Return or Stay? Impact of Reverse Brain Drain: The Case of the Youth Thousand Talents Plan in China

By

HWANG, Ji Young

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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Committee in charge:

Professor Yoon, Chungeun, Supervisor

Professor Rhee, Inbok

Professor Lee, Changkeun

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ABSTRACT

RETURN OR STAY? IMPACT OF REVERSE BRAIN DRAIN: THE CASE OF THE YOUTH THOUSAND TALENTS PLAN IN CHINA

By

HWANG, Ji Young

This study examines the impact of the Youth Thousand Talents Plan (YTTP), a Chinese policy to combat brain drain, on the research performance of the award recipients. China has suffered from a lack of high-skilled talent since the Open Door Policy in the 1970s and has thus implemented the YTTP to alleviate this trend by attracting young high-skilled workers in the STEM fields. To estimate the program's impact, I collected novel data on 1,116 YTTP awardees, covering five waves (2011–2013), and matched them with their publication metrics on Google Scholar. I then analyze the dataset employing a difference-in-differences strategy. The findings show that accepting the YTTP and returning to China decreased the number of publications authored by the awardees by 13.5%. However, there are also some notable heterogenous effects: the results also suggest that the YTTP increased the research performance of female awardees and the number of publications in materials engineering. These findings have three important policy implications. First, the Chinese government should implement countermeasures to support its reverse brain drain policy. Second, the government should consider increasing the number of female high-skilled workers selected for the program. Third, prioritizing certain fields, such as materials engineering, may be useful.

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I. INTRODUCTION

Brain drain has intensified across developing countries, especially of high-skilled workers who are engaged in the STEM (science, technology, engineering, and mathematics) fields. This raises a significant issue as a new paradigm of the science and knowledge that drives economic development has underscored the need for skilled human capital. High-skilled workers create innovations that serve as critical catalysts for growing national economies (Docquier et al., 2007), and the loss of human capital negatively impacts future economic development in the workers' countries of origin (Haque & Kim, 1995; Miyagiwa, 1991; Todoro, 1977; Wong & Yip, 1999).

This concern has ushered in policies to prevent brain drain throughout the developing world, such as penalty systems and strict regulations on those seeking to leave their country. However, some brain drain policies have been designed to attract high-skilled talents based on pull factors (Roudgar & Richards, 2015) to reverse the brain drain, such as high salaries and improved working and living conditions, since many high-skilled professionals chose to leave their country to find better career opportunities, quality of life, educational environment, and political climate in the host countries (Docquier et al., 2007; Dodani & LaPorte, 2005; Kwok & Leland, 1982).

Despite its authoritarian regime, the People's Republic of China (referred to hereafter as China) has been vulnerable to brain drain since 1970, when the Open Door Policy was enacted. China has employed reverse brain drain policies based on pull factors to entice high-skilled talent to return to China since 1990. Beginning in 2010, the Chinese Communist Party's (CCP) Central Committee intensified such efforts and introduced a proactive return program called the Youth Thousand Talents Plan (referred to hereafter as the YTTP or the Plan), which

was included in the overarching Thousand Talents Plan. At its core, the Plan seeks to shift China into a knowledge-based economy by increasing the number of high-skilled workers in the country. However, the evaluation of the Plan remains ambiguous. Data accessibility is limited, as the CCP conceals the awardees' information from the public. Thus, a limited amount of research has measured the impact of the YTTP on reversing brain drain through policy.

Therefore, the purpose of this study is to narrow the gap in the literature and assess the impact of accepting the YTTP on the Plan's awardees. The existing literature tends to examine a single academic major and a limited time range of the YTTP, while efforts have also been made to analyze the causal relationship between receiving the YTTP and research performance (Lundh, 2011; Marini & Yang, 2021a, 2021b; Shi et al., 2022; Sun & Zhang, 2021; Yang & Marini, 2019; Zweig & Kang, 2020). In spite of the importance of estimating the impact of reverse brain drain, research that evaluates the comprehensive impact of the YTTP on research performance remains limited. Thus, by examining the consequence of accepting the YTTP, this paper seeks to address the following research questions:

1. What is the research performance difference between YTTP awardees who accepted and returned to China and YTTP awardees who renounced the award and remained overseas?

2. What is the research performance difference between YTTP awardees, who accepted and renounced, by gender, PhD attainment location, and academic major?

By examining manually constructed individual-year-level data from 2011 to 2013 from the Program of Global Experts Recruitment (PGER) website, the policy's official page, this paper estimates the research performance differences between the accepted and the renounced YTTP awardees. The main independent variable is the decision to return to China after winning the YTTP. The dependent variable is the research performance of the awardees, as measured through their number of publications per year.

The author employs a difference-in-differences strategy to estimate the research

performance of YTTP awardees. The difference-in-differences strategy allows for the comparison of changes in the number of publications of the YTTP awardees according to their acceptance status in each award year. The empirical result indicates that a decrease in the number of publications is associated with YTTP acceptance and with returning to China. This effect corresponds to a 13.5% decrease in their number of publications per year after winning the YTTP in all five waves, and this finding is statistically significant at the 1% level. The estimation is robust when controlling for awardees' ages and PhD attainment years. Moreover, the number of publications by female awardees 49.9% more likely to increase the number of publications, at the 1% level of significance. The findings also show that the awardees who earned their PhD in China showed a larger decrease in publications than those that studied overseas and YTTP acceptance impact on the number of publications differs from academic major.

This study makes four contributions to the existing literature on evaluating reverse brain drain policies in China, specifically the YTTP. First, the study expands on the little research that has been done on YTTP acceptance and how it affects research performance. The analysis clarifies the YTTP's impact on research performance by exploring awardees in all five waves since earlier findings have resulted in controversial conclusions that portray the YTTP as either positive or negative. Furthermore, the findings of the impact by gender, PhD attainment location, and academic major present a comprehensive understanding of the YTTP's impact. Second, the paper analyzes the difference between YTTP awardees that accepted and those that renounced the award, as the researcher is unaware of any literature that has compared the two groups. Unlike previous studies, which often only estimate the YTTP's impact by comparing the awardees to similar counterparts that did not receive the Plan, this study provides results that are likely to more clearly analyze YTTP acceptance impact. Third, the data in the present paper is potentially useful for future research evaluating the YTTP, as the dataset was

manually constructed through official Chinese-language data from 2011 to 2013. Moreover, the data used in this study can also track awardees' research performance in the long term, as personal information is included. Fourth, these findings have significant policy insights for countries that have suffered from brain drain. Empirical evidence on how reverse brain drain policies affect research performance can present implications on how to cope with brain drain.

The following sections explain the background of brain drain in China and the YTTP. Section 3 reviews the previous literature. Section 4 provides data and descriptive statistics. Section 5 presents the methodology. Section 6 describes the main findings of the paper, and Section 7 includes the discussion and conclusion.

II. BACKGROUND

2.1. Why brain drain in China?

China has suffered from brain drain since the adoption of the Open Door Policy in 1978. As part of market liberalization reforms, Deng Xiaoping, the former leader of China, encouraged promising Chinese students to study abroad to bring back knowledge from overseas as a means of advancing human capital. In contrast with the initial vision of having a highly skilled workforce to contribute to Chinese economic development, a significant portion of these students did not return. Many Chinese students decided to remain overseas due to the political instability and lack of political freedom in China (Zweig, 2006), as shown by events such as the Tiananmen Square protests and massacre and the issuance of the Chinese Student Protection Act in the late ’80s to the early ’90s. This phenomenon resulted in the undesired consequence of brain drain. According to Pells (2018), only one in seven high-skilled workers returned to China in 2008. China began to suffer from a lack of high-skilled professionals, as many of them remained overseas.

To reverse the brain drain, China has sought to successfully remigrate high-skilled Chinese talent from abroad. To achieve this aim, the Chinese government has been introducing proactive ways to attract highly skilled talent back to the country since the 1990s. Deng Xiaoping promised to overlook any political activities by overseas Chinese students if they avoided anti-government behavior. Following Deng’s promise, policies liberalized to favor Chinese high-skilled talent who were overseas. The Chinese government announced a new strategy to reverse brain drain by providing monetary assistance and supporting a favorable job market. Return programs such as the Hundred Talents Program and the Cheung Kong Scholar

Program have attracted high-skilled talent from abroad. The Hundred Talents Program, led by the Chinese Academy of Sciences and the Cheung Kong Scholar Program, aims to develop Chinese higher education by attracting returnees and providing them with substantial subsidies. These two programs focus on attracting high-skilled workers from overseas by subsidizing between 500,000 and 2 million RMB for research and salaries.

