CHAIR INNOVATION
CREATION, DEVELOPMENT AND COMMERCIALISATION OF INNOVATION

POLYTECHNIQUE MONTRÉAL
LE GÉNIE EN PREMIÈRE CLASSE

IMPACT OF MOBILITY AND COLLABORATION ON SCIENTIFIC OUTPUT IN AFRICA: FIRST LESSONS FROM A PAN-AFRICAN SURVEY

Bassirou Diagne Catherine Beaudry and Carl St-Pierre
Polytechnique Montreal (Canada)

SCIENCE, TECHNOLOGY & INNOVATION INDICATORS

Open indicators: innovation, participation and actor-based STI indicators
PARIS 2017

Plan

1 INTRODUCTION

2 BACKGROUNG

3 METHODOLOGY

4 STATISTICS ANALYSIS

5 DISCUSSION AND CONCLUSION

Introduction

- Academic research activity is increasingly viewed as an important contributor to the production of knowledge and thus to innovation and growth
- Country's research system influences its capacity to find innovative solutions to societal problems and needs
- The central role of universities holds even more true for the African countries (Mouton, 2008)
- Comparable findings on scientists in various countries are sparse in general and even more so in developing countries

Background

- Several factors influence research performance, which ultimately contributes to building a research career

- A number of these factors are socio-demographic
  - Age (Feist, 2006)
  - Gender (Aksnes *et al*., 2011; Fox, 2005; Hesli & Lee, 2011; Nakhaie, 2002; Prpić, 2002; Xien & Shauman, 1998, 2003; Zuckerman, 1991).

- Others are related to the choices made by the researchers, collaboration and mobility

Background: Mobility

- Mobile talent contributes to the creation and diffusion of knowledge, particularly tacit knowledge (OECD, 2001, 2008 and 2010)
- Mobility of academic staff is one of the many aspects of the internationalization of the research system (Knight, 2008; Huang, 2013; Rostan&Höhle, 2014)
- The mobile individuals. Mobile researchers generally have a larger international network and perform better than their non-mobile peers (Franzoni et al., 2012; Cruz &Sanz, 2010)
- Where research is conducted on the basis of national, regional and international interaction is important for scientific success
- **H1** : The impact of mobility on scientific productivity in Africa.

Background: Collaboration

- Researchers move and collaborate to pursue scientific excellence
- Positive relationship between collaboration and scientific productivity (Lotka 1962; Price and Beaver 1966)
- Multi-project research centers encourage researchers and their universities to collaborate more efficiently (Zucker et al., 2007).
- Positive effect on scientific production of more central scientists in more cliquish networks(Beaudry and Allaoui, 2012)
- **H2** : African researchers who collaborate will also generate more research output.

Background:
Mobility and Collaboration

- Impact of mobility and collaboration on scientific productivity
- Mobility can induce scientific collaboration, new or existing collaboration ties may also drive mobility decisions
- The link between mobility and collaboration is likely to run in both directions
- **H3**: Mobility has a moderating effect on collaboration

Methodology

- Web-based survey was conducted between May 2016 and February 2017
- More than 120 000 questionnaires were distributed through two online survey platforms
- Across 21 African countries
- Total of 7 515 completed questionnaires had been received

STATISTICS ANALYSIS
ANOVA OUTPUT BY FIELD AN MOBILITY

- First, it should be noted that there are differences in the average productivity among the fields (the two-tailed Mann-Whitney test)

		Mobile			**Other**	
Variable	STEM	Health	SSH	STEM	Health	SSH
nbArticles	8.782**	10.019*	7.014	8.374	9.381	6.439
nbBooks	.468	.298	.755**	.355	.307	.610
nbChapters	.843***	.751	2.169***	.676	.746	1.709
nbOutreach	2.075	2.554	2.651***	2.330	2.231	2.046

STATISTICS ANALYSIS
ANOVA OUTPUT BY AGE AND MOBILITY

- We also analysed how the publication patterns varied with age and mobility

	Mobile				Other			
Variable	Age_1	Age_2	Age_3	Age_4	Age_1	Age_2	Age_3	Age_4
nbArticles	6.926***	8.959***	9.905**	9.891*	6.058	7.947	8.944	9.154
nbBooks	.263	.393	.537*	.940***	.220	.266	.450	.605
nbChapters	.616	.892	1.381***	1.984***	.523	.734	1.008	1.315
nbOutreach	1.655*	2.191***	2.738	3.138**	1.377	1.975	2.621	2.731

STATISTICS ANALYSIS

ANOVA OUTPUT BY FIELD AND COLLABORATION IN OWN UNIVERSITY

- the average output index by field and collaboration in own university

	CollOwnInst			**Other**		
Variable	STEM	Health	SSH	STEM	Health	SSH
nbArticles	9.30***	10.502***	7.103***	7.164	7.884	6.287
nbBooks	.441	.300	.623	.313	.277	.703
nbChapters	.810**	.644	1.975	.594	.795	1.793
nbOutreach	2.486***	2.252	2.228	1.800	2.039	2.281

