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# Effects of mobilities on the research output and its multidisciplinary of academics in Hong Kong and Macau: An exploratory study

## Abstract

This article explores how the past mobilities of academics affect their current research output (and its multidisciplinaryity). Five types of mobility are used simultaneously in the analysis. Field mobility and transnational educational mobility are associated with academics' educational path, whereas transnational job mobility, intrasectoral job mobility and intersectoral job mobility refer to their career path. The analysis is based on a representative sample of academics based in Hong Kong and Macau. Results show that intrasectoral job mobility (up to a threshold) and transnational job mobility positively affect research output and its multidisciplinaryity, whereas intersectoral job mobility, field mobility and transnational educational mobility exert slight or no effect. Nested analyses of Science, Technology, Engineering and Mathematics (STEM) and non-STEM academics as well as experienced and junior academics offer further insight into the roles of these mobilities. Impacts of mobile experience were stronger among junior than senior academics, and in STEM fields than non-STEM fields. The article discusses these findings along with the significance of considering *mobilities* rather than *mobility* when analysing academic trajectories and the determinants of academic research production.

**Keywords:** Mobility, Transnational mobility, Job mobility, Field mobility, Research productivity, multidisciplinaryity, STEM/Non-STEM, Senior/junior academics, Hong Kong, Macau

## Introduction

The mobility of academics is not new; several references to peripatetic professors can be traced in the universities of medieval Europe. Earlier examples of scholarly mobility can be found in East and Southeast Asia, the Middle East and Greece, and the names of these scholars and their works (e.g. Confucius, Plato) remain influential (Welch, 2008). The mobility of academics became increasingly international and widespread with the discoveries, the Renaissance, the creation of colonial empires that established the European model of the university upon a global scale and the Enlightenment. Such an expansion led to the formation of the first global scholarly communities (e.g. Pietsch, 2010). After the Second World War, growing investment into intangibles associated with the realisation of learning as a key driver for socioeconomic development led to international research collaborations and competition for talent, which further promoted the global mobility of academics (Chen, 2017). The globalisation and creation of regional higher education systems (e.g. the European Higher Education Area), along with globally organised scientific associations that host yearly conferences and decreasing costs of transportation, further accelerated and extended the transnational mobility of students and academics (Scott, 2015).

Despite the increasing number of mobile academics, the general benefits that accrue from the mobility of academics remain the same, that is, exposition to different environments, people and ideas that stimulate creativity, leading to the accumulation of human capital, including knowledge, skills, resources, cultural

awareness, prestige and professional networks (Fumasoli et al., 2015; Cañibano et al., 2008). The process of being mobile continues to include tensions associated with adaptation, stereotypes, culture shocks and identity searching that affect the personal and professional development of mobile academics (Patrício et al., 2017; Gopaul & Pifer, 2016; McAlpine et al., 2014). The larger number of mobile scholars crossing borders relates to the belief that the mobility of scholars induces innovation and fosters knowledge production (Ackers, 2005; Jacob & Meek, 2013), and policy efforts are made to encourage academic mobility by governments, research funding agencies and universities (Kim, 2017; Veugelers & Bouwel, 2015). Mobility is becoming an integral part of academic careers in the globalised academic labour markets (Jacob & Meek, 2013), and researchers are given incentives to be mobile early in their academic careers (McAlpine, 2012).

Given the increasing importance of mobility, scholars attempted to explain the types, patterns, causes and outcomes of academic mobility (see Chen, 2017). However, two main limitations persist in empirical studies. Firstly, the definitions of mobility tended to be narrow and focused mainly on transnational mobility, which became a locus of attention due to political and economic changes and open global academic job markets (Mamiseishvili & Rosser, 2010; Welch, 2005). This narrow definition was criticised by scholars, including Hoffman (2009) and Ackers (2008), who argued that framing academic mobility as transnational mobility is analytically limiting because academics can experience many types of mobility. In this context, mobility studies identify mobility as inter- or intra-organisational and sectorial, wherein academic career mobility can be measured by the frequency of job changes over one's career in and out of the higher education sector (Horta & Yonezawa, 2013; Kondratik et al., 2004). Specifically, mobility across academic and non-academic sectors is raising interest from scholars, university managers and policymakers because changing jobs between academia, industry and government is becoming increasingly frequent and related to the transformation of universities into engines of economic growth (Veugelers, 2016). Other studies complement these findings and highlight the role of disciplinary and educational mobility and their effects on current academic activities and output (Horta et al., 2016).

