or even investigate the effect of initial conditions on research impact/quality.

In terms of policy implication, we can conclude that CRC program is an effective strategy to improve research impact and the quality of research. In addition, one may argue that collaborative works (measured by the size of research team) should be encouraged in order to have scientific productivity with higher level of quality.

REFERENCES

- Aksnes, D.W., Rorstad, K., Piro, F., Sivertsen, G., 2011. Are female researchers less cited? A large-scale study of Norwegian scientists. *Journal of the American Society for Information Science and Technology* 62, 628-636.
- Arundel, A., Geuna, A., 2004. Proximity and the use of public science by innovative European firms. *Economics of Innovation and new Technology* 13, 559-580.

- Baird, L.L., 1991. Publication productivity in doctoral research departments: Interdisciplinary and intradisciplinary factors. *Research in Higher Education* 32, 303-318.
- Blackburn, R.T., Behymer, C.E., Hall, D.E., 1978. Research note: Correlates of faculty publications. *Sociology of Education*, 132-141.
- Blundell, R., Smith, R.J., 1990. Conditions initiales et estimation efficace dans les modèles dynamiques sur données de panel: Une application au comportement d'investissement des entreprises. *Annales d'économie et de Statistique*, 109-123.
- Bornmann, L., Mutz, R., Neuhaus, C., Daniel, H.-D., 2008. Citation counts for research evaluation: standards of good practice for analyzing bibliometric data and presenting and interpreting results. *Ethics in Science and Environmental Politics* 8, 93-102.
- Buchmueller, T.C., Dominitz, J., Lee Hansen, W., 1999. Graduate training and the early career productivity of Ph.D. economists. *Economics of Education Review* 18, 65-77.
- Calderini, M., Franzoni, C., 2004. Is academic patenting detrimental to high quality research. An empirical analysis of the relationship between scientific careers and patent applications. Bocconi University: Cespri Working Paper.
- Cantu, F.J., Bustani, A., Molina, A., Moreira, H., 2009. A knowledge-based development model: the research chair strategy. *Journal of Knowledge Management* 13, 154-170.
- Carayol, N., Matt, M., 2006. Individual and collective determinants of academic scientists' productivity. *Information Economics and Policy* 18, 55-72.
- Feist, G.J., 1997. Quantity, quality, and depth of research as influences on scientific eminence: Is quantity most important? *Creativity Research Journal* 10, 325-335.
- Golden, J., Carstensen, F.V., 1992. Academic research productivity, department size and organization: Further results, comment. *Economics of Education Review* 11, 153-160.
- Harman, G., 2000. Allocating research infrastructure grants in post-binary higher education systems: British and Australian approaches. *Journal of Higher Education Policy and Management* 22, 111-126.
- Heinze, T., Shapira, P., Rogers, J.D., Senker, J.M., 2009. Organizational and institutional influences on creativity in scientific research. *Research Policy* 38, 610-623.
- Johnes, G., 1988. Determinants of research output in economics departments in British universities. *Research Policy* 17, 171-178.
- Jordan, J.M., Meador, M., Walters, S.J.K., 1989. Academic research productivity, department size and organization: Further results. *Economics of Education Review* 8, 345-352.
- Kostoff, R.N., 1998. The use and misuse of citation analysis in research evaluation. *Scientometrics* 43, 27-43.
- Kyvik, S., 1990. Age and scientific productivity. Differences between fields of learning. *Higher Education* 19, 37-55.
- Kyvik, S., Olsen, T.B., 2008. Does the aging of tenured academic staff affect the research performance of universities? *Scientometrics* 76, 439-455.
- Long, J.S., 1990. The origins of sex differences in science. *Social Forces* 68, 1297-1316.
- Long, J.S., 1992. Measures of sex differences in scientific productivity. *Social Forces* 71, 159-178.
- Long, J.S., Allison, P.D., McGinnis, R., 1979. Entrance into the academic career. *American Sociological Review*, 816-830.

- Melin, G., 1996. The networking university. *Scientometrics* 35, 15-31.
- Merton, R.K., 1968. The Matthew effect in science. *Science* 159, 56-63.
- Mirnezami, S.R., Beaudry, C., 2016. The effect of holding a research chair on scientists' productivity. *Scientometrics* 107, 399-454.
- Mirnezami, S.R., Beaudry, C., Larivière, V., 2015. What determines researchers' scientific impact? A case study of Quebec researchers. *Science and Public Policy*, scv038.
- Pavitt, K., 2000. Why European Union funding of academic research should be increased: a radical proposal. *Science and Public Policy* 27, 455-460.
- Pavitt, K., 2001. Public policies to support basic research: What can the rest of the world learn from US theory and practice?(And what they should not learn). *Industrial and corporate change* 10, 761-779.
- Salter, A.J., Martin, B.R., 2001. The economic benefits of publicly funded basic research: a critical review. *Research Policy* 30, 509-532.
- Stegmann, J., Grohmann, G., 2001. Citation rates, knowledge export and international visibility of dermatology journals listed and not listed in the Journal Citation Reports. *Scientometrics* 50, 483-502.