STATISTICS ANALYSIS

ANOVA OUTPUT BY FIELD AND COLLABORATION IN OWN COUNTRY

- Collaboration within the country with other researchers

	CollOwnCount			Other		
Variable	STEM	Health	SSH	STEM	Health	SSH
nbArticles	9.824***	11.318***	7.477***	7.759	8.650	6.396
nbBooks	.524***	.332*	.75	.318	.269	.634
nbChapters	.951***	.937***	2.029*	.601	.631	1.828
nbOutreach	2.797	3.151***	2.675***	1.905	1.890	2.106

STATISTICS ANALYSIS
ANOVA OUTPUT BY FIELD AND COLLABORATION IN AFRICA

- collaboration within the African continent

	CollAfrica			**Other**		
Variable	STEM	Health	SSH	STEM	Health	SSH
nbArticles	10.464***	11.406***	7.647***	7.552	8.470	6.185
nbBooks	.573***	.354	.990***	.305	.252	.498
nbChapters	1.095***	.954**	2.587***	.546	.606	1.520
nbOutreach	3.017***	2.983***	3.040***	1.844	1.946	1.854

STATISTICS ANALYSIS
ANOVA OUTPUT BY FIELD AND COLLABORATION IN OUT OF AFRICA

- publications by field and collaboration in out of Africa

	CollOutAfrica			Other		
Variable	STEM	Health	SSH	STEM	Health	SSH
nbArticles	9.735***	11.212***	7.011***	7.728	8.645	6.530
nbBooks	.409	.315	.820***	.386	.278	.593
nbChapters	.933***	.970***	2.076***	.597	.601	1.791
nbOutreach	2.532***	2.827***	2.474***	2.045	2.064	2.156

Article					
Variable	I	II	III	IV	V
dHealth	YES	YES	YES		
dSTEM	YES	YES	YES		
Age	YES	YES	YES		
dFemale	YES	YES	YES		
dMobility	**.0408***				
dCollOwnInst	**.1264*****				
dCollOwnCount	**.1066*****				
dCollAfrica	**.1272*****		.		
dCollOutAfrica	**.0770*****				

Article

Variable	I	II	III	IV	V
dMobility x dCollOwnInst11		**.1667*** **			
dMobility x dCollOwnInst01		**.1462*** **			
dMobility x dCollOwnInst10		**.0790** **			
dMobility x dCollOwnCount11			**.1417*** **		
dMobility x dCollOwnCount01			**.1138*** **		
dMobility x dCollOwnCount10			**.0531***		
dMobility x dCollAfrica11				**.1280*** **	
dMobility x dCollAfrica01				**.1784** **	
dMobility x dCollAfrica10				**.1132** **	
dMobility x dCollOutAfrica11					**.1257*** **
dMobility x dCollOutAfrica01					**.0731** **
dMobility x dCollOutAfrica10					**.0373**

BOOKS					
Variable	**B1**	**B2**	**B3**	**B4**	**B5**
dSSH	YES	YES	YES	YES	YES
dSTEM	YES	YES	YES	YES	YES
Age	YES	YES	YES	YES	YES
dFemale	YES	YES	YES	YES	YES
dMobility	**.2326*** **				
dCollOwnInst	**-.0759**				
dCollOwnCount	**.2018*** **	.			
dCollAfrica	**.3770*** **		.		
dCollOutAfrica	**.0539**				

BOOKS					
Variable	**B1**	**B2**	**B3**	**B4**	**B5**
dMobility x dCollOwnInst11		**.1654***			
dMobility x dCollOwnInst01		**-.0307**			
dMobility x dCollOwnInst10		**.3275*****			
dMobility x dCollOwnCount11			**.4593*****		
dMobility x dCollOwnCount01			**.1938****		
dMobility x dCollOwnCount10			**.2419*****		
dMobility x dCollAfrica11				**.6207*****	
dMobility x dCollAfrica01				**.4017*****	
dMobility x dCollAfrica10				**.2949*****	
dMobility x dCollOutAfrica11					**.3229*****
dMobility x dCollOutAfrica01					**.0241**
dMobility x dCollOutAfrica10					**.2135*****

Analysis OF BOOKS

- Mobility would increase by 26% (expo (0.2326) -1) ($p < .01$) the chance of publishing a book
- collaboration with other researchers at the national level would improve its productivity by 23% ($p < .01$)
- collaboration with The continental scale would have a greater impact with an increase of 46% ($p < .01$)

Analysis of BOOKS

- Interaction between mobility and collaboration in Africa , we find an 86% ($p < .01$) increase in the chances of publishing a book
- Interaction between mobility and collaboration at the country level is added, and we get a 58% ($p < .01$)
- Interaction between mobility and collaboration within the institution, leads to a slight increase of 18% ($p < .01$)
- Interaction between mobility and collaboration outside Africa, we see that it becomes significant with a 38%

