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The Impact of the Transnational Mobility Experience in Japan on the Academic Performance of Chinese Scientists

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ABSTRACT

Internationalization of higher education has dramatically expanded, and transnational academic mobility is one of the key mechanisms through which internationalization occurs. A number of studies have explored the experience of transnational mobility on scientists' academic output and international collaboration. However, in the case of China, few studies have paid attention to how scientists' mobility experience in Japan relates to their academic performance and collaboration with colleagues in Japan, although, as a non-English-speaking country, Japan is one of the foremost partners of China in the field of scientific research. This study attempts to explore these relationships by creating an original dataset of Chinese scientists affiliated to Peking University. The results show that the scientists' experience of a temporary stay in Japan as visiting scholars significantly enhances their publication productivity, *h*-index, international collaboration, and collaboration with colleagues in Japan. Furthermore, the experience of doctoral study and postdoctoral research also increases the likelihood of collaboration with Japan. The study sheds new light on Chinese scientists' mobility at different career stages in foreign countries and provides implications for enhancing individual scientists' academic performance and international collaboration.

1 Introduction

Internationalization of higher education has dramatically expanded in volume, scope, and complexity, and academic mobility is one of the key mechanisms through which internationalization occurs (Altbach & Knight 2007; Morley et al. 2018). Transnational academic mobility is a longstanding phenomenon, and it has become important to governments and universities worldwide that compete internationally as a key part of the global transfer and production of knowledge in the context of the knowledge economy (OECD 2008; Kim 2009; Kim 2017).

At the individual level, transnational mobility makes possible various forms of transnational academic activities, including conducting joint research and publishing in co-authorship, which have significantly influenced the role of academics (Chen & Li 2013). Individual scientists can benefit from the transnational mobility experience by accumulating capital in various forms that help enhance their academic capacity (Bozeman et al. 2001; Turpin et al. 2010; Bauder 2012).

China has achieved spectacular growth in scientific research (Zhou & Leydesdorff 2008), and led the world

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in the number of scientific research publications (National Science Foundation 2018), which can be attributed to policies aimed at recruiting top international talent to China, such as the Thousand Talents Plan initiated in 2008 by the central government of China. Those leading Chinese scientists recruited back to China under such policies indeed play an important role in China's scientific and higher-education development, and they also benefit from their transnational mobility experience in terms of their own research output (Jonkers & Tijssen 2008).

While a number of studies have verified the impact of the transnational mobility experience in Western countries on Chinese scientists' academic careers (Gu & Schweisfurth 2015; Leung 2012), no study has yet focused on their mobility in Japan. Although English-speaking countries such as the United States and the United Kingdom are currently the major study- or work-abroad destinations for Chinese nationals, Japan is still an important mobility choice for Chinese students and scientists.

The Sino–Japanese educational exchange can be traced back to the late sixth century when Japan took the initiative to send students and monks to China to learn the latter's culture and politics, and in turn China sent numerous students to Japan in the late 20th and early 21st century in order to modernize China. Nowadays, despite language barriers that may discourage international students from coming to Japan, Japanese universities have been developing degree programs that can be completed entirely in English, since the launch of the Global 30 Project in 2009, which aimed at promoting internationalization of the academic environment of Japanese universities and acceptance of excellent international students studying in Japan. In addition, English is *lingua franca* in all countries including Japan, especially in the hard disciplines, and Japan has shown its leading research capacity in those disciplines, as can be seen from the rapid increase in the number of its Nobel laureates since 2000, which may be one of the important reasons why Chinese students and scientists come to study in Japan.

Consequently, according to the latest data, Chinese students constitute the highest proportion of international students in Japan (Japan Student Services Organization 2019), and Japan has become the most important non-English-speaking collaborator of China in the field of scientific research (Zhang & Guo 2017). Therefore, this study attempts to test the hypothesis that mobility experience in Japan helps enhance individual Chinese scientists' academic performance, which will be proxied by their scientific publication productivity and international scientific collaboration. As Japan has also tried to recruit various forms of international scientists, such as PhD students, postdoctoral researchers, and visiting scholars, and encouraging them to conduct collaborative research with Japanese colleagues (Japan Society for the Promotion of Science 2019), this study will also help explore whether the mobility experience in Japan does contribute to the establishment of scientific collaboration.