However, despite the effort of the Chinese government, these high-skilled workers rarely returned to China. A substantial number of high-skilled workers remained abroad, even though returnees tended to be higher-skilled professionals than people who stayed in China (Zweig, 2006). Only a quarter returned among 1.21 million Chinese students who studied abroad between the late 1970s and 2007 (Cao, 2008). Several reasons, such as a highly regulated and closed society, a lack of political liberalization, high levels of bureaucracy, and a guanxi-based society, which contrasts with a merit-based society, negatively influenced workers' decisions not to return to China (Cao, 2008; Cheung & Xu, 2015; Zha, 2014; Zweig & Wang, 2013). Stifling organizational and institutional drawbacks resulted in a failure to bring back highly talented professionals from overseas, although the Chinese government further liberalized its returnee policy.

With its increasing awareness of brain drain, the Chinese government changed its view on brain drain and prepared to focus increasingly on brain circulation policy rather than on preventing brain drain, which regards brain drain as positive phenomenon. As a result, the Central Organization Department of the Chinese Communist Party (CODCCP) launched a policy to attract high-skilled talent from overseas called the Thousand Talents Plan (TTP) in 2008. The program was an unprecedented measure, as the CCP had never been involved in reversing brain drain. The program aimed to attract highly skilled Chinese and foreign human capital to boost China's economic growth and industrial advancement by assigning them to nationally focused innovation projects and offering them key roles in Chinese university

departments and laboratories, major Chinese companies, and state-owned financial institutions.

Under the TTP, the CODCCP included a new policy to attract young high-skilled workers from overseas in STEM fields in 2010, the Youth Thousand Talents Plan (YTTP). The YTTP differs from the TTP in terms of its qualifications and the working conditions offered to awardees upon their return. The YTTP is designed to recruit young professionals under the age of 40, and the main target group comprises those who are in STEM fields, unlike the TTP, which includes business professionals. YTTP awardees must work full-time in China, whereas TTP awardees can maintain their full-time positions overseas. The distinction implies the Chinese government's increased determination to attract high-skilled talent. It also indicates China's desire to improve its economic capacity and produce high-quality research in the shift toward a knowledge-based economy (Li et al., 2018).

Surprisingly, the outflow of talent shifted in the late 2000s in response to the adoption of the TTP. The return rate boomed from around 39% to 78% from 2008 to 2018 (Jin, 2020). Table 1 and Figure 1 depict the return rate to China from 2002 to 2019. According to the Ministry of Education of China (2020), the cumulative number of overseas Chinese students was 656 million, and 423.17 million Chinese students returned between 1978 to 2019. Around 64.5% of Chinese students had returned to China by 2019. The current return rate is somewhat higher compared to the early statistics provided by Cao (2008), in which the return rate was only 25%. Given these recent figures, it is possible to declare the success of the policy efforts undertaken by the CODCCP. The Chinese government also evaluates reverse brain drain as a result of its policy to attract high-skilled talent (Kim & Kim, 2020). Nevertheless, no firm evidence indicates whether the return policy led by the CODCCP is the major cause of return, as the Chinese government does not provide publicly available information on the policy beneficiaries. In addition, other external factors such as the global financial crisis, tightening legal systems in Western countries, and China's economic boom may also explain the increase

in returns (Jin, 2019).

Table 1. RETURN RATE TO CHINA, 2002-2019

Year	Number of students studying abroad	Number of returning students	Return rate (%)
2002	124,690	17,628	14.14
2003	117,300	20,100	17.14
2004	114,663	25,116	21.9
2005	118,500	35,000	29.54
2006	134,000	42,000	31.34
2007	144,000	44,000	30.56
2008	179,800	69,300	38.54
2009	229,300	108,300	47.23
2010	284,700	136,800	48.05
2011	339,700	186,200	54.81
2012	399,600	272,900	68.29
2013	413,900	353,500	85.41
2014	459,800	364,800	79.34
2015	523,700	409,100	78.12
2016	544,500	432,500	79.43
2017	608,400	480,900	79.04
2018	662,100	519,000	78.39
2019	703,500	580,300	82.49

Source: Ministry of Education of the People's Republic of China

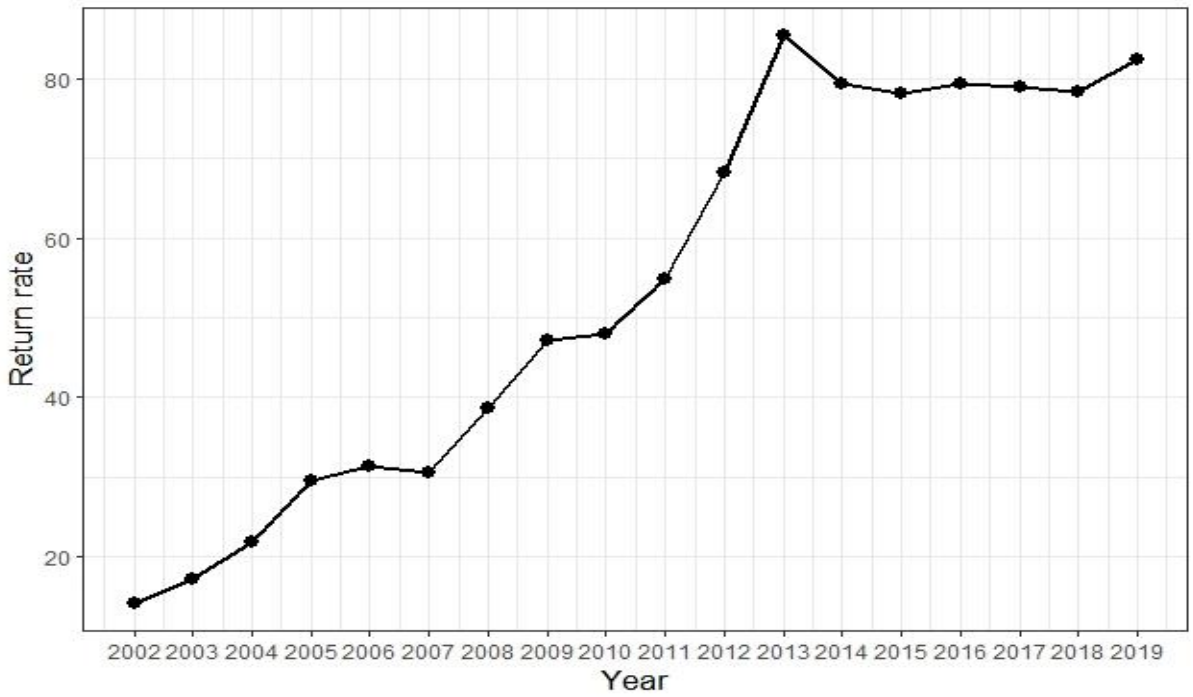

Figure 1. RETURN RATE TO CHINA, 2002–2019

Source: Ministry of Education of the People's Republic of China

2.2. Youth Thousand Talents Plan

The Chinese government recently adopted the YTTP and included it within the TTP to attract outstanding young workers and scientists from overseas in 2010. The organizational chart of the YTTP is illustrated in Figure 2. The YTTP was established at the 29th Meeting of the Central Human Resources Cooperation of China under the responsibility of the CODCCP on November 4th, 2010. Since then, the YTTP has been actively promoted in each domestic province and autonomous district through local-level committees with the specific purpose of organizing high-skilled talent, some state-owned enterprises, and communist party committees in major Chinese universities.

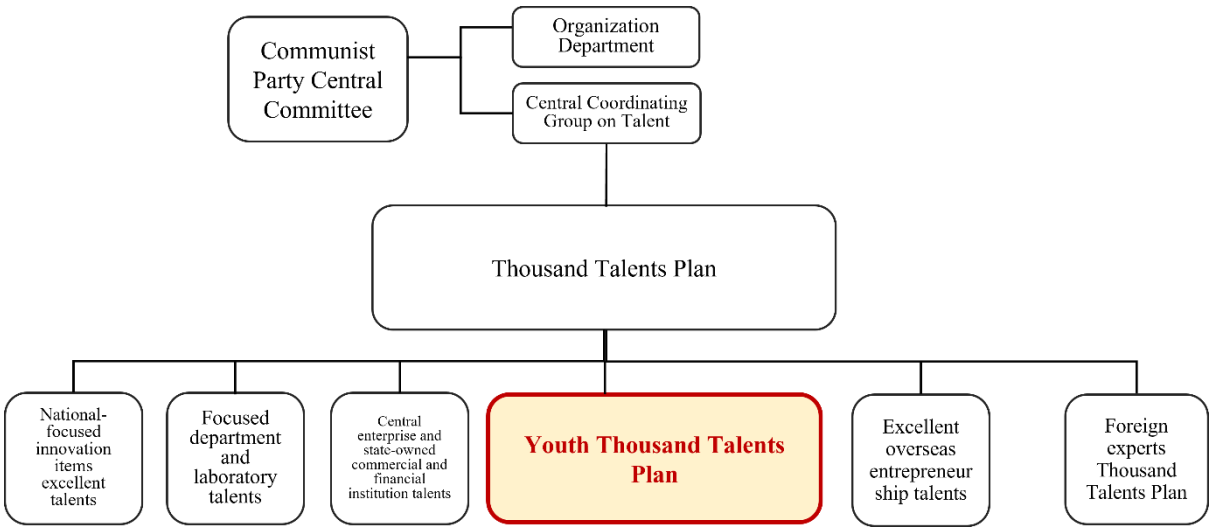

Figure 2. ORGANIZATION CHART OF THE YOUTH THOUSAND TALENTS PLAN

Source: Author's illustration based on different YTTP-related sources.