Analysis of chapters

- We found that mobility had a positive impact by increasing production by 15% ($p < .01$)
- Collaboration in Africa would allow 23% ($p < .01$)
- Other types of collaboration didn't have a significant impact

Analysis of chapters

- By adding an interaction variable between mobility and collaboration in Africa in the, we obtain a 44% ($p < .01$)
- When we integrate an interaction variable between mobility and national collaboration, we find a 29% ($p < .01$)
- An interaction variable between mobility and collaboration in the same institution increase publication of 23% ($p < .01$)
- An interaction between mobility and collaboration outside Africa increase production of 23% ($p < .01$)

Discussion and Conclusion

- Our three hypotheses have been validated in the case of articles well that mobility alone has an impact not very important.
- The mobility combined with the three types of collaboration leads to a very significant impact on the production of African researchers
- Collaboration in Africa plays a major role in the productivity of researchers

Discussion and Conclusion

- In terms of book publishing, mobility and collaboration in Africa are definitely determinant of the fact that the subjects treated are national or continental
- The publication of chapters is like that of books, it is positively impacted by continental mobility and collaboration
- would be interesting to combine this study with bibliometrics studies in order to have a more general view of the scientific production of African researchers

Thank you

Annexes

Chapters

Variable	Ch-1	Ch-2	Ch-3	Ch-4	Ch-5
nbChapters					
Ln(nbKids)	-.1123	-.1144	-.1097	-.1159	-.1141
Sqrt(ln(nbKids))	.1280***	.1288***	.1287***	.1277***	.12913***
perCareMe	-.0020***	-.0020***	-.0019***	-.0020***	-.0020***
dHomeSA	.1139**	.1110**	.1194***	.1014**	.1118**
Ln(nbWHoursTeaching)	.1228**	.1204**	.1156**	.1196**	.1211**
Sqrt(ln(nbWHoursTeaching))	-.0402**	-.0393**	-.0383**	-.0389**	-.0394**
Ln(nbWHoursSupervising)	.3148***	.3108***	.3099***	.3119***	.3116***
Sqrt(ln(nbWHoursSupervising))	-.0564***	-.0557***	-.0560***	-.0555***	-.0558***
Ln(nbWHoursResearch)	.0445	.0425	.0687	.0283	.0391
Sqrt(ln(nbWHoursResearch))	-.0161	-.0151	-.0206	-.0120	-.0140
Ln(nbWHoursAdmin)	.0868	.0871	.0742	.0872	.0879

Sqrt(Ln(nbWHoursAdmin))	-.0459**	-.0458**	-.0424**	-.0459**	-.0460**
Ln(nbWHoursService)	.1033*	.0993	.1026*	.0975	.0980
Sqrt(Ln(nbWHoursService))	-.0210	-.0201	-.0209	-.0188	-.0196
Ln(nbWHoursConsult)	.2116***	.2161***	.2153***	.2118***	.2154***
Sqrt(Ln(nbWHoursConsult))	-.0638***	-.0654***	-.0652***	-.0638***	-.0649***
Ln(nbWHoursFundraising)	-.0229	-.0192	-.0197	-.0167	-.0195
Sqrt(Ln(nbWHoursFundraising))	.0085	.0071	.0040	.00670	.0068
dSSH	.6508***	.6468***	.6410***	.6472***	.6464***
dSTEM	.0270	.0284	.0243	.0313	.0284
Age_1	-.5287***	-.5088***	-.5159***	-.5107***	-.5092***
Age_2	-.5259***	-.5206***	-.5214***	-.5233***	-.5206***
Age_3	-.2120***	-.2118***	-.2164***	-.2115***	-.2114***

Ln(Funds)	-.0583***	-.0578***	-.0570***	-.0569***	-.0579***
Sqrt(Ln(Funds))	.0074***	.00733***	.0072***	.0072***	.0073***
dMobility	**.1433*** **				
dCollOwnInst	**.0531**	.0567	.0557		.0573
dCollOwnCount	**.0405**	.0417		.0419	.0407
dCollAfrica	**.2108*** **		.2075***	.2115***	.2088***
dCollOutAfrica	.0412	.0430	.0498	.0449	
dMobHQual	-.0501	-.0461	-.0395	-.0421	-.0484

dMobility x dCollAfrica11		**.3649*** **			
dMobility x dCollAfrica01		**.2139*** **			
dMobility x dCollAfrica10		**.1634*** **			
dMobility x dCollOwnCount11			**.2548*** **		
dMobility x dCollOwnCount01			**-.0509**		
dMobility x dCollOwnCount10			**.0507**		
dMobility x dCollOwnInst11				**.2046*** **	
dMobility x dCollOwnInst01				**.1246*** **	
dMobility x dCollOwnInst10				**.2684*** **	
dMobility x dCollOutAfrica11					**.1925*** **
dMobility x dCollOutAfrica01					**.0637**
dMobility x dCollOutAfrica10					**.1836*** **