Table 4 - Variable description

Variable name	Variable description
<i>Tier1</i>	Dummy variables taking the value 1 if a scientist has a Canada research chair (tier 1)
<i>Tier2</i>	Dummy variables taking the value 1 if a scientist has a Canada research chair (tier 2)
<i>Citavg3</i>	The average of number of citations during the first three years
$\ln(nbCitation)_{it}$	Natural logarithm of number of citations of papers published by scientist <i>i</i> in year <i>t</i> (10 years following publication year) divided by the average citation rate of the papers published in the same year in the same discipline
$\ln(PublicfundingO)_{it}$	Natural logarithm of the three-year average up to year <i>t</i> of public sector funding for the purpose of operational costs and direct expenditures of research of researcher <i>i</i>
$\ln(PublicfundingI)_{it}$	Natural logarithm of the three-year average up to year <i>t</i> of public sector funding for the purpose of buying instruments for researcher <i>i</i>
$\ln(PrivatefundingO)_{it}$	Natural logarithm of the three-year average up to year <i>t</i> of private sector funding for the purpose of operational costs and direct expenditures of research of researcher <i>i</i>
$\ln(NFPfundingO)_{it}$	Natural logarithm of three-year average up to year <i>t</i> of funding from not-for-profit institutions (NFP) for the purpose of operational costs and direct expenditures of research of researcher <i>i</i>
$\ln(nbArticle)_{it}$	Natural logarithm of number of articles published in year <i>t</i> by researcher <i>i</i>
$\ln(nbAuthor)_{it}$	Natural logarithm of the three-year average up to year <i>t</i> of number of authors in the papers of researcher <i>i</i>
$\ln(Impactfactor)_{it}$	Natural logarithm of the five-year average up to year <i>t</i> of journal impact factor in which the scientist publishes
<i>dFemale_i</i>	Dummy variable taking the value 1 if the scientist is a woman and 0 otherwise
<i>Age_{it}</i>	Age of a researcher <i>i</i> at year <i>t</i>
<i>dUniv</i>	Dummy variables indicating the universities

Table 5 - Summary statistics (Number of observation = 39,911) – the variables are not summarized in logarithmic scale and they are raw amount²

<i>Variable</i>	<i>mean</i>	<i>Standard Deviation</i>	<i>min</i>	<i>max</i>
<i>nbCitation</i>	1.161812	1.820302	0	74.575
<i>dFemale</i>	0.231646	0.421889	0	1
<i>Tier1</i>	0.031571	0.174857	0	1
<i>Tier2</i>	0.024004	0.153063	0	1
<i>nbArticle</i>	3.257379	3.518717	1	85
<i>nbAuthor</i>	6.918378	49.73654	1	3174.5
<i>PublicfundingO</i>	105301.2	246244.1	0	1.59E+07
<i>PrivatefundingO</i>	19415.13	106610	0	6934758
<i>NFPfundingO</i>	19606.49	138335.3	0	1.12E+07
<i>Age</i>	50.12962	9.424855	14	92

² In some disciplines of Physics, there are many scientists involved in one project and therefore, the maximum for the number of authors is high.

Table 6 - Correlation table (all of them are significant at 1% level)

	$\ln(nbCitation)_i$	$Citavg3_i$	$dFemale$	$\ln(nbArticle)_i$	$\ln(PublicfundingO)_i$	$\ln(PrivatefundingO)_i$	$\ln(NFPfundingO)_i$	$\ln(Impactfactor)_i$
$\ln(nbCitation)_i$	1							
$Citavg3_i$	0.3453	1						
$dFemale$	-0.0311	-0.0589	1					
$\ln(nbArticle)_i$	0.2437	0.2787	-0.1015	1				
$\ln(PublicfundingO)_i$	0.0723	0.1084	-0.0312	0.237	1			
$\ln(PrivatefundingO)_i$	0.0789	0.1173	-0.1175	0.2299	0.1224	1		
$\ln(NFPfundingO)_i$	0.1053	0.129	-0.0203	0.2426	0.1773	0.2286	1	
$\ln(Impactfactor)_i$	0.4696	0.2516	-0.0314	0.2105	0.101	0.0468	0.1129	1
$\ln(nbAuthor)_i$	0.2856	0.2384	-0.0022	0.3091	0.0126	0.1624	0.2125	0.2366