All YTTP candidates must meet the following conditions: they must belong to a field of natural science or technology, be under the age of 40, and have the ability to work full-time in China if selected. In addition, candidates must fulfill one of the following employment-related conditions: they must receive a doctorate from a renowned foreign university and obtain at least three years of experience in a scientific organization or R&D department of a famous

company, or they must outperform others of a similar age in the same field and demonstrate the potential for further development in academic and technical fields.

The Chinese government provides an extensive range of benefits for YTTP awardees who remigrate to China. If the recipients are foreign nationals, they can apply for permanent residency or a two-to-five-year long-term resident visa that includes the professional, their spouse, and their children. High-skilled professionals of Chinese nationality can select any region as their census registration (*hukou*) without restrictions before their return from overseas. This is an unprecedented benefit considering that one's *hukou* region cannot be freely changed in China. Other incentives provided to highly skilled professionals include one-time subsidies of approximately USD 71,200 per individual; research grants ranging from USD 142,000 to 427,000 over three years for each individual; exemption from personal income tax; medical benefits for the professional, their accompanying spouse, and their children; and various social insurance benefits such as basic nursing care, basic medical care, and industrial accident insurance.

III. LITERATURE REVIEW

3.1. Brain drain and reverse brain drain

Before proceeding further, it is imperative to clearly define the key terminology used in this paper. To clarify the concept of reverse brain drain, it is necessary to first define brain drain as the phenomenon of high-skilled workers such as scientists, engineers, physicians, and other high-skilled professionals from less developed countries migrating to work in more developed countries (Carrington & Detragiache, 1998; Miyagiwa, 1991; Wong & Yip, 1999). Highly skilled workers migrate to different countries to seek better working and living conditions, higher wages, greater accessibility to developed technology, and higher levels of political stability (Dodani & LaPorte, 2005; Kwok & Leland, 1982).

Reverse brain drain occurs when these workers return to their home country to continue their professional careers (Cyranoski, 2009). Throughout this research paper, the term reverse brain drain is used to describe the phenomenon in which highly skilled professionals who initially migrated to seek better work conditions return to their home countries to begin a career (Badruddin, 2016; Carrington & Detragiache, 1998; Cyranoski, 2009; Dodani & LaPorte, 2005; Kwok & Leland, 1982; Miyagiwa, 1991; Wong & Yip, 1999).

3.2. Brain drain in China

Despite the efforts of the Chinese government to attract high-skilled Chinese talent from overseas, the majority of students are determined to remain abroad. With the aim of examining their motivation for migration, a body of literature has researched the reasons Chinese nationals do not return to China. According to Chang and Deng (1992), brain drain in

China is a social, economic, and political problem. Specifically, frequent human rights violations, substandard research facilities, and a lack of capability in human resources management are the main factors that deter professionals from returning to China (Chang & Deng, 1992). The desire for higher-quality equipment and better future prospects for their children's education are two considerations that result in high-skilled talent remaining overseas (Zweig, 2006). These factors indicate that high-skilled workers consider their environment and their children's futures in their decision making.

In addition to the visible social aspects, Ma and Pan (2015) argue that overseas talent is concerned about readaptation, and the concern is often aggravated when professionals live abroad with their families. Moreover, the prospect of returning to a guanxi-based society, which represents a stark contrast from a merit-based system, decreases the chances of high-skilled talent returning (Cao, 2008; Cheung & Xu, 2015; Fedasiuk & Felgoise, 2020; Zha, 2015; Zhu, 2019). Readaptation issue and the guanxi-based society hinder career development due to the high dependence on personal relationships rather than one's performance.

Economic factors are another reason for talent remaining overseas. Many high-skilled workers seek better conditions in their careers and in their living environments. A lack of opportunities for career advancement, low income, and poor living conditions encourage migration to other countries (Deng, 1992; Zweig, 1997; Zweig, 2006). Therefore, monetary benefit is a salient factor in high-skilled workers' decisions to either return to China or remain overseas.

In addition to economic reasons, previous literature has identified political motivations that discourage talent from returning to China. A lack of political stability, political freedom, and trust in the local government may influence Chinese immigrants to remain overseas (Zweig, 1997). Chang and Deng (1992) emphasize that political instability intensified workers' unwillingness to return to China after the massacre in Tiananmen Square occurred in 1989. As

Chinese students feared the collateral effects of political instability in China, they chose to migrate (Lu & Zhang, 2015).

The motivation that drives high-skilled Chinese workers to migrate to host countries is multidirectional. Social, economic, and political mechanisms are key concerns that influence the choice to remain overseas for high-skilled talent.

3.3. Reverse brain drain in China

Two major factors caused a boom in the number of returns to China: external conditions and China's own return policies. Many studies have analyzed the cause of the return boom in China that began in the 21st century. According to Kellogg (2012), "pull–push factors" represent a category of factors that motivate high-skilled Chinese talent to return to China. China's rapid economic growth, admission to the World Trade Organization (WTO), continuation of the Open Door Policy, and government incentive programs began attracting overseas Chinese talent to return (Ma & Pan, 2015). Career opportunities and job prospects have been primary motivators for returnees to remigrate to China. China's rapid economic development and improved technology, as well as the hardship of finding better job opportunities overseas, have encouraged high-skilled workers to return home (Zweig, 2006). The return rate drastically increased in 2008, as the global economy became unstable. The global financial crisis in 2008, the adoption of strict immigration policies in the United States and European countries, and China's economic growth led returnees to favor returning to China over facing the difficulty of finding a suitable job abroad (Jin, 2020). In addition to a lack of career opportunities, a failure to assimilate into the host country and experiences of discrimination constitute additional reasons to return (Tharenou & Seet, 2014). The uncertainties of living abroad have resulted in the return of Chinese high-skilled workers to China.

Aggressive and ambitious return policies led by the CCP are another cause of reverse brain drain. However, the degree of impact of the CCP's return policies remains contentious. Some scholars have argued that CCP's return programs have been effective in attracting high-skilled talent from overseas. The opportunity to participate in an encouraging returnee program is a key motivation for returning to China (Jin, 2020). Yang and Chen (2013) claim that the TTP operates efficiently and substantially attracts overseas talent. The program has attracted more than 7,000 people from abroad (Jia, 2018). The Chinese government has recognized reverse brain drain as a consequence of its policy to attract high-skilled talent from overseas (Kim & Kim, 2020). However, some other studies assert that the CCP's return programs have failed to attract the most talented professionals. Cao (2017) and Tian (2013) contend that the return program has only achieved partial success. Cao (2017) further explains that only 13.87% of overseas PhD holders returned between 2008 and 2014. Moreover, TTP awardees often prefer to remain overseas to maintain a full-time position, and this phenomenon means that the program only marginally addresses brain drain issues (Cao, 2008; Cao, 2017; Tian, 2013).

The motivation for the return boom after 2008 remains unclear. First, previous studies have mainly attempted to research this trend through qualitative methods based on in-depth interviews and case studies. Due to the limitation in research methods, no consensus has been established on whether the CCP's reverse brain drain programs were the only factor that resulted in success in attracting high-skilled talent. Moreover, information unavailability on the program makes estimating its effect difficult.