The next section of this study will review the studies on the relationship between transnational mobility, scientific publication productivity, and international scientific collaboration. "Methodology, dataset, and variables" explains the methodological approach adopted in this study. The "General analysis" section presents descriptive statistics of the observations belonging to the sample of this study. The "Results" section reports the results of the investigation. The concluding section comments on the results and indicates possible directions in future research.

2 Literature Review

2.1 Transnational mobility and scientific publication productivity

For individual scientists, the publication of research is a symbolic equivalent to a significant scientific discovery, and it is also essential to the advancement of science itself (Merton 1957). Publication thus can be one of the most important measures affecting the academic career of individual scientists in regard to issues like the allocation of material resources and obtaining recognition. Indeed, it should be noted that contemporary academia has placed too much emphasis on publication, which is summarized by the idiom "publish or perish." Such a practice can lead scientists to ignore truly important research agendas but takes time, since they are supposed to conduct studies on whatever can be in print as soon as possible. Nevertheless, bibliometric methods are still highly effective at evaluating scientists' research activities.

Among a number of determinants that affect publication productivity of individual scientists, several studies have attempted to examine the relationship between their transnational mobility experience and scientific output measured by bibliometric methods. Aksnes et al. (2013) conducted a study on Norwegian scientists and found that the scientists who have been educated or worked internationally before or during their formal scientific career have a higher publication productivity and citation index than non-mobile ones. Similarly, De Filippo et al. (2009) focused on a Spanish university and observed that mobile scientists there have better academic performance measured by productivity and citation than their non-mobile counterparts. Zubieta (2009) also established a positive correlation between international mobility experience (as a postdoctoral researcher in this study) and UK scientists' academic performance. Kato and Ando (2013) noted that internationally mobile Japanese chemists academically outperform non-internationally mobile ones. Jonkers and Cruz-Castro (2013) also found that although Argentinean scientists with foreign work experience do not tend to publish more than their compatriots, they tend to publish more in high-impact-factor journals than their non-mobile compatriots.

Some studies have also paid specific attention to the transnational mobility experience and publication productivity of Chinese scientists. Zweig et al. (2004) found that Chinese scientists who studied overseas and returned to China performed better than others, and Jonkers and Tijssen (2008) found empirical support for this thesis by studying a sample of Chinese scientists specializing in plant molecular life in several top-level research organizations. Their study revealed that overseas experience has a positive impact on academic publication productivity by scientists.

However, some other studies have proposed contrary conclusions on the relationship between transnational mobility and scientific output of individual scientists. Cruz-Castro and Sanz-Menéndez (2010) found that scientists in Spain did not necessarily benefit from national or international postdoctoral mobility, while remaining at the same institution accelerated their publication output, especially when they were in those fields in which supply of scientists did not exceed demand.

The studies on the relationship between individual scientists' transnational mobility experience and scientific publication output have provided conflicting results. Hence, this study will examine the following question:

Question 1: Does transnational mobility experience in Japan have a positive impact on Chinese scientists' academic publication productivity?

2.2 Transnational mobility and international academic collaboration

The internationalization of higher education has integrated the international dimensions into the research functions of universities (Knight 1994). The internationalization of academic research marks "the fourth age of research," which is driven by international collaborations between elite research groups (Adams 2013). It has also been noted that international scientific collaboration is strategic for the growth of a country, in particular for those developing countries including China (Finardi & Buratti 2016). Hence, a number of studies have attempted to explore how transnational mobility factors affect the occurrence of international academic collaboration.

Alami et al. (1992) analyzed international academic collaboration by certain Arab countries, and they concluded that a major proportion of co-authorships of academic articles between less-developed and developed countries resulted from collaborative projects arising from prolonged stays in industrialized countries by doctoral or postdoctoral students. Ynalvez and Shrum (2009) chose scientists in the Philippines to analyze the relationship between their experience of overseas graduate education and international academic collaboration. Among Japan, Australia, and the United States, Japan is the most frequent source of research collaboration with scientists in the Philippines. It was noted that the Japanese graduate training system is characterized by frequent, intense, and personal interaction and close supervision of its mentors in addition to intensive laboratory research work without academic courses as the mode of study. Such a graduate training system fosters the development of durable and strong professional ties. Melkers and Kiopa (2010) studied a sample of scientists and engineers in the United States and found that individual characteristics, including nationality and international experience, have an impact on whether a scientist has close international collaborative ties. Eduan (2017) examined how study-abroad factors influenced international research collaboration among a sample of academics in sub-Saharan Africa. The results showed that the destination of mobility for study was associated with international collaboration because the developed countries encouraged and seeded collaboration in certain countries. The depth of international study experience was also important for the outcome of international collaboration in the hard disciplines since hard disciplines are often standardized, which provides the basis for collaboration between researchers from different countries. International work experience also has been shown to have a positive impact on rates of co-publication with international colleagues among Argentinian scientists (Jonkers & Cruz-Castro 2013).