Secondly, mobility experiences are increasingly discussed in terms of their effects on academics' scholarly output—more concretely, their research productivity—but the findings are mixed thus far (Bolli & Schlapfer, 2015; Shin et al., 2014). The reason for these mixed findings is dual. Mobility experiences exert different effects according to the academics' educational background, gender, age, previous professional activities and competencies, and such experiences are associated with the characteristics of the higher education systems in which the academics work, regions of the world, career stages, disciplines and occupational sectors (Hoffman, 2009). In addition, the meaning and importance of these mobilities can be expected to differ for academics in Science, Technology, Engineering and Mathematics (STEM) fields and those in non-STEM fields (and thus is bound to influence their research output and its multidisciplinaryity). The contextual nature of the research of the latter academics, associated with the relevance of national language, focus and communities, can minimise the perceived relevance of transnational mobility when compared to academics who work in STEM fields which are more international by nature (Yonezawa et al., 2016). Mobile experiences may also affect academic generations distinctly. For junior academics, mobility experience is important to build a career in the job market by providing opportunities to search for more suitable jobs, whereas mobility experience for senior

academics relates to establishing more networks, income and reputation (Jung, 2014; Khattab & Fenton, 2016; Mahroum, 2000a). These differences highlight the importance of accounting for different mobilities as part of the individual trajectories of academics to better understand the complexity of mobility and its effects on knowledge-producing activities from an empirical perspective (as argued by Fontes, 2013 and Cañibano et al., 2008).

This article examines the effects of these diverse mobilities on research output (and the multidisciplinary nature of this output) using variables associated with academics, framed by their career trajectories and working environments. In this analysis, attention is paid to the fields of knowledge and the generational differences between academics. The added focus on the multidisciplinary nature of research output is relevant because, to the best of our knowledge, no study examines the effects of mobilities on the multidisciplinary nature of research output. The multidisciplinary nature of research is considered problematic due to the marked disciplinary differences in the ways that universities, publishers, academic communities and research funding agencies organise their resources and incentives (Goldin & Kutarna, 2016). Nevertheless, the research gap is surprising because the multidisciplinary nature of research increasingly defines the production of knowledge and the organisation of academic careers in years to come.

This analysis also considers other dimensions that warrant attention from an analytical standpoint. Although most academic mobility studies tend to focus on North America, Europe and Oceania (e.g. Mamiseishvili & Rosser, 2010; Laudel, 2005), analyses of the mobility of academics in Asia are scarce and recent, and they focus mostly on the Chinese government's programmes to attract Chinese scholars who previously worked abroad (e.g. Lu & Zhang, 2015). Studies in Asia concerning the effects of academics' mobility on research output are fewer (Shin et al., 2014, is an exception), and no study assesses these effects in cosmopolitan and multicultural cities/territories in East Asia. This study focuses on academics who work in higher education systems at the city level, not at the country level. This analytical level is uncommon but accounts for the growing role of cities as higher education systems that contribute to the global knowledge economy (see Kong, 2014). The higher education systems under study, Hong Kong and Macau, are characterised by being multilingual, multicultural, postcolonial, geographically close and special administrative regions of China, but they differ in size, resources, international reputation, development stage, official languages (Portuguese in Macau; English in Hong Kong) and academic job market conditions (Chou, 2012).

The article is organised as follows. The next section presents a brief literature review on academic mobility and the findings concerning the effects of academic mobility on research output. The methods section describes the data and methods for analysis, and the following section presents the results. The concluding section discusses the results.

## **Literature Review**

### *Academic Mobility: Concepts and Issues*

Transnational mobility is the most focused and discussed type of academic mobility in higher education research. Teichler (2015) and Ackers (2008) defined transnational mobility of academics as a permanent

form of ‘migration’ and, broadly, a more temporary form of ‘mobility’. Many studies do not distinguish these two concepts, and the use of several conceptualisations leads to a profusion of categorisations of transnational mobility that occasionally or mostly overlap but are given different names (Table 1). Transnational mobility can occur during education (often during the PhD programme), career or both, and it influences the work and working place of mobile academics due to cognitive and socialisation processes that shape mindsets, collaborations, knowledge and behaviour (Patrício et al., 2017; Yonezawa et al., 2016). Transnational mobility is generally defined as geographical movement from one country to another and associated with brain-drain, brain-gain and brain-circulation fluxes (Fangmeng, 2016).

**Table 1: Transnational mobility in the literature.**

<b>Categories of transnational mobility</b>	<b>Literature reference</b>
Early immigrants, doctoral immigrants, mobile study academics, doctoral mobile academics and professional migrants	(Teichler, 2015)
Stayers, returnees and emigrants	(Fangment, 2016)
Foreign highest degree, foreign citizenship or those nationals who have studies abroad	(Welch, 2005a)
Third-country nationals, expatriates and locals	(Dedoussis, 2007)
Short-stay pre-doctorate, short-stay post-doctorate, long-stay pre-doctorate and long-stay post-doctorate	(Cañibano et al., 2008)
Never experienced international mobility, international educational circulation, international short-term professional circulation, internationally circulating for work and spending long periods abroad, international late migrants for work, international early migrants and migrants for study	(Rostan & Ceravolo, 2015)
Long-term (involving employment or permanent change of residence), short-term and recurrent mobility and short-term, recurrent and repetitive mobility	(Jacob & Meek, 2013)
Short-term exchange and excursions, national career patterns and ICT-based mobility	(Hoffman, 2009)
Accidental mobility, forced mobility and negotiated mobility	(Gopaul & Pifer, 2016)