3.4. Previous study on the Youth Thousand Talents Plan

A limited body of literature has nevertheless attempted to measure the effect of the YTTP by focusing on the research performance of the program's awardees. Studies have focused on estimating two research productivity measures: quantitative output and research

quality. The former involves estimating the number of publications produced by the YTTP awardees, and the latter involves measuring the number of citations per publication. Sun and Zhang (2021) found that YTTP awardees significantly increased their number of publications, but their study only measured the impact on chemistry majors. Other studies have established similar associations between scholars' acceptance of the YTTP and their number of publications, although research limitations still exist. Cao et al. (2020), Marini and Yang (2021a), and Shi et al.'s (2022) results match those of Sun et al. (2017). Cao et al. (2020) argue that receiving the YTTP increases the number of publications; however, their study did not estimate the counterfactual groups for YTTP awardees. The number of publications significantly increased during the Plan's first and second waves (Marini & Yang, 2021a). However, it is difficult to draw firm conclusions by measuring only the first two waves. Shi et al. (2022) asserted that YTTP awardees increased their publication numbers in the years from 2011 to 2017. However, the control group remains ambiguous since Shi et al. (2022) manually selected the group. They matched each YTTP awardee with a comparable overseas scholar who did not receive the Plan based on their PhD attainment location, academic major, and period of return in the ProQuest Dissertation and Theses Database.

Adding to the uncertainty, Liu et al. (2019) found that the number of works published by YTTP awardees decreased after their acceptance into the Plan. Sun et al. (2017) examined awardees' academic positions and institutions. They found that the working institutions where awardees received the Plan had no effect on their research productivity; however, an awardee's academic position and age had a significant impact on increasing their number of publications. Sun et al. (2017) found that when an awardee had a stable work position, such as being a tenure track professor, they were less likely to return to China. Similarly, a YTTP awardee who earned their PhD in China was more likely to remain overseas to further their career development. Therefore, it is difficult to identify whether the YTTP has had a positive or negative impact on

the number of awardee publications

Furthermore, as the procedure for measuring research quality performance is still contentious in academia (Aksnes et al., 2019), each study used a different methodology to estimate the research quality. Cheng and Xu (2019) found that academic influence developed of awardees in mechanical engineering during the fifth waves but did not conduct a causality analysis. Marini and Yang (2021b) claimed that there is no consistency in research quality performance. Research quality performance is based on where the publications percentile belongs in the list of institutional qualifiers, such as the average of the Journal Normalized Citation Index (Marini & Yang, 2021b). Shi et al. (2022) also argue that no consistent impact on the awardees' research quality could be determined. Shi et al. (2022) used ISI's Web of Science SCI-Expanded and Social Science Citation Index (SSCI). The Web of Sciences (ISI) is a multidisciplinary index of journal articles in the sciences, social sciences, arts, and humanities that is used to find cited references. It constitutes a commercialized citation index. Due to conflicting measurements of the citations per publication, it is imperative to analyze this factor to assess the consistency of the impact on the research quality of the YTTP awardees.

To summarize the literature review, the existing research shows that the YTTP has had an unclear impact on the research performance of the Plan's awardees. In order to carry out a comprehensive empirical analysis of the YTTP's acceptance result on quantity measures of research performance, this research develops the econometrics models from Sun and Zhang (2021) and Shi et al. (2022). No studies have analyzed the differences between those who accepted and those who renounced the YTTP from 2011 to 2013. This study is essential for settling debate in the previous research regarding the relationship between membership in the YTTP and research productivity. Accordingly, this paper compares the impact before and after the YTTP in terms of the research performance of the accepted and the renounced awardees.

IV. DATA

This study manually collected YTTP data based on the PGER (Program of Global Experts Recruitment) website. The website only displays basic profiles of the awardees, which include their names and applied affiliations. Applied affiliation refers to a future workplace if a scholar decides to remigrate to China. The Central Coordinating Group (CCG) began to report each awardee's nationality, birth year, applied affiliation, doctorate-granting institution, prior affiliation, and job position when they applied for the YTTP starting with the fourth wave (2013). To construct an individual-year-level pooled cross-sectional dataset, the researcher collected scholars' information by using Baidu, Google, LinkedIn, the awardee's curriculum vitae (CV), and the awardees' websites based on their posted profiles on the PGER websites. The data source used in this study included nationality, sex, birth year, undergraduate institution and its location (country), applied affiliation, professional major, PhD major, doctorate-granting institution and its location (country), prior affiliation, country of the previous affiliations, and past job position, current affiliation, country of the current affiliation, and current job position.

The dataset has several advantages for further analysis. First, this novel data allows future researchers to measure the impact of reverse brain drain policy, especially for high-skilled workers due to a lack of empirical evidence on higher-skilled talents (Mckenzie, 2011). Second, the data overcomes language barriers since the researcher collects and translates Chinese language data on the PGER website into English. Third, an in-depth understanding of the YTTP is possible, as the data contains information of interest for research, such as gender, PhD attainment location, and academic major.

关于公布第四批“青年千人计划”引进人才名单的公告

来源：千人计划网 2013-03-06 16:17:52

根据《青年海外高层次人才引进工作细则》的规定，海外高层次人才引进工作专项办公室组织实施了第四批“青年千人计划”申报评审工作。经初审、通信评审、面试评审、公示及复核，北京大学刘小云等183人入选第四批“青年千人计划”，特此公布。

第四批“青年千人计划”引进人才名单

序号	姓名	性别	国籍	出生日期	申报单位	毕业院校	回国前任职单位	回国前职务（英文）
1		男	中国	1979-9-6	北京大学	2009年01月毕业于[美国]印第安那大学	[美国]耶鲁大学医学院	Postdoctoral Associate
2		男	中国	1980-7-18	北京大学	2008年11月毕业于[美国]宾夕法尼亚大学	[美国]康奈尔大学，霍华德休斯研究所	instructor
3		男	中国	1974-8-30	北京大学	2009年08月毕业于[美国]德克萨斯A&M大学	[美国]洛斯阿拉莫斯国家实验室	Postdoc Research Associate
4		男	中国	1978-11-16	北京大学	2007年07月毕业于[中国]北京大学	[德国]莱布尼茨对流层研究所	Postdoctoral researcher
5		男	中国	1977-8-6	北京大学	2005年07月毕业于[中国]北京大学	[美国]宾夕法尼亚大学	Research Investigator Senior
6		男	意大利	1978-10-24	北京大学	2005年11月毕业于[意大利]米兰比科卡大学	[美国]普林斯顿大学	Visiting Postdoctoral Research Associate
7		男	中国	1979-3-7	北京大学	2006年07月毕业于[中国]中国工程物理研究院	[美国]美国加州大学圣地亚哥分校	Assitant Project Scientist
8		女	中国	1978-6-16	北京大学	2009年08月毕业于[美国]俄亥俄州立大学	[美国]俄亥俄州立大学	Postdoctor
9		男	中国	1980-5-31	清华大学	2010年12月毕业于[美国]斯坦福大学	[美国]通用电气研发中心	Research Engineer
10		男	中国	1982-7-10	清华大学	2009年08月毕业于[美国]密歇根州立大学	[美国]哥伦比亚大学 系统生物学联合中心	Associate Research Scientist

Figure 3. YOUTH THOUSAND TALENTS PLAN ANNOUCEMENT, THE FOURTH WAVE

Source: Program of Global Experts Recruitment.

In its exploration of consequences of accepting or rejecting the YTTP, this paper will cover the period between 2011 and 2013. This timeframe was selected due to a sudden program cessation from 2013 to 2015. The CCG has announced the final awardee list of the YTTP on

the website twice of per year, starting in 2012. Table 2 provides the outline of the YTTP from the first to the fifth waves. The final awardee lists for each wave were announced in November 2011, February 2012, September 2012, March 2013, and November 2013, respectively. In the first wave, 143 scholars were selected for the YTTP. Due to academic fraud, one scholar was later disentitled by the CCG; therefore, 217 scholars won the YTTP in the second wave. In the third wave, 177 scholars were chosen for the Plan. In the fourth and fifth waves, 183 scholars and 396 scholars received the YTTP, respectively. In total, 1,116 scholars received the YTTP from the first to the fifth waves. While creating the dataset, the researcher found that 122 scholars renounced the YTTP and remained overseas, while 992 scholars accepted the YTTP and returned to China.

Table 2. YTTP, 1ST–5TH WAVE

Wave	Announcement date	Number of total awardees	Accepted	Renounced	Acceptance rate (%)
1st	November 2011	143	127	16	88.8
2nd	February 2012	217	191	26	88.0
3rd	September 2012	177	162	15	91.5
4th	March 2013	183	163	19	89.1
5th	November 2013	396	349	46	88.1
	Total	1,116	992	122	89.9

Note: While constructing the dataset, the author found that two awardees who won in the fourth and fifth waves later died from accidents.