Similar studies focus on the relationship between Chinese scientists' transnational mobility experience and their engagement in international collaboration. Jonkers and Tijssen (2008) established a positive correlation between Chinese scientists' foreign experience and their number of international co-publications. Jiang and Shen (2019) focused on a sample of Chinese PhD students who studied in European Union countries for short periods through an exchange program and found that such transnational doctoral study helped them build international collaborative networks. More than 60% of those who obtained PhDs in European countries engaged in co-

authorship with their supervisors before and/or after their return to China, and most of the international mentoring co-authorships established during the doctoral study were maintained upon their return to China.

It seems that the studies agree that for individual scientists having transnational mobility experience can increase the possibility of their involvement in international academic collaboration. Hence, this paper attempts to verify the assumption that transnational mobility experience will promote collaboration between Chinese scientists and colleagues in Japan. To be more specific, the following question will be answered:

Question 2: Does transnational mobility experience in Japan have a positive impact on occurrence of academic collaboration between Chinese scientists and those in Japan?

The studies on the impact of transnational mobility experience on academic performance generally draw on mobility experience during doctoral or postdoctoral study without considering the temporary relationships. In other words, from the perspective of career development of individual scientists, doctoral and postdoctoral studies presume them to be at different career stages. Therefore, this study attempts to pay special attention to any difference in the impact of transnational experience that occurred at different career stages of individual scientists.

3 Methodology, dataset, and variables

3.1 Data

To provide a robust response to the questions, we examine a sample of Chinese scientists affiliated to Peking University, which is one of the flagship research universities in China. The personal information and experience of transnational mobility were collected from their CVs, and their academic publication productivity and international collaborative publications were obtained from the Scopus database as proxies of their academic performance.

The author chose the scientists in three fields of basic sciences, mathematics, physics, and chemistry, as the sample of the study. These basic sciences are relatively globally standardized through academic publication databases and are dominated by English as the *lingua franca* of academic communication, so it will be feasible to adopt bibliometric methods to conduct further analysis. Accordingly, the author manually searched the official webpages of the three schools of Peking University – the School of Mathematical Sciences, the School of Physics, and the College of Chemistry and Molecular Sciences – and noted all the Chinese scientists affiliated to them. Then the author gathered the CVs of the scientists on the official webpages of the schools and their personal webpages in August 2019. The author collected the following information on the scientists by analyzing their CVs: name, gender, current academic rank, the year when and the country where a scientist obtained a PhD, whether a scientist received a postdoctoral post in Japan, and whether a scientist went to Japan as a visiting scholar.

On the basis of the results of CV analysis, the author managed to match the data of the experience of transnational mobility with the information on the scientists' scientific publications extracted from the Scopus database, so their publication productivity and international collaboration could be effectively measured. The scientists who had published at least one academic article since they obtained their PhDs were included in the analysis. There were 603 staff in total (including administrative staff and scientists) listed on the webpages of

the schools, and, finally, CVs were obtained from 267 scientists, with a collection rate of 44.3%.

3.2 Variables

The author conceptualized four dependent variables to represent the scientists' publication productivity and international collaboration. First, the variable "Productivity" is used to refer to the total number of academic articles that one scientist published between the years when he or she received his/her PhD and 2018. Then "H-index" was retrieved from the Scopus for every scientist. "Collaboration" refers to the sum of academic articles co-published by one scientist of Peking University and at least one affiliated to an institution outside Mainland China. "Collaboration_Japan" represents the number of articles co-authored by one scientist of Peking University and at least one affiliated to a Japanese institution.