Whilst acknowledging the relevance of transnational mobility, Ackers (2008) suggested that mobility should be understood more broadly and include sectoral mobility, interdisciplinary mobility, transdisciplinary mobility and virtual mobility as well as mobility between public and private sectors. Heeringen and Dijkwel (1986) and Bolli and Schlapfer (2015) highlighted the relevance of job mobility from

one organisation to another within and across a country as important in terms of networking, experiencing new ideas and adjusting to new environments. Job mobility is entangled with transnational mobility and is observed mostly in academics who move from the peripheries to the centres of scientific power and academic prestige (Bennion & Locke, 2010). In this context, the non-economic factors of transnational and job mobility, such as independence, autonomy, intellectual challenge, network-building capacity and social status, can be as relevant economic reasons promoting the brain-drain, brain-gain and brain-circulation of academics (Baruffaldi & Landono, 2016). Hong Kong universities, for example, attract scholars from all over the world because Hong Kong is a place where East and West meet. Hong Kong is also a place characterised by academic freedom and autonomy, resources, international orientation and networking and the quality of the academic community (Postiglione & Jung, 2017; Yonezawa et al., 2016).

The growing emphasis on knowledge transfer also leads to the increasing mobility of academics between universities and industry. The contribution of this mobility to industry was found to influence the input and output of the companies' innovation process (Herrera et al., 2010). This mobility relates to network-building processes concerning teaching, research and commercialisation activities between industry and universities and is in tune with the third mission of the universities and the growing prominence of triple helix structures (Bienkowska & Klofsten, 2012). Such a mobility also exerts positive effects on collaborative research activities (Dietz & Bozeman, 2005). Those who work in industry and then move to academia are expected to show less research productivity due to their expertise in industry and continue to focus on knowledge exchange, innovation and commercialisation of research-based outputs (Toole & Czarnitzki, 2010). However, other scholars argue that intersectoral mobility can benefit the research productivity of academics when they return to academia (Lin & Bozeman, 2006) while fostering transdisciplinarity and industry-university collaboration (Ponomarev & Boardman, 2010). In academic systems that promote change contextualised by growing complexity and rapid advancement of knowledge, academics also change their positioning throughout their educational path and academic careers. This process of field mobility (i.e. 'thematic mobility') can be related to changing fields during education, a transition from a PhD to a new academic position, engagement in interdisciplinary projects or from a change in fields of knowledge to foster creativity and research output (Lawson & Soos, 2014; Stirling, 2007; Aboelela et al., 2007).

Regardless of the type of mobility, the mobility of academics in general is regarded as key for professional socialisation (Mahroum, 2000b), stimulation of creativity, independence, proactive behaviour, critical thinking and networking, whilst immobility reinforces organisational senses of identity and belonging, knowledge considered as legitimate and power structures (Horta & Yudkevich, 2016). However, mobilities occur at different times in an academic's educational and professional career, are associated with various reasons and are bound to generate distinct effects (Crespi et al., 2007). Mobilities can be strongly mediated by academic and career rewards and strategising—even in relation to the decision to be mobile—suggesting that incentives and context are important (Cruz-Castro & Sans-Menendez, 2010). Motivations in this framework can be relevant; academics early in their careers are concerned with independence, networking and tenure and plan their mobilities accordingly, whilst senior academics favour resources and mobilities that allow them to take up new lines of research, networking and income (Janger & Nowotny, 2016).

### *Mobilities and research output*

Studies have examined the effects of mobile experience on academics and their research output. Most studies focus on transnational mobility, and many find a positive relationship between transnational mobility and research output. Academics with such a mobility experience exhibit better research performance indicators (more publications, more citations and higher rates of international collaboration) than those without mobility (Filippo et al., 2009). Fangment (2016) compared the research productivity of Chinese academics between stayers, returnees and emigrants and found that returnees are more productive than stayers in general, reflecting similar findings (i.e. Yamashita & Yoshinaga, 2014; Jonkers & Tijssen, 2008). However, other studies find no relationship between transnational mobility and research output. Bolli and Schlapfer (2015) found no influence of overseas experience on research productivity and argued that today's Information and Communication Technologies (ICT) environment and its implied virtual mobility may replace the need for geographical mobility. Hunter et al. (2009) also identified that internationally mobile physicists did not have higher h-indices than their non-mobile peers. Their finding is similar to the results of Cañibano et al. (2008), although the latter authors argued that mobile academics had more opportunities to be involved in international projects and underlined the relevance of the qualitative dimension of mobility. This argument was underlined by Shin et al. (2014), who showed that obtaining a PhD abroad exerts positive effects on the research output of natural science academics but non-significant effects for social science academics in South Korea. This finding suggests that transnational mobility may exert different effects on academics who work in STEM fields and those who work in other fields. However, the authors also argued that the effects varied according to the local contexts, including the working conditions offered, resources and integration time, a conclusion also made by Jonkers (2011) in a study of Argentinian academics. Other studies have highlighted factors that may determine how transnational mobility influences research output and underlined the importance of career stage and the purpose of mobility (see Franzoni et al., 2015).