In order to estimate the impact YTTP acceptance on research performance, the researcher used the awardees' Google Scholar ID information to determine the number of publications for each awardee. The Google Scholar database is one of the largest web search indexes for scholarly journals. The database contains academic information on each scholar, along with their publications index. The researcher merged the five waves of the pooled cross-sectional data with the awardees' academic productivity data. Utilizing Google Scholar ID information presented two limitations: the coverage excluded those who did not have Google

Scholar IDs, and there was a possibility for errors in accessing their Google Scholar websites. Data on the research performance of 447 scholars were available, out of a total of 1,116 scholars. The subsample of this study consists of 373 scholars who accepted the YTTP and returned to China and 74 scholars who renounced the YTTP. Figure 4 plots the average difference in the number of publications between those who accepted and those who renounced the program. The figure indicates similar trends prior to receiving the YTTP in the number of publications of the accepted and renounced awardees.

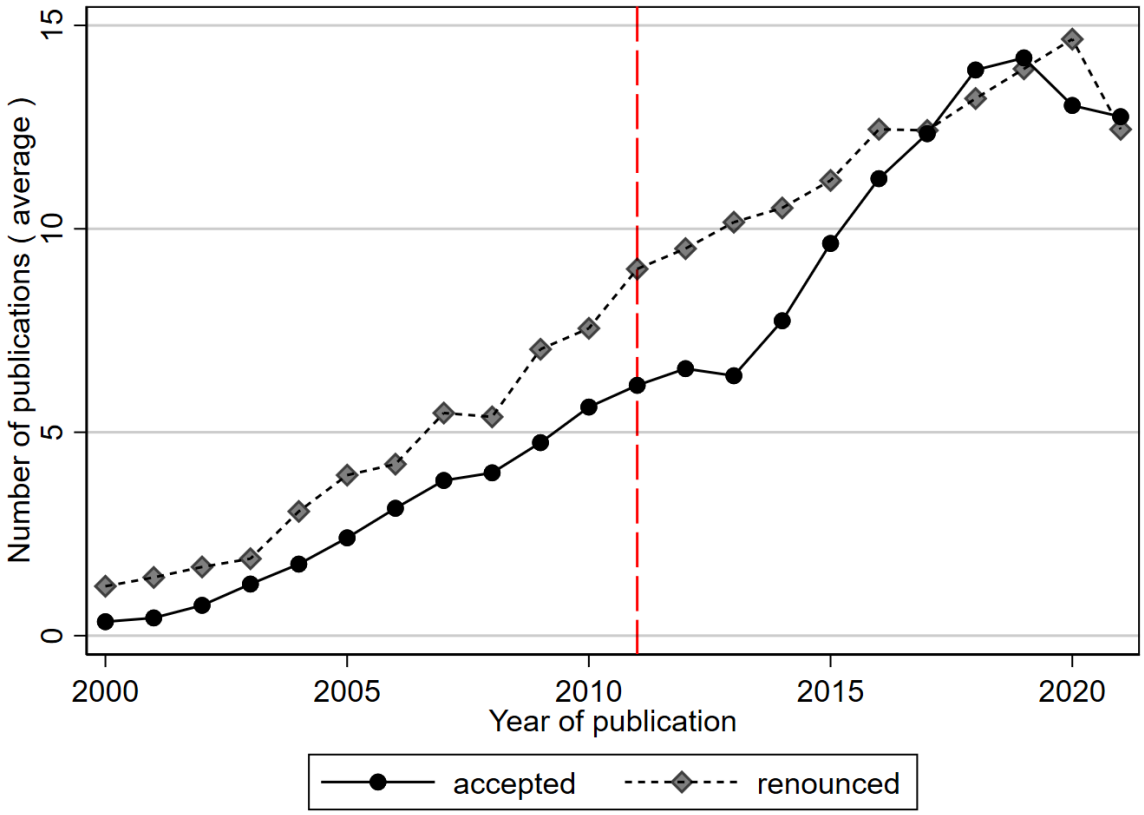

Figure 4. NUMBER OF PUBLICATIONS OF YTTP AWARDEES WHO ACCEPTED AND RENOUNCED

Table 3 shows the descriptive statistics of the variables. The result of the total subsample appears in the first column. The researcher divided the awardees from all five waves into two groups based on their final decision to accept or renounce the YTTP. The results for those who accepted and those who renounced are reported in column (2) and column (3),

respectively. Panel A contains the data for all wave of awardees. In total, this sample comprised 8,206 awardees who accepted the YTTP and 1,628 that renounced it. The estimated average number of annual publications indicates seven publications for the sample based on the mean of the number of publications associated with all YTTP awardees. Those who accepted produced six publications annually, on average, and those that renounced produced eight publications annually. In Panel B, the demographic characteristics of the YTTP awardees are described. In Panel C, YTTP awardees are sorted by academic major for further analysis of the differences in impact different majors.

As research performance is often measured using productivity bibliometrics data (Way et al., 2019), the number of publications serve as the main dependent variable in this analysis. This study measures the dependent variables as count variables. The independent variable in this paper is the decision to return to China as a condition of the YTTP. It examines the causal relationship between the research performance of both returnees and renouncers and explores the consequence of accepting the YTTP.

Table 3. DESCRIPTIVE STATISTICS

	Full sample (1)	Accepted (2)	Renounced (3)
Panel A. Outcome			
Number of publications	6.692	6.465	7.836
	(14.42)	(14.67)	(13.00)
Observations	9,834	8,206	1,628
Panel B. Demographic characteristics			
Age	32.31	31.96	34.09
	(7.034)	(6.988)	(7.001)
Male	0.913	0.912	0.919
	(0.282)	(0.284)	(0.273)
PhD in China	0.280	0.311	0.122
	(0.449)	(0.463)	(0.327)
Observations	9,834	8,206	1,628
PhD attainment year	2007.3	2007.5	2006.1
	(2.515)	(2.375)	(2.869)
Observations	9,724	8,140	1,584
Panel C. Proportion of awardees by academic major			
Biological science	0.176	0.184	0.133
Chemistry	0.098	0.095	0.117
Environment and earth sciences	0.117	0.114	0.133
Information science	0.168	0.161	0.200
Materials engineering	0.250	0.244	0.283
Mathematical sciences	0.130	0.139	0.833
Physics	0.061	0.063	0.050
Observations	8,272	6,952	1,320

Note: Standard deviations appear in parentheses.

V. EMPIRICAL STRATEGY

The goal of the empirical strategy in this study is to identify the consequences of winning the YTTP on awardees' research performance. Specifically, this research concentrates on comparing the research performance of awardees who decided to return to China as a consequence of YTTP acceptance to the control group. During data collection, the researcher found that a subset of awardees renounced the YTTP and remained overseas. Therefore, in this empirical study, the researcher identifies the treatment group as those who returned to China as a consequence of accepting the YTTP, whereas those who remained overseas even after winning the YTTP but renounced it constitute the control group. As age is the influential factors on research performance (Costas et al. 2010), this paper controls for the age of the awardees to ensure a precise estimation.

The difference-in-differences approach allows the researcher to estimate the differences between the treatment and control groups before and after YTTP acceptance status in terms of their research performance. Specifically, this paper employs the following difference-in-differences model:

$$Y_{it} = \alpha_i + \lambda_t + \beta YTTP_{it} + age_{it} + age_{it}^2 + \epsilon_{it} \quad (1)$$

where Y_{it} indicates the dependent variables, that is, the number of publications of awardee i in year t. The variable $YTTP_{it}$ is a dummy variable that assumes the value of one if awardee i accepts the YTTP and returns to China after receiving the YTTP in year t, and zero otherwise. The β is the main coefficient of interest; it captures the causality of returning to China as a consequence of accepting the YTTP on the dependent variable Y_{it}. age_{it} indicates the age

when the scholar was awarded the Plan, and age_{it}^2 is a squared term of the variable age_{it}. The individual fixed effect α_i controls for unobserved time-invariant individual characteristics that may correlate with the independent variable, and year-fixed effect λ_t captures common trends that affect the individuals in a given year. The variable ϵ_{it} is an awardee time-varying error term of unobservable factors that change over time and affect Y_{it}. The key identification assumption for this approach is that the accepted and the renounced awardees would have similar trends in the number of publications in the absence of the YTTP impact.

In order to provide evidence for this assumption, this study also employ used the empirical strategy, as indicated in the following form:

$$Y_{it} = \alpha_i + \lambda_t + \sum_{\tau=-2000`}^{2021} \beta_\tau YTTP_i * Yeardummy_t^\tau + age_{it} + age_{it}^2 + \epsilon_{it} \qquad (2)$$

where all variables are defined as in equation (1). In equation (2), the researcher defines the interactions of the treatment variable with each year's fixed effect. The coefficient β_τ shows the change in the number of publications of the treated awardee relative to the base year of 2010, a year before the YTTP. Figure 5 plots the estimation of equation (2).