In terms of dependent variables, this study focuses on three variables of transnational experience in Japan as follows. Firstly, the categorical variable "PhD_country" refers to the country where a scientist received his or her PhD. To be more specific, "PhD_country" = 1 if a scientist obtained a PhD in Mainland China, 2 if in the United States, 3 if in Japan, and 4 if in other countries. Secondly, the binary variable "PD_Japan" represents whether a scientist worked in Japan as a postdoctoral researcher. Finally, this study also included the experience of a visiting scholar in Japan, since other studies have noted that the experience of international visiting scholars can promote international collaboration (Liu & Jiang 2015; Xue et al. 2015). Accordingly, the variable "Visit_Japan" is defined as referring to whether a scientist went to Japan as a visiting scholar.

The author also included several control variables in the study. "Gender" (a dummy variable, with "female" as the reference group) was adopted in the study, and the variable "Rank" (a dummy variable, with "not a professor" as the reference group) indicates whether a scientist has received the academic title of "professor" yet. Since those star scientists can contribute to excessively high numbers in terms of academic performance, the variable "Honor" (a dummy variable, with "not Academician of the CAS" as the reference group) was used to indicate whether a scientist has been elected as Academician of the Chinese Academy of Sciences (CAS), which is the highest academic title in China for scientists with significant achievements in science and technology. The author included the dummy variable "Discipline" (Discipline = 1 if a scientist is affiliated to the School of Mathematical Sciences, 2 if the School of Physics, and 3 if the College of Chemistry and Molecular Sciences) in the study. The author also attempted to measure the seniority of the scientists but failed to gather all their birth years, so the quantitative variable "Year_PhD," which indicates the year when a scientist obtained the PhD, was included. Finally, the quantitative variable "Early_Productivity" was adopted, which is the total number of articles a scientist published before he or she obtained his/her PhD. **Table 1** shows a description of the variables.

Table 1 Description of the variables

Variables	Scale
Dependent variable	
Productivity	The number of articles published between the years when a scientist received a PhD and 2018
H-index	The *h*-index of the individual scientists
Collaboration	The number of articles co-authored with at least one scientist from an institution outside Mainland China between the year when a scientist received a PhD and 2018
Collaboration_Japan	The number of articles co-authored with at least one scientist from an institution in Japan between the year when a scientist received a PhD and 2018
Independent variable	
PhD_Country	Dummy variable 1–4 (1 = China, 2 = United States, 3 = Japan, 4 = Others)
PD_Japan	Dummy variable 0–1 (0 = No, 1 = Yes)
Visit_Japan	Dummy variable 0–1 (0 = No, 1 = Yes)
Control variable	
Gender	Dummy variable 0–1 (0 = Female, 1 = Male)
Rank	Dummy variable 0–1 (0 = Not professor, 1 = Professor)
Honor	Dummy variable 0–1 (0 = Not Academician of CAS, 1 = Academician of CAS)
Discipline	Dummy variable 1–3 (1 = Mathematics, 2 = Physics, 3 = Chemistry)
PhD_Year	The year when a scientist obtained a PhD
Early_Productivity	The number of articles published before a scientist received a PhD

4 General Analysis

The scientists of the three schools of Peking University with full CV information and who had published at least one academic article since they obtained the PhD were used as the sample in the analysis (N = 267). Table 2 shows the descriptive statistics of the observations belonging to 267 scientists.

A Kruskal-Wallis H test conducted to determine academic performance, which was measured by four variables, is different for four groups who obtained PhDs in Mainland China, the US, Japan, and other countries. There is a statistically significant difference in the dependent variable "Productivity" ($\chi 2(3) = 10.432$, $p = 0.015$) with a mean rank of 137.19 for the scientists who obtained their PhDs in Mainland China, 111.95 for ones in the US, 181.36 for ones in Japan, and 138.18 for ones in other countries. There is also a statistically significant difference in the dependent variable "Collaboration_Japan" ($\chi 2(3) = 18.104$, $p < 0.001$) with a mean rank of 130.57 for the scientists who received their PhDs in Mainland China, 125.98 for ones in the US, 213.36 for ones in Japan, and 131.95 for ones in other countries.