Although the relationship between changing jobs in academia and the production of research output are less studied, the results tend to point towards a positive relationship. Halevi et al. (2016) analysed the effects of transnational and job mobility in top-producing academics in seven disciplines and showed that mobility between at least two affiliations increased the output and its influence. Horta's studies in Mexico and Portugal showed that academics who never changed jobs communicated less with peers outside their own university and produced fewer publications (Horta, 2013; Horta et al., 2010). However, his study on Japan showed that academics who changed jobs were more productive in research than those who did not, but only up to a threshold, after which the gains in research productivity began to decline (Horta & Yonezawa, 2013). One condition that can affect this relationship was given by Fernandez-Zubieta et al. (2016), who found that job mobility itself does not increase academic performance and highlighted instead the destination of that mobility. Changing jobs to a more research-oriented department exerts a weak positive significant effect, whereas doing so to a less research-oriented department reduces an academic's productivity (Fernandez-Zubieta et al., 2016).

Studies on intersectoral mobility also assess its effects on academic research output, but the findings are mixed. Zucker et al. (1997) found that the greater mobility academics have between university and industry, the greater their research productivity. Other studies present dissimilar results, such as the analysis by Dietz and Bozeman (2005) who found that researchers who had several industry-university job changes had lower productivity than those with fewer changes. They also found that more time in one's career spent in industry led to a reduced ability to publish articles but a greater number of patents, a finding in accordance with the different types of research output more valued either by academia or industry (Dietz & Bozeman, 2005).

Transdisciplinary mobility is also important, although it occurs less frequently than job mobility (Teichler, 2016). The effects on the production of research output are argued to be variable because different fields of knowledge are associated with various traditions, publication venues, collaborative efforts, publication cycles and types of publications, making the assessment of transdisciplinary mobility on research production difficult to measure (Jansen et al., 2010).

## **Methods**

### **Participants**

The data for this study were collected via an on-line survey between December 2015 and February 2016 that was sent to all academics who work in universities in Hong Kong and Macau (a total of 11,210 invitations). Questions included demographic issues, employment and educational paths, with start and end dates to establish a timeline of events. An informed consent form was presented at the start of the survey, in which the participants had to agree before participating; 1,035 academics agreed to participate, but 545 did not complete the survey, yielding a final sample size of 487. The effective sample size is slightly lower in the reported analysis due to critical non-imputable non-survey missing data (e.g. publications) because the publication data for the survey respondents were extracted from Scopus after the survey had concluded. The sample comprised mostly men (295; 60.6%). The participants varied in age from 25 to 78 years (mean, 44.63 years; SD, 10.50 years). The most represented institution was the University of Hong Kong (119; 24.4%), followed by the Chinese University of Hong Kong (77; 15.8%) and the Hong Kong Polytechnic University (62; 12.7%). Table 2 lists the population and sample distribution by university, which is quite similar, evidencing that the final sample is generally representative of the population of academics in Hong Kong and Macau.



**Table 2: Population and sample distribution by university.**

<i>University</i>	<i>Population</i>		<i>Sample</i>		
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>% Diff</i>
Chu Hai College of Higher Education	34	0.30%	3	0,62%	0.31%
City University of Hong Kong	1,065	9.50%	48	9,86%	0.36%
Hang Seng Management College	176	1.57%	9	1,85%	0.28%
Hong Kong Baptist University	721	6.43%	28	5,75%	-0.68%
Hong Kong Shue Yan University	207	1.85%	4	0,82%	-1.03%
Institute for Tourism Studies	161	1.44%	6	1,23%	-0.20%
Kiang Wu Nursing College of Macau	28	0.25%	1	0,21%	-0.04%
Lingnan University	215	1.92%	8	1,64%	-0.28%
Macau Institute of Management	54	0.48%	1	0,21%	-0.28%
Macau University of Science and Technology	476	4.25%	5	1,03%	-3.22%
The Chinese University of Hong Kong	1979	17.65%	77	15,81%	-1.84%
The Hong Kong Institute of Education	509	4.54%	30	6,16%	1.62%
The Hong Kong Polytechnic University	1470	13.11%	62	12,73%	-0.38%
The Hong Kong University of Science and Technology	913	8.14%	27	5,54%	-2.60%
The Open University of Hong Kong	276	2.46%	6	1,23%	-1.23%
The University of Hong Kong	2074	18,0%	119	24,44%	5.93%
University of Macau	780	6.96%	38	7,80%	0.84%
University of Saint Joseph	72	0.64%	15	3,08%	2.44%

## Procedure, variables and limitations

### *Procedure and variables*

The analysis is based on two dependent variables. The first is *Publications*, which refers to the number of articles published during the past three years (i.e. 2014 to 2016). The second is *Multidisciplinarity*, which refers to the number of fields in which the individual published; this is based on the 27 major subject thematic areas used by Scopus to categorise journals<sup>1</sup>. As the dependent variables—Publications and Multidisciplinarity—are non-negative count data and the error term is over-dispersed (bibliometric data are by nature highly skewed)—that is, the variance exceeds the mean—negative binomial regression is used to analyse the data (see Wooldridge, 2010). In the first analysis, two models are specified, one for each dependent variable. In the second and third analyses, the initial models are subdivided into nested models. The second analysis separates the analysis by STEM and non-STEM fields, and the third analysis assesses the effects of mobilities on the research output and multidisciplinarity between academics with up to 10 years of working experience and their peers with more than 10 years of working experience in academia.