VI. RESULTS

This section presents empirical results regarding the causal estimation of returning to China as a consequence of receiving the YTTP on the awardees' research performance. Table 4 shows the estimation result of equation (1) using a difference-in-differences methodology based on whether the scholars decide to return to China and the number of publications as the dependent variable. Considering the large-time in which YTTP awardees' received their education, the study Winsorized the research performance reported in the yearly range from 2000 to 2021. The number of publications was Winsorized by 50 publications.

Column (1) in Table 4 shows the effect of returning to China after receiving the YTTP on the number of publications for all five waves along with the controlling age variable. The coefficient is negative and statistically significant at the 1% level, which implies that the decision to return to China had a negative impact on the number of publications by the scholars. An interpretation of column (1) in Table 4 indicates that the coefficient estimation of remigrating to China is 0.825. This result indicates that the awardees were 13.5% more likely to produce fewer publications than their counterparts in the control group.

Columns (2) and (3) display the effect of the YTTP on the first and second waves, respectively. Recall that the first wave was announced in November 2011. The data in column (2) implies that there was no significant impact on the first wave even after the individuals returned to China. Column (3) shows a strong negative impact the number of publications per awardee in the second wave, the final list for which was announced in February 2012. The estimation in column (3) is statistically significant at the 1% level, and it suggests that returnees were 38.3% less likely to publish more of their works than those in the counterpart group.

Column (4) depicts the third wave. Column (4) and shows that the number of publications decreased among the returnees and indicates the statistical significance at the 1% level. Therefore, the YTTP negatively impacted the returnee's number of publications compared to non-returnees, decreasing them by 65.1%.

Columns (5) and (6) display the relationship between the effect of the YTTP and the number of publications in the fourth and fifth waves, respectively. The results in columns (5) and (6) show that no statistical YTTP impact was associated with the number of publications of awardees who received the YTTP in 2013.

The last two columns of Table 4 present the number of publications for multiple waves, combining the first three waves (7) and the last two waves (8). In order to depict the average changes in findings, the two combined waves are divided into pre- and post- 2013 categories. The estimate in column (7) shows the combined waves, including from the first to the third wave before 2013. The coefficient estimation is 2.067, and it is statistically significant at the 1% level. The acceptance consequence resulted in decreased publication numbers of the awardees from 2011 to 2012. This indicates that returnees who won the YTTP decreased their number of publications by 30.1%. Column (8) shows the number of publications for the combined fourth and fifth waves after 2013. The researcher found no statistically significant impact of YTTP acceptance after 2013 for the number of publications.

The results are similar to findings from the previous literature. For instance, Liu et al. (2019) reported a decrease in the number of publications by scholars after they received the YTTP and returned to China. In this paper, the results demonstrate that the number of publications decreased for awardees who returned to China during all five waves. Nevertheless, the estimation results differ from those of Marini and Yang (2021a) and Shi et al. (2022), as they indicated that the number of awardees' publications increased after receiving the YTTP and consequently returning to China. Marini and Yang (2021a) found that the number of

publications by the scholars increased in the first two waves. However, the estimation showed no impact on those who returned to China after winning the YTTP in the first wave, and the number of publications decreased for the second wave. The findings of Shi et al. (2022) also indicate that publication numbers increased from 2011 to 2017, whereas this paper found that the number of publications is likely to decrease, with no impact on increasing the number of publications.

Overall, the results in Table 4 show that returning to China as a consequence of accepting the YTTP had a negative impact on the number of publications in all five waves. Taking each wave separately, the estimation results of this study showed a decreasing impact of returning to China on the number of publications in the second and third waves, whereas the researcher found no impact on the first, fourth, and fifth waves in terms of the number of publications.

Table 4. YTTP IMPACT ON THE NUMBER OF PUBLICATIONS

		Each wave					Combined waves	
	All waves	1st wave	2nd wave	3rd wave	4th wave	5th wave	1st–3rd waves (Before 2013)	4th–5th waves (After 2013)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of publications	-0.825***	0.104	-2.648***	-4.277***	0.980	0.308	-2.067***	0.499
	(-3.19)	(0.13)	(-3.86)	(-5.06)	(1.43)	(0.61)	(-5.09)	(1.23)
Mean of the dependent variable	6.115	7.090	6.922	6.571	5.225	5.554	6.86	5.455
Age controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
adjusted. R^2	0.597	0.566	0.557	0.718	0.503	0.601	0.614	0.578
Observations	9,834	1,364	1,782	1,474	1,562	3,652	4,620	5,214

Notes: Standard errors are in parentheses. Statistically significant at the *10%, **5%, ***1% level.

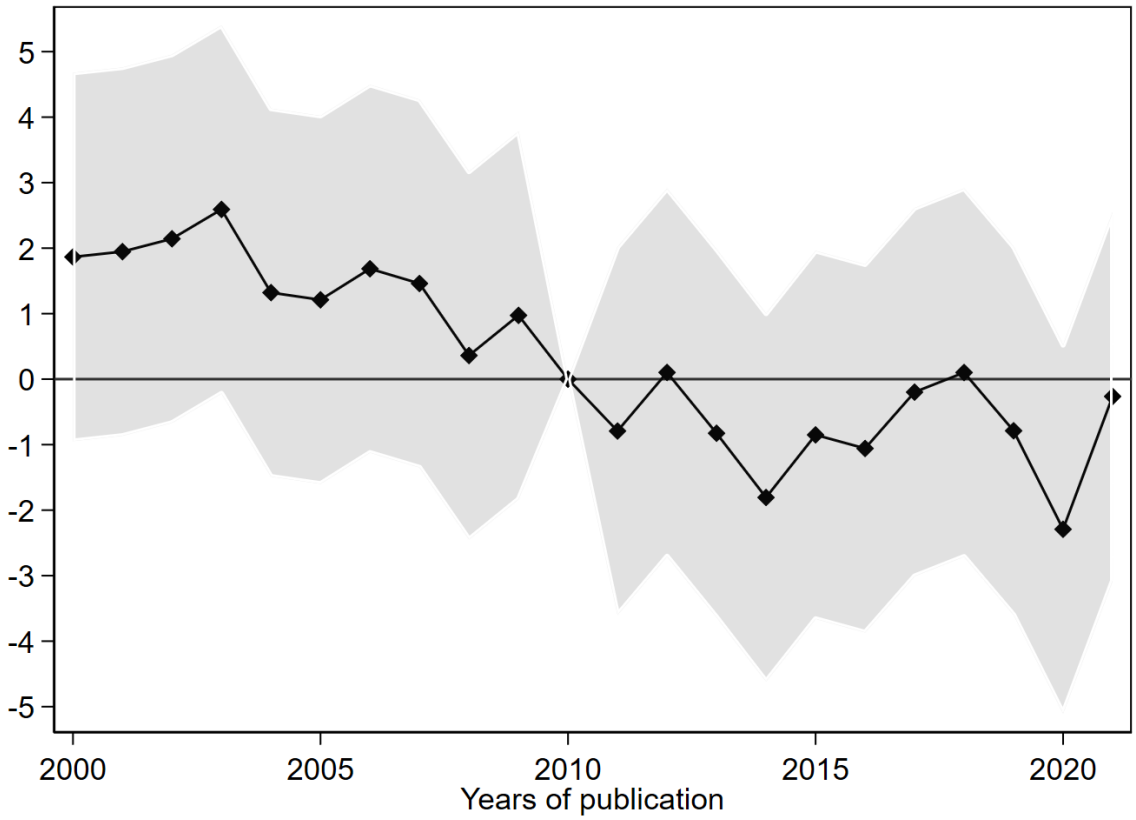

Figure 5. COEFFICIENTS OF THE NUMBER OF PUBLICATIONS BEFORE 2013

To examine the change pattern representing the number of publications for those who accepted the Plan before 2013 (that is, the first, second, and third waves), Figure 5 plots equation (2). The pattern of the coefficient β_τ is testable since the awardees before 2011 were not affected by the Plan. To identify the treatment intensity of accepted awardees by year of publication, Figure 5 plots the coefficient variance of the β_τ across the years from 2000 to 2021. Each dot on the solid line represents the coefficient estimation of interaction between the dummy variable for accepting the YTTP in each winning year and the number of publications by year of publication. The 95% confidence interval is plotted with the shaded gray areas. The coefficients of the number of publications varied from one to two until the Plan was initiated in 2011, and Figure 5 shows a decreasing pattern after 2011. Thus, Figure 5 indicates that YTTP acceptance before 2013 had a negatively associated with the number of publications.