Furthermore, a Mann-Whitney U test indicated a significant difference in academic performance between the scientists with and without postdoctoral experience in Japan. "Productivity" is significantly greater for those who had postdoctoral experience in Japan (with a mean rank of 188.48) than for those who did not (with a mean rank of 129.59), U = 1380.500, $p = 0.001$. Those who had worked as postdoctoral researchers in Japan (with a mean rank of 178.65) had a higher *h*-index than those who had not (with a mean rank of 130.38), U = 794.500, $p < 0.001$. The former kind of scientists (with a mean rank of 180.20) co-published with international colleagues more than the latter (with a mean rank of 130.26), U = 1546.000, $p = 0.005$. The scientists who had once worked as postdoctoral researchers (with a mean rank of 217.78) also co-published with colleagues in

Table 2 Descriptive Statistics (N = 267)

Variable	Mean	SD	Min	Max
Dependent Variable				
Productivity	100.476	123.616	1	1089
H-index	25.064	18.738	1	116
Collaboration	34.790	72.363	0	1038
Collaboration_Japan	5.221	17.586	0	228
Independent Variable				
PhD_Country (ref. = Mainland China)	1.551	0.897	1	4
PD_Japan (ref. = No)	0.075	0.264	0	1
Visit_Japan (ref. = No)	0.086	0.281	0	1
Control Variable				
Gender (ref. = Female)	0.854	0.354	0	1
Rank (ref. = Not professor)	0.599	0.491	0	1
Honor (ref. = Not Academician of the CAS)	0.060	0.238	0	1
Discipline (ref. = Mathematics)				
Physics	0.401	0.491	0	1
Chemistry	0.360	0.481	0	1
Year_PhD	1999.682	7.195	1983	2015
Early_Productivity	3.086	4.672	0	26

Japan more than those who had not (with a mean rank of 127.22), U = 794.500, $p < 0.001$.

There are also significant differences between the scientists who stayed in Japan temporarily as visiting scholars and those who did not. The former (with a mean rank of 197.48) have significantly higher "Productivity" than the latter (with a mean rank of 128.02), U = 1346, $p < 0.001$. The former (with a mean rank of 188.37) also have a higher *h*-index than the latter (with a mean rank of 128.88), U = 1555.500, $p < 0.001$. Those who were visiting scholars (with a mean rank of 174.87) in Japan have published more in the form of international collaboration, U = 1866.000, $p = 0.008$. They (with a mean rank of 208.11) also have co-published with colleagues in Japan more than those who did not go to Japan as visiting scholars (with a mean rank of 127.01), U = 1101.500, $p < 0.001$.

5 Results

Negative binomial regressions were conducted to measure the effect of the transnational experience in Japan on academic performance, which is proxied by four dependent variables.

Table 3 shows the results of the models for publication productivity. Only one independent variable, "PhD_Country," was included in Model 1. "PD_Japan" was added in Model 2, and all the independent variables were included in Model 3. It is quite surprising that the transnational mobility experience during doctoral study in the United States has a significantly negative impact on the scientists' publication productivity. In Model

Table 3 Negative binomial regression models for publication productivity

	(1)	(2)	(3)
Intercept	107.580	107.600	104.647
Independent variables			
PhD_Country (ref. = Mainland China)			
United States	-0.424***	-0.425***	-0.370***
Japan	-0.015	-0.013	0.005
Others	-0.274	-0.274	-0.216
PD_Japan (ref. = No)	-	-0.005	0.027
Visit_Japan (ref. = No)	-	-	0.454**
Control variables			
Gender (ref. = Female)	0.197	0.197	0.192
Rank (ref. = Non-professor)	0.479***	0.479***	0.448***
Honor (ref. = Not Academician of the CAS)	0.759***	0.759***	0.728***
Discipline (ref. = Mathematics)			
Physics	1.352***	1.354***	1.278***
Chemistry	1.595***	1.595***	1.531***
PhD_Year	-0.052***	-0.052***	-0.051***
Early_Productivity	0.020*	0.020*	0.024**
Observations	267	267	267
Log likelihood	-1344.334	-1344.334	-1337.877
Pseudo R^2	0.103	0.103	0.108

Statistical significance levels: * = $p < 5\%$; ** = $p < 1\%$; *** = $p < 0.1\%$.

3, "Visit_Japan" is a significantly positive predictor of publication productivity, while whether the scientists obtained their PhDs or worked as postdoctoral researchers in Japan does not have a statistical impact.

Table 4 shows the effect of transnational mobility experience as a doctoral student, postdoctoral researcher, and visiting scholar on *h*-index, which measures quantity and quality of the scientists' publications at the same time. Among all the variables of the transnational mobility experience, only "Visit_Japan" has a significantly positive effect on the scientists' *h*-index.