<sup>1</sup> Scopus content coverage guide: [https://www.elsevier.com/data/assets/pdf\\_file/0007/69451/scopus\\_content\\_coverage\\_guide.pdf](https://www.elsevier.com/data/assets/pdf_file/0007/69451/scopus_content_coverage_guide.pdf) [accessed 22nd May 2017]

The explanatory variables are included in each model. *Academic Job Count* refers to the number of jobs in academic institutions and reflects intra-sectoral mobility. *Non-academic Job Count* refers to the number of jobs in non-academic institutions, including firms, governments and nongovernmental organisations (NGOs), and reflects inter-sectoral mobility. These two explanatory variables are expected to be nonlinear in terms of their effects on research output (e.g. Horta & Yonezawa, 2013), and thus quadratic terms are included for both (*Academic Job Count*<sup>2</sup> and *Non-academic Job Count*<sup>2</sup>). The mobilities that involve transnational mobility are measured with two variables. *Transnational Educational Change* is a dummy variable that indicates whether the educational process involved changing countries, such as obtaining a bachelor's degree in one country and a PhD in another. The lack of such a mobility is the baseline. *Transnational Job Changes Count* refers to the number of times that changing jobs, either intrasectoral or intersectoral, involved a change of country. The final explanatory variable, *FOS mobility during education (Mobile)* refers to a change in Field of Science (FOS), as defined by the OECD (2007), during one's educational path (e.g. from the health sciences to engineering).

**Table 3. Types of mobility and its measurement**

<i>Types of mobility</i>	<i>Measurement</i>
intra-sectoral mobility	Number of jobs in academic institutions
inter-sectoral mobility	Number of jobs in non-academic institutions, including firms, governments and nongovernmental organisations
Transnational Educational mobility	Whether the educational process involved changing countries
Transnational job mobility	Number of times that changing jobs, either intrasectoral or intersectoral, involved a change of country
Field mobility	Change in Field of Science during one's educational path

The analysis draws a well-established set of control variables from the literature, including gender (dummy variable; male equals 1), age, time since first job (in years), field of science (natural sciences as the baseline)<sup>2</sup>, publications during the PhD, perceived PhD skills (average of a set of 17 skill block items used in the OECD's Careers of Doctorate Holders 2012 survey), local (a native of Macau or Hong Kong equals 1) and current location (i.e. Hong Kong or Macau). Tests for multicollinearity were performed, and the mean variance inflation factor warranted a result of 1.37, well below the threshold of 10, which dispelled multicollinearity concerns in the models (O'Brien, 2007).

### *Limitations*

The analysis bears four limitations. Firstly, mobility duration is not included in the model. Apart from mobile experience, the issues of whether longer experience improves research output (and its multidisciplinary) and whether mobile experience has an optimal period are not addressed. Secondly, the specific destinations of the mobilities are not considered. Although we are aware that during the educational or career mobility, specific countries and working places may influence research output because of their pool of potential collaborators, resources and visibility, and pressure for publication, this type of analysis is absent from this article. Follow-up studies that include a qualitative approach will address the differential effects on research output and its multidisciplinary based on destination. Thirdly,

<sup>2</sup> Agricultural Sciences was represented by a single participant and thus removed from analysis.

the quality of publications is not included due to data limitations. Finally, this study does not answer the quintessential question concerning the relationship between mobility and research output: does mobility lead to more research output or does research output trigger mobility? The available data do not allow assessment of this question. These limitations are left for future research.

## Results

Table 4 shows that intrasectoral mobility has a positive and statistically significant effect on research output and the multidisciplinaryity of research output. However, this effect is only positive up to a threshold, after which it begins to have decreasing marginal gains. This finding is in line with those of Horta and Yonezawa (2013) and reflects that intrasectoral mobility is better than no mobility (which is often associated with academic inbreeding; see Horta, 2013), but the concept of ‘the more mobility, the better’ should be observed with caution. Intersectoral mobility (i.e. the number of jobs outside academia) has no statistically significant effect on either research output or multidisciplinaryity. However, an excessive number of jobs in the non-academic sector has negative effects on research output, which is expected because non-academic jobs do not necessarily require research tasks, and researchers who prefer to take non-academic jobs that involve research tend to have a lesser ‘taste for science’ than those who pursue academic careers (Roach & Sauermann, 2010). The results confirm Toole and Czarnitzki’s (2010) expectations that experience in non-academic settings is associated with a lack of socialisation and habitus of engaging in research and inevitably leads academics with many jobs in non-academia to have less research output. Contrarily, experience in non-academic settings is not found to boost research productivity (Lin & Bozeman, 2006), nor does it potentially lead to greater multidisciplinaryity (Ponomariov & Boardman, 2010), although it may positively affect intersectoral collaborative endeavours as suggested by Dietz and Bozeman, 2005, and Ponomariov and Boardman, 2010.

The number of transnational job changes positively affects research output and multidisciplinaryity, which aligns with the literature that underlines the relevance of transnational mobility for research activities and production (Fangment, 2016; Yamashita & Yoshinaga, 2014; Filippo et al., 2009; Jonkers & Tijssen, 2008) and suggests that transnational mobility remains important in today’s academia despite the greater frequency of virtual mobilities permitted by advances in ICT (Bolli & Schlapfer, 2015). The mobility variables associated with the educational path are not significant, which may indicate that mobility can be influential right after the conclusion of education and entry into the labour market, but not later.