Table 5 shows the results of YTTP acceptance on awardees' research performance, controlling for age and PhD attainment year. The study excludes the years when awardees published articles before they attained a doctoral degree. An examination of the number of publications for all waves in column (1) makes it evident that the estimated coefficient demonstrates a negative association between accepting the YTTP and the number of publications, and it is statistically significant at the 99% confidence level. The point estimation presents 1.250 and indicates that those who accepted were 14.8% less likely to publish their works than the renouncers. Nonetheless, the acceptance effect of the YTTP was larger when controlling for age and PhD attainment year.

Columns (2), (3), and (4) show the impact of YTTP acceptance on the number of publications, followed by return decisions for the first, second, and third waves. The decisions of the awardees in the first wave were statistically insignificant and had no relationship with the number of publications. However, the coefficient estimation was 2.294 if the awardee decided to return to China with the YTTP in the second wave, and the awardee was 25% less likely to publish their works than the non-returnee. The coefficient estimates in column (4) also indicate negative association with the number of publications and show that accepting the YTTP decreased the awardee's number of publications by 53.9%. It provides no effect of accepting the YTTP in the fourth and fifth waves, which are reported in columns (5) and (6). This indicates that YTTP acceptance had no statistically significant impact on the number of publications.

In the last two columns, the researcher measured the same causality with respect to the number of publications divided into the periods before and after 2013. The coefficient indicates a negative effect of accepting the YTTP before 2013, and it is statistically significant at the 1% level. The control group was more likely to have a higher number of publications than the treatment group by 24.8%. However, column (8) indicates no impact of the YTTP acceptance

on the number of publications after 2013.

In sum, the findings show that YTTP acceptance had a negative impact on the number of publications when controlling for PhD attainment year.

Table 5. YTTP IMPACT ON THE NUMBER OF PUBLICATIONS CONTROLLING PHD ATTAINMENT YEAR

		Each wave					Combined waves	
	All waves	1st wave	2nd wave	3rd wave	4th wave	5th wave	1st–3rd waves (Before 2013)	4th–5th waves (After 2013)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of publications	-1.250***	-0.922	-2.294**	-4.798***	1.167	-0.517	-2.245***	0.0399
	(-3.91)	(-0.91)	(-2.56)	(-4.14)	(1.31)	(-0.76)	(-4.47)	(0.07)
Mean of the dependent variable	8.430	9.033	9.164	8.902	7.280	8.084	9.044	7.835
Age controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PhD attainment year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
adjusted. R^2	0.640	0.588	0.594	0.756	0.536	0.664	0.649	0.633
Observations	6,510	1,010	1,233	957	1,023	2,282	3,205	3,305

Notes: Standard errors are in parentheses. Statistically significant at the *10%, **5%, ***1% level.

To identify the variation in treatment intensity across demographic characteristics and academic majors, Table 6 presents the results of treatment effect by gender, country of PhD education, and academic major. Following the demographic characteristics, the estimated results are presented in Panel A.

The number of publications for males and females in columns (1) and (2) indicate a statistically significant effect at the 1% level in opposite directions. Male scholars who accepted the YTTP decreased the number of publications by 17.3% compared with those who renounced, while female scholars were 49.9% more likely to publish more frequently, at the 1% level of significance. This shows that the impact of YTTP acceptance on the number of publications varied based on gender differences. The estimations in columns (3) and (4) indicate the differences based on whether awardees earned their doctoral degrees in China or overseas. The coefficient estimations show that the YTTP effect was negatively associated with the number of publications for Chinese professionals educated in China and overseas. The estimated coefficient in column (3) for awardees who earned doctorates was 1.986, with a standard error of 2.99. Column (4) indicates that the number of publications of YTTP awardees with doctoral degrees abroad decreased by 12.3%.

In Panel B of Table 6, the estimation coefficients show the YTTP effect based on the awardees' academic majors. The CCG classified the awardees' professional majors into seven different categories: biological science, chemistry, environment and earth science, information sciences, materials engineering, mathematical engineering, and physics. Columns (1) and (2) indicate that if the winner's majors were biological science or chemistry, the effect of the YTTP was statistically negative on the number of publications when an awardee accepted the YTTP. This finding indicates that high-skilled workers in biological science are 57.2% less likely to publish their works, and when the awardee was a professional in chemistry, one was 85.2% less likely to publish it at the 1% level of significance. Nevertheless, columns (3) and (4)

indicate no impact on the number of publications for environment and earth science, as well as for information science professionals. In contrast with the estimation results, column (5) shows that an awardee who was a professional in materials engineering was 18.76% more likely to publish more of their works than their counterparts in the control group. Column (6) shows a negative YTTP acceptance impact on the number of publications in the mathematics fields, and it is statistically significant at the 10% level. The result does not show a statistically significant impact for physics majors, as indicated in column (7).

In sum, Table 6 shows that there is a distinct impact based on gender and country of PhD education, and an overall inconsistent effect when accounting for an awardee's academic major. Unlike Sun and Zhang (2021), this study's results indicate that the number of publications decreased in the field of chemistry. The results show that YTTP impact has a negative association for chemistry majors. Nevertheless, the estimation for material engineering bolsters the findings of Cheng and Xu (2019) through this paper's causality analysis. The results also demonstrate that the YTTP's impact on the material engineering field has a positive association with the number of publications.

Table 6. YTTP IMPACT BY DEMOGRAPHIC CHARACTERISTICS AND ACADEMIC MAJORS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Demographic characteristics	Gender		PhD attainment by country				
	Male	Female	China	Overseas			
Number of publications	-1.086***	2.126***	-1.986***	-0.710**			
	(-3.96)	(3.01)	(-2.99)	(-2.54)			
Mean of the dependent variable	6.292	4.263	7.022	5.763			
Age controls	Yes	Yes	Yes	Yes			
adjusted. R^2	0.599	0.551	0.665	0.553			
Observations	8,976	858	2,750	7,084			
Panel B. Professional majors	Biological science	Chemistry	Environment and earth sciences	Information science	Materials engineering	Mathematical sciences	Physics
Number of publications	-1.620***	-6.313***	-0.325	0.126	1.222**	-1.283*	-1.920
	(-4.40)	(-6.83)	(-0.38)	(0.15)	(2.23)	(-1.75)	(-1.14)
Mean of the dependent variable	2.831	7.407	6.433	9.607	6.515	5.351	6.036
Age controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
adjusted. R^2	0.471	0.693	0.555	0.615	0.593	0.720	0.502
Observations	1,452	814	968	1,386	2,068	1,078	506

Notes: Standard errors are in parentheses. Statistically significant at the *10%, **5%, ***1% level.

VII. CONCLUSION

The purpose of this study was to empirically examine the impact of reverse brain drain policy on research performance in China. In order to estimate the impact of reverse brain drain policy, this paper investigated the effect of the YTTP, a policy enacted in 2011 that, aimed to attract young high-skilled workers in STEM fields from overseas, on the awardees' research performance when they complied and returned to China. While collecting the data, the researcher found that some YTTP awardees renounced the Plan and chose to remain overseas. This allowed for an examination of the impact of the YTTP by comparing returnees and non-returnees. By exploiting a manually collected YTTP dataset that included 1,116 awardees from 2011 to 2013, the study employed a difference-in-differences strategy to compare candidates who accepted and those that renounced the YTTP based on their number of publications before and after receiving the YTTP.

The findings showed that when high-skilled workers decided to return to China as a consequence of winning the YTTP, their research performance decreased. The returnees who were awarded the YTTP for three years (2011–2013) issued fewer publications after they won the YTTP than the awardees who decided to remain overseas. The findings of this study support much of the existing literature, which contends that research performance, especially as measured by the number of publications, decreases when awardees accept the YTTP and return to China (Liu et al., 2019). Conversely, in comparing those that accepted and those that renounced, the main findings of this study also revealed that YTTP acceptance had negative impact on the number of publications rather than positive impact (Cao et al., 2020; Marini & Yang, 2021a; Shi et al., 2022; Sun & Zhang, 2021;). This study allowed for examining extended waves in order to compare the inconsistent results of the YTTP's impact on research

performance. It is possible that different impact patterns before and after 2013 demonstrate a need to revise the Chinese national strategy. With the appointment of a new director of the Chinese Central Organization Department, Zhao Leji, in November 2012, the Chinese government launched the National Special Support Plan for High-level Talents to promote a more innovative economy through a systematic approach in January 2013. This change may have resulted in an intense recruitment process in the YTTP, as the Plan constitutes the core of the national reverse brain drain program. Nevertheless, further studies are necessary to explain the difference in the patterns observed before and after 2013.