Table 4 Negative binomial regression models for h-index

	(1)	(2)	(3)
Intercept	37.191	37.000	34.441
Independent variables			
PhD_Country (ref. = Mainland China)			
United States	-0.098	-0.092	-0.064
Japan	-0.140	-0.163	-0.137
Others	-0.105	-0.098	-0.066
PD_Japan (ref. = No)	-	-0.098	0.082
Visit_Japan (ref. = No)	-	-	0.260**
Control variables			
Gender (ref. = Female)	0.152	0.150	0.148
Rank (ref. = Non-professor)	0.388***	0.386***	0.373***
Honor (ref. = Not Academician of the CAS)	0.613***	0.612***	0.595***
Discipline (ref. = Mathematics)			
Physics	0.956***	0.944***	0.918***
Chemistry	1.308***	1.301***	1.267***
PhD_Year	-0.018**	-0.018**	-0.016**
Early_Productivity	0.023**	0.023**	0.024**
Observations	267	267	267
Log likelihood	-979.573	-979.362	-975.924
Pseudo R^2	0.114	0.114	0.117

Statistical significance levels: * = $p < 5\%$; ** = $p < 1\%$; *** = $p < 0.1\%$.

Table 5 shows the results of the models for the scientists' collaboration with colleagues outside Mainland China. The results are similar to the models for *h*-index in **Table 4** in that only the experience of visiting scholars in Japan significantly increases the likelihood of international co-publications, but where the scientists studied as PhD students or whether they worked as postdoctoral researchers in Japan does not have a significant impact on international collaboration.

Table 5 Negative binomial regression models for international collaboration

	(1)	(2)	(3)
Intercept	73.668	73.343	68.802
Independent variables			
PhD_Country (ref. = Mainland China)			
United States	0.084	0.090	0.179
Japan	-0.162	-0.212	-0.223
Others	-0.256	-0.245	-0.143
PD_Japan (ref. = No)	-	0.119	0.266
Visit_Japan (ref. = No)	-	-	0.732***
Control variables			
Gender (ref. = Female)	0.475**	0.473**	0.456**
Rank (ref. = Non-professor)	0.575***	0.574***	0.503***
Honor (ref. = Not Academician of the CAS)	0.745**	0.742**	0.758**
Discipline (ref. = Mathematics)			
Physics	1.439***	1.421***	1.238***
Chemistry	1.076***	1.066***	0.964***
PhD_Year	-0.036**	-0.036**	-0.034**
Early_Productivity	0.003	0.004	0.011
Observations	267	267	267
Log likelihood	-1141.013	-1140.886	-1133.920
Pseudo R^2	0.058	0.058	0.064

Statistical significance levels: * = $p < 5\%$; ** = $p < 1\%$; *** = $p < 0.1\%$.

Table 6 shows how different kinds of mobility experience in Japan affect the scientists' collaboration with colleagues in Japan. Although the doctoral and postdoctoral experiences are not statistically significant in Model 2, all three kinds of mobility experience in Japan in Model 3 are significantly positive predictors of collaboration with Japan, which means studying as a PhD student, working as a postdoctoral researcher, and staying in Japan temporarily as a visiting scholar all increase the likelihood of co-publishing with scientists in Japan.

Table 6 Negative binomial regression models for collaboration with Japan

	(1)	(2)	(3)
Intercept	129.913	142.232	147.721
Independent variables			
PhD_Country (ref. = Mainland China)			
United States	-0.571	-0.500	-0.130
Japan	1.314**	0.945	1.103**
Others	-0.898	-0.735	-0.516
PD_Japan (ref. = No)	-	1.056	1.344***
Visit_Japan (ref. = No)	-	-	1.765***
Control variables			
Gender (ref. = Female)	0.422	0.390	0.553
Rank (ref. = Non-professor)	0.511	0.353	0.077
Honor (ref. = Not Academician of the CAS)	0.359	0.309	0.384
Discipline (ref. = Mathematics)			
Physics	3.727***	3.458***	2.949***
Chemistry	2.807***	2.554***	2.148***
PhD_Year	-0.066**	-0.072**	-0.075***
Early_Productivity	-0.006	0.003	0.036
Observations	267	267	267
Log likelihood	-529.733	-525.601	-509.526
Pseudo R^2	0.098	0.105	0.132

Statistical significance levels: * = $p < 5\%$; ** = $p < 1\%$; *** = $p < 0.1\%$.