<b>Table 4: Determinant effects on publications and multidisciplinaryity.</b>		
<i>Variables</i>	<i>Publications</i>	<i>Multidisciplinaryity</i>
Academic Job Count	0.307 *** (0.111)	0.253 *** (0.083)
Academic Job Count <sup>2</sup>	-0.030 ** (0.015)	-0.031 *** (0.011)
Non-academic Job Count	0.229 (0.207)	-0.009 (0.181)
Non-academic Job Count <sup>2</sup>	-0.234 ** (0.096)	-0.124 (0.079)
Gender (Male)	0.351 ***	0.155

	(0.130)	(0.127)
Time Since First Job	0.002 (0.006)	0.001 (0.006)
FOS (Engineering and Technological Sciences)	0.314 (0.209)	0.160 (0.113)
FOS (Medical and Health Sciences)	0.148 (0.256)	0.163 (0.221)
FOS (Social Sciences)	-0.888 *** (0.091)	-0.575 *** (0.083)
FOS (Humanities)	-2.402 *** (0.178)	-2.107 *** (0.200)
Publications during the PhD	0.026 ** (0.011)	0.015 *** (0.005)
Transnational Job Changes Count	0.106 ** (0.178)	0.172 *** (0.005)
Perceived PhD Skills	-0.232 * (0.133)	-0.223 ** (0.088)
Local (Yes)	-0.435 *** (0.126)	-0.185 (0.121)
Transnational Education Change (Changed)	-0.126 (0.204)	-0.064 (0.179)
FOS mobility during education (Mobile)	-0.014 (0.109)	0.065 (0.078)
Location (Hong Kong)	0.272 (0.199)	0.309 (0.194)
Log pseudolikelihood	-927.813	-699.362
Observations	405	405

Notes. Negative binomial models with fixed factors (coded as dummies) and covariates are shown. Clustered robust standard errors for the universities in which academics work are shown in parentheses.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

Table 5 disentangles the analysis for academics in STEM fields and those in non-STEM fields. The results for intrasectoral mobility are consistent with the main analysis of Table 3. However, only the academics in non-STEM fields have positive research output and multidisciplinary. This positive influence is nonlinear and curvilinear because an excessive number of jobs in other academic settings leads to decreasing marginal gains in both dependent variables. Previous employment in non-academic settings is not statistically significant for academics in STEM fields, and a high number of jobs in these settings eventually exerts a detrimental effect on both research output and multidisciplinary. The latter finding holds true for non-STEM academics, but some work experience outside academia benefits their research output. These findings may be related to the type of non-academic environment experienced by STEM and non-STEM academics. STEM academics are more likely to have worked in the business sector, in which research is not a necessary condition or is applied on technological development, which entails research processes that differ substantially from academic traditions and related publications, thus making them less accustomed or prone to publishing academic papers. Non-STEM academics may work outside academia in government, NGOs or public research institutes in which the work developed may have more similarities to the work and research in which they need to engage as academics. By contrast, the effect

of transnational mobility in jobs on research output and multidisciplinary is statistically significant and impactful only for academics in STEM fields, which may be explained by the more internationally oriented work of STEM academics (vis-à-vis the more contextual and often nationally oriented work of non-STEM academics) and the access to laboratories, instrumentation and facilities they need to be internationally mobile (see Yonezawa et al., 2016). For these possible reasons, for academics in STEM fields, the role of intrasectoral job changes for academics in non-STEM fields in terms of research output and multidisciplinary impact is likely ‘replaced’ by transnational job changes that may also be intrasectoral but benefit from the international exposure that characterises the STEM fields.

Transnational education is only statistically significant for academics in STEM fields and warrants a negative effect on research productivity. The research output and multidisciplinary of academics in STEM or non-STEM fields who experienced field mobility during their education is undistinguishable from those who did not.

**Table 5: STEM versus Non-STEM nested models.**

<i>Variables</i>	<i>Publications</i>		<i>Multidisciplinary</i>	
	<i>Non-STEM</i>	<i>STEM</i>	<i>Non-STEM</i>	<i>STEM</i>
Academic Job Count	0.679 *** (0.231)	-0.079 (0.099)	0.584 ** (0.237)	-0.024 (0.107)
Academic Job Count^2	-0.079 *** (0.030)	0.014 (0.015)	-0.075 ** (0.031)	0.001 (0.014)
Non-academic Job Count	0.455 *** (0.168)	0.169 (0.080)	0.206 (0.172)	0.005 (0.281)
Non-academic Job Count^2	-0.272 *** (0.053)	-0.372 *** (0.080)	-0.145 ** (0.058)	-0.237 *** (0.086)
Gender (Male)	0.429 (0.270)	0.369 *** (0.141)	0.129 (0.192)	0.236 * (0.129)
Time Since First Job	-0.006 ** (0.003)	0.015 (0.013)	-0.005 (0.006)	0.008 (0.015)
Publications during the PhD	0.052 (0.091)	0.026 ** (0.012)	0.036 (0.030)	0.015 * (0.008)
Transnational Job Changes Count	0.052 (0.139)	0.201 ** (0.083)	0.094 (0.131)	0.260 *** (0.101)
Perceived PhD Skills	-0.078 (0.161)	-0.397 *** (0.132)	-0.155 (0.172)	-0.254 * (0.137)
Local (Yes)	-0.435 (0.288)	-0.320 ** (0.145)	-0.147 (0.318)	-0.085 (0.182)
Transnational Education Change (Changed)	0.023 (0.247)	-0.290 * (0.160)	0.031 (0.252)	-0.144 (0.133)
FOS mobility during education (Mobile)	-0.075 (0.295)	-0.015 (0.159)	0.004 (0.237)	-0.081 (0.116)
Location (Hong Kong)	0.847 ** (0.384)	0.073 (0.251)	0.614 (0.388)	0.298 (0.202)
Log pseudolikelihood	-412.467	-537.552	-334.996	-390.053
Observations	222	183	222	183

Notes. Negative binomial models with fixed factors (coded as dummies) and covariates are shown. Clustered robust standard errors for the universities in which academics work are shown in parentheses.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

The third analysis (see Table 6) refers to the effects of the various mobilities on the research output of junior academics (i.e. those with 10 years or less of working experience in academia) and senior academics (i.e. those with more than 10 years of working experience in academia). The results show that intrasectoral mobility is particularly relevant for senior academics; such outcomes are expected because the effects of job changes from one university to another need time, and many of these changes do not likely occur during the first 10 years of the career of a junior academic. For junior academics, a greater number of jobs outside academia led to fewer publications and a lower incidence of multidisciplinary, which may be explained by the lack of focus on research-related training, publication experience and fieldwork. Instead, these junior academics might have gained skills and interests in other non-research-related tasks, which may not contribute to greater research output and multidisciplinary focus. Transnational job changes are only statistically significant for junior academics and exert positive effects on the multidisciplinary of their publications, but not on their research output. This finding shows that research output and the multidisciplinary of publications are two different aspects and highlights the importance of experiencing other academic cultures and university settings to broaden one's horizons, drive creativity and establish international collaborations. This result seems to be particularly important during the socialisation years in the early stages of one's academic career.

**Table 6: Junior versus senior generations of academics nested models.**

<i>Variables</i>	<i>Publications</i>		<i>Multidisciplinarity</i>	
	<i>Seniors</i>	<i>Juniors</i>	<i>Seniors</i>	<i>Juniors</i>
Academic Job Count	0.423* (0.232)	0.085 (0.383)	0.261** (0.133)	0.100 (0.420)
Academic Job Count^2	-0.040 (0.029)	0.032 (0.071)	-0.0315* (0.019)	0.019 (0.066)
Non-academic Job Count	0.045 (0.262)	0.515 (0.592)	-0.311 (0.211)	0.340 (0.359)
Non-academic Job Count^2	-0.067 (0.095)	-0.430** (0.176)	0.073 (0.086)	-0.345** (0.138)
Gender (Male)	0.131 (0.142)	0.393* (0.218)	-0.012 (0.124)	0.219 (0.149)
FOS (Engineering and Technology)	0.634 (0.461)	-0.004 (0.277)	0.100 (0.278)	0.171 (0.163)
FOS (Medical and Health Sciences)	-0.017 (0.285)	0.217 (0.382)	0.006 (0.220)	0.253 (0.289)
FOS (Social Sciences)	-1.102*** (0.177)	-0.834*** (0.194)	-0.727*** (0.106)	-0.436** (0.196)
FOS (Humanities)	-2.376*** (0.267)	-2.534*** (0.388)	-2.049*** (0.245)	-2.214*** (0.334)
Time Since First Job	0.005 (0.009)	-0.014 (0.025)	0.004 (0.010)	-0.020 (0.015)
Publications during the PhD	0.098*** (0.031)	0.018*** (0.007)	0.072*** (0.019)	0.012*** (0.003)

Transnational Job Changes Count	-0.031 (0.106)	0.308 (0.214)	0.013 (0.069)	0.429*** (0.135)
Perceived PhD Skills	-0.272 (0.168)	-0.407 (0.314)	-0.235* (0.139)	-0.379* (0.230)
Local (Yes)	-0.441*** (0.134)	-0.476** (0.201)	-0.110 (0.146)	-0.298* (0.153)
Transnational Education Change (Changed)	0.033 (0.230)	-0.314 (0.259)	0.066 (0.197)	-0.289 (0.221)
FOS mobility during education (Mobile)	0.041 (0.261)	0.126 (0.172)	0.169 (0.194)	0.132 (0.122)
Location (Hong Kong)	0.499** (0.227)	0.052 (0.220)	0.471*** (0.125)	0.094 (0.158)
Log pseudolikelihood	-429.974	-465.710	-323.336	-343.465
Observations	186	207	186	207

A brief analysis of the control variables shows that they are aligned with previous empirical literature findings. Men tend to publish more than women, academics in different fields of knowledge vary in their publication patterns, publication during the PhD positively affects research output (Horta & Santos, 2016) and non-locals publish more than local academics (aligned with results from other cosmopolitan, internationally oriented and wealthy higher-education systems; see Mamiseishvili & Rosser, 2010). Two results should be underlined. Academics based in Hong Kong publish more than those based in Macau, and the higher one perceives his or her skills gained during the PhD to be, the lesser the research output and the multidisciplinary of that output. The latter result may be hypothetically explained by the Dunning-Kruger effect (Kruger & Dunning, 1999), that is, the tendency of unskilled individuals to overestimate their capabilities and for skilled individuals to underestimate their abilities. This phenomenon occurs because unskilled individuals lack not only the capacity to produce results but also the capability to correctly evaluate their own performance (Schlösser et al., 2013).