6 Conclusions

The study attempts to verify the impact of transnational mobility experience on academic performance of individual scientists by focusing on a sample of Chinese scientists and their mobility experience in Japan and academic performance. To provide robust responses to the research questions, the study drew on a dataset of transnational mobility experience among 267 Chinese scientists and their academic publications in the Scopus database and analyzed the relationships between their mobility experience in Japan during their doctoral studies and their publication productivity and international collaboration. Compared to previous studies, this study paid special attention to the mobility experience of Chinese scientists in Japan and their collaboration with scientists in Japan, which has been not fully discussed yet, and the study explores the impact of the transnational mobility experience in the framework of different career stages, whereas most studies have not distinguished the impact of mobility experiences on different career stages.

According to the results of the analysis, mobility experience in Japan for a doctoral degree and postdoctoral research does not predict higher publication productivity upon graduation or *h*-index, while temporary stay in Japan as a visiting scholar does significantly increase the scientists' productivity and *h*-index. The probable explanation is that the scientists had been more mature than PhD students and postdoctoral researchers when they were invited to Japan as visiting scholars in their academic capacity. With more mature academic capacity, the scientists might better benefit from the stay in Japan to enhance their quantity and quality of publications, probably by approaching different research agendas and equipment. However, educational experience in the US has a surprisingly negative impact on productivity of the scientists, which is quite

counterintuitive. On the one hand, this can be the result of this study's limited sample size since it only focuses on the scientists of Peking University, and the advantage of gaining a doctoral degree in the US may have diminished as the university is one of the best research universities in China. On the other hand, scientists with a US educational background may tend to publish more slowly than others, which may reflect differences between the doctoral education system of the US and that of other countries. These results require more data and methodologies to be effectively explained in further studies.

The mobility experience in Japan for visiting scholars is again a significant predictor for international collaboration with scientists outside Mainland China. This result can also be inferred from the fact that those visiting scholars tend to have already been relatively mature or senior, and when they arrived in Japan, they were probably able to launch international research projects involving scientists from multiple countries including Japan, while further studies need to confirm this speculation. In terms of collaboration between scientists in China and Japan, all three kinds of mobility experience – as PhD student, postdoctoral researcher, and visiting scholar – are significant positive predictors, which means the scientists managed to establish collaborative networks in Japanese academia. This result echoes the consensus that scientists can establish collaborative networks in host countries as international doctoral students. As Ynalvez and Shrum (2009) note, the unique characteristics of the graduate training system in Japan, as mentioned in the literature review, help establish a sense of community within a research laboratory that fosters the development of durable and strong professional ties.

One implication of the study's findings is that Chinese scholars will benefit from going to foreign countries as visiting scholars for a certain period, both in terms of their professional development and the quantity and quality of their academic publications. They will find it rewarding to go abroad as doctoral students or as scientists upon graduation from a PhD program if they seek to be embedded in international collaborative networks.

The study also holds implications for policymakers in China and Japan. China's policymakers should be aware that an overseas PhD does not necessarily represent better academic output but is still an effective way to encourage more students and scientists to study or conduct research in foreign countries and to actively bridge the collaborative connections between China and the host countries. On the other hand, it is also necessary and rewarding for Japan to continue recruiting international students into doctoral programs and scientists to academic institutions so that international collaboration between Japan and their home countries can be intensified as the Japanese government has been seeking to use scientific collaboration to develop sound diplomatic relations with other countries (The Cabinet Office 2016).

Nevertheless, this study has several potential limitations. First of all, the study focuses on the scientists from Peking University, which is one of the flagship research universities in China. So the results of the study can be relevant to the scientists affiliated to those elite research universities in China, but a more inclusive sample is necessary in further studies if more universal conclusions are expected. Secondly, it should be admitted that the CV analysis, which is one of the core methodologies adopted in this study, faces potential problems. Although CV analysis has been considered an effective method to describe scientists' academic outputs and trajectories, it is questionable whether all the selected scientists had fully updated all their

information in time for the CVs to be viewed and coded for this study. In further studies, other methods like online questionnaires should also be included, so that comprehensive and accurate information for scientists will be available. Finally, it should be noted that in the "Results" section, the Pseudo R^2 of some models is obviously low, which indicates that this study has room for improvement. In addition to a more inclusive sample, more potential important variables are expected in further studies like the scientists' mobility experience in foreign countries other than Japan.

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