## Conclusions

The article's main contribution to the literature is that it assumes the mobility of academics as varied and broad, including a set of mobilities into a single model that identifies how they affect current research output and the multidisciplinary of this output, while controlling for one another.

The analysis finds that not all mobilities experienced by academics during their educational and professional paths influence their research output similarly. Mobilities that relate to intrasectoral and intersectoral job mobilities, appear more relevant than transnational education changes or field mobility, which exerts no effect on research output. Considering the high proportion of overseas doctorates in Hong Kong and Macau, transnational educational experience is expected to generate positive effects on academics' research output, but the findings are consistent with the results from other recent studies such as those by Fangment (2016) and Shin et al. (2014). The results also align with the argument of Breimer et al. (2011) that educational international mobility is not necessary for a successful research career in Europe. These studies suggest that the working condition after overseas study is more important

than the transnational educational experience itself. Transnational education experiences are only expected to warrant positive effects when those trained abroad can successfully integrate their professional networks in their home/host country (Jonkers & Tijssen, 2008) and when they maintain professional linkages with their colleagues and supervisors in the former host country (Fangment, 2016). These factors can also offer explanatory light for transnational work experience results in the sense that the research environment matters and the mobility related to it is becoming increasingly important and resonates with the growing importance of non-economic factors for mobility (see Baruffaldi & Landono, 2016). In this context, Yamashita and Yoshinaga (2014) showed that only highly productive researchers tend to move to other countries to seek a better research environment (similar to the findings by Khattab and Fenton, 2016, for the UK higher-education system).

The findings on intrasectoral mobility highlight its importance in academia. Experiencing different university cultures and research and learning styles associated with these institutions adds to personal growth and widens the professional experience of academics. Mobility experience also exposes academics to new situations and challenges that stimulate creativity, networking and the drive to publish. In this sense, this article warns against policies that favour academic immobility and the processes associated with it (e.g. those of academic inbreeding; Altbach et al., 2015). In addition, an excessive number of jobs outside academia leads to less current research output and less multidisciplinary. Taking those jobs indicates time and effort dedicated to learning skills and work that probably do not contribute to the skillset needed to conduct research and publish in academic settings (see Dietz & Bozeman, 2005).

The association of intersectoral mobility and research production and multidisciplinary, however, is better understood through the settings of academics in STEM and non-STEM fields. That experience in non-academic settings positively affect the research output of non-STEM academics may be related to the sector of activity in which non-STEM academics worked before joining academia (i.e. government, NGOs), sectors that in many ways share more similarities to academic work and with the type of research that is done in academia (of a more fundamental and mixed basic/applied nature) than the work and research usually done in business settings (strong applied focus and technological development). Non-STEM researchers may be granted not only a training and non-academic experience that is rather similar to that of academia but also an experience that can inform and influence their research agendas in academia and thus provide some effectiveness to their research productivity (see Schafer, 2012). By contrast, the dissimilarities between previous work in non-academic settings performed by academics in STEM fields may not be grant the same benefits in terms of research output when compared with their colleagues without working experience outside academia.

Another finding of key relevance and associated to the characteristics of broad fields of knowledge is the apparent 'trade-off' in relation to their effects on research output between intrasectoral mobility and transnational job mobility. The findings suggest that due to the international orientation of STEM fields, the type of mobility that matters most for research production of academics is transnational job changes. In the more national and contextual orientation of non-STEM fields, the type of mobility is intrasectoral mobility for academics who work in the social sciences and humanities, which may see their research output benefit from changing academic positions within universities in the same higher-education system.



The national/international focus of STEM and non-STEM fields dictate which type of mobility affects academics' research output.

The analysis of junior and senior academics also highlights the different effects of mobilities on the research output of academics in different career stages. Of all the mobilities, transnational job experience was more significant for junior academics than senior academics. This finding aligns with the findings of Gopaul and Pifer (2016) that cross-border experiences are particularly meaningful for early career academics to build a research agenda and scholarly identity. The number of job changes in the academic sector has greater positive significance to senior academics than to juniors, which is expected. On one hand, junior academics may not have the time to experience many job changes so that these have an effect on their research output. On the other hand, intrasectoral mobility for junior academics in many cases is 'forced' due to limited career opportunities and resources (Ackers, 2008), whereas mobility amongst senior academics is more lateral and vertical based on research interests and working conditions (Hoffman, 2009).

Overall, the findings suggest that mobilities exert different effects on research output and its multidisciplinary. Although all types of mobility matter, and they should be assessed by researchers, policymakers and university managers in terms of their association with research output and multidisciplinary while accounting for factors such as fields of knowledge and career stage. In any case, incentives for mobility should be made available because the added value of mobility for research endeavours is evident for academics and therefore for universities and knowledge advancement alike.

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