In addition, the YTTP's impact on the number of publications differed based on gender, country of PhD education, and academic major. The YTTP had a positive impact on the number of publications issued by female professionals in comparison with males. This finding suggests that female scholars are more likely to regard this Plan as a serious opportunity to a greater extent than male scholars, as fewer opportunities are given to female scholars (Gu, 2021). The awardees who earned their PhD in China showed a larger decrease in publications than those that studied overseas. The reported estimations showed that the impact of the YTTP on research performance depended on the individual's PhD attainment location. Different patterns across seven academic majors revealed that the YTTP had a positive impact only in the field of materials engineering, whereas in the fields of biological science and chemistry, the YTTP negatively impacted the number of publications. The differing results by academic major represented significant findings, as previous studies only analyzed chemistry majors (Sun & Zhang, 2021). The difference in findings can be explained through this study's use of a three-year dataset that did not set limits on the awardee's educational background. Furthermore, this finding suggests that materials engineering has a close relationship with China's 2012 National Development Strategy for Novel Material since cooperation with academia is critical for advancing R&D in the novel materials industry.

The results of the study shed light on three feasible policy recommendations. First, the government must implement countermeasures on its reverse brain drain policy to ensure better management. The Plan's deviation from its intended impact may be due to a lack of measures to support and evaluate returnee performance. To maintain effective research performance, the Chinese government could provide sustainable ex post remigration facto management (such as two to three years) for awardees. For instance, an extra subsidy can provide to an awardee who outperformed in each wave after receiving the YTTP by tracking the awardee's research performance. Second, the YTTP officials should consider selecting more female researchers in STEM fields. The findings indicated that the research performance of female YTTP awardees has led to a positive impact of the YTTP, while male awardees experienced a negative impact on their research performance. The YTTP may reduce the gender-based "glass ceiling" that often blocks female professionals from promotion to higher positions in Chinese academia. Third, the YTTP could be revised to balance out the differences between the seven majors. The Plan could be streamlined to focus on the majors with a higher return on investment, such as those that have demonstrated a positive impact and those that are better aligned with current government priorities, such as material engineering.

Several limitations of this study indicate the need for further research. First, since the data used in this study represents a sample that spanned three years, it is difficult to establish a comprehensive evaluation of the Plan. Second, an individual's number of publications is not an all-inclusive measure of research performance. Third, other research performance measurements examined in the existing literature, such as the number of citations, should be considered to serve as additional dependent variables. Future research may address these limitations to enable more precise empirical analyses.

REFERENCES

Aksnes, D. W., Langfeldt, L., & Wouters, P. (2019). Citations, citation indicators, and research quality: An overview of basic concepts and theories. *Sage Open, 9*(1), 2158244019829575. https://doi.org/10.1177/2158244019829575

Badruddin, A. (2016). Reverse the brain drain. *Stanford Social Innovation Review*. https://doi.org/10.48558/TZM0-9979

Cao, C. (2008). China's brain drain at the high end: why government policies have failed to attract first-rate academics to return. *Asian Population Studies, 4*(3), 331–345. https://doi.org/10.1080/17441730802496532

Cao, C. (2017). China's approaches to attract and nurture young biomedical researchers. *Washington, DC: National Academies* https://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_184821.pdf

Cao, C., Baas, J., Wagner, C. S., & Jonkers, K. (2020). Returning scientists and the emergence of China's science system. *Science and Public Policy, 47*(2), 172–183. https://doi.org/10.1093/scipol/scz056

Carrington, W. J., & Detragiache, E. (1998). How big is the brain drain?. https://ssrn.com/abstract=882624

Chang, P., & Deng, Z. (1992). The Chinese brain drain and policy options. *Studies in Comparative International Development, 27*(1), 44–60. https://doi.org/10.1007/BF02687104

Cheng, H.J., & Xu, W,T. (2019). "qingnianqianrenjihua" xingmuhuozizhuzheruxuanqianhouxueshuyingxianglipingjia:jiyu2013nianhuaxueling

yuhuozizhuzhedeanliyanjiu [Academic influence evaluation of the young talents program]. *Fundamental Research, 19*(2), 169–175.

Cheung, A. C. K., & Xu, L. (2015). To return or not to return: Examining the return intentions of mainland Chinese students studying at elite universities in the United States. *Studies in Higher Education, 40*(9), 1605–1624. https://doi.org/10.1080/03075079.2014.899337

Costas, R., Van Leeuwen, T. N., & Bordons, M. (2010). A bibliometric classificatory approach for the study and assessment of research performance at the individual level: The effects of age on productivity and impact. *Journal of the American Society for Information Science and Technology, 61*(8), 1564–1581. https://doi.org/10.1002/asi.21348

Cyranoski, D. (2001). A great leap forward. *Nature, 410*, 10–11. https://doi.org/10.1038/35065246

Deng, Z. (1992). China's brain drain problem: Causes, consequences and policy options. *The Journal of Contemporary China, 1*(1), 6–33. https://doi.org/10.1080/10670569208724154

Docquier, F., Lohest, O., & Marfouk, A. (2007). Brain drain in developing countries. *The World Bank Economic Review*, *21*(2), 193–218. https://doi.org/10.1093/wber/lhm008

Dodani, S., & LaPorte, R. E. (2005). Brain drain from developing countries: how can brain drain be converted into wisdom gain?. *Journal of the Royal Society of Medicine*, *98*(11), 487–491. https://doi.org/10.1177/014107680509801107

Fedasiuk, R., & Felgoise, J. (2020). The Youth Thousand Talents Plan and China's military. *Center for Security and Emerging Technology.* https://doi.org/10.51593/20200041

Gu, C. (2021). Women scientists in China: Current status and aspirations, *National Science Review*, *8*(10). https://doi.org/10.1093/nsr/nwab101

Haque, N. U., & Kim, S. J. (1995). “Human capital flight”: Impact of migration on income and growth. *Staff Papers*, *42*(3), 577–607. https://doi.org/10.2307/3867533

Jia, H. (2018). China’s plan to recruit talented researchers. *Nature*, *553*(7688), S8–S8. https://doi.org/10.1038/d41586-018-00538-z

Jin, H.L. (2019). Junggugui haeoe usuinjae yuchi jeongchaek yeongu [A study on the policy of introducing excellent overseas talents in China]. *The Academy of Asian Cultural Studies*, *10*(4), 867–880. https://papersearch.net/thesis/article.asp?key=3698386

Jin, H.L. (2020). Jungguk haeoe yuhaksaengui moguk gwihwangwa gwiguk yeonghyangyoin bunseok [An analysis of the return and the reasons of overseas Chinese students to their home country]. *Journal of North-East Asian*, *62*(), 145–158. https://www.dbpia.co.kr/Journal/articleDetail?nodeId=NODE09320168

Kellogg, R. P. (2012). China’s brain gain?: Attitudes and future plans of overseas Chinese students in the US. *Journal of Chinese Overseas*, *8*(1), 83–104. https://doi.org/10.1163/179325412X634319

Kim, B. G., & Kim, I. S. (2020). A study on policies of Chinese overseas talents and entrepreneurial activities in distribution industry. *The Journal of Distribution Science*, *18*(11), 79–90. https://doi.org/10.15722/jds.18.11.202011.79

Kwok, V., & Leland, H. (1982). An economic model of the brain drain. *The American Economic Review*, *72*(1), 91–100. https://www.jstor.org/stable/1808577

Liu, W., Guo, J., & Shi, D. (2019). Mobile landscape: An analysis of Chinese foreign-educated young scientists. http://dx.doi.org/10.2139/ssrn.3152726

Lu, X., & Zhang, W.X. (2015). The reversed brain drain: a mixed-method study of the reversed migration of Chinese overseas scientists. *Science, Technology and Society*, *20*(3), 279–299. https://doi.org/10.1177/0971721815597127

Ma Y.P., & Pan, S.Y. (2015). Chinese returnees from overseas study: An understanding of

brain gain and brain circulation in the age of globalization. *Frontiers of Education in China*, *10*(2), 306–329. https://doi.org/10.3868/s110-004-015-0019-6

Marini, G., & Yang, L. (2021a). The research productivity of Chinese academic returnees from the Global West: An evaluation of Young 1000 Talents recipients' productivity. https://discovery.ucl.ac.uk/id/eprint/10119717

Marini, G., & Yang, L. (2021b). Globally bred Chinese talents returning home: An analysis of a reverse brain-drain flagship policy. *Science and Public Policy*, *48*(4), 541–552. https://doi.org/10.1093/scipol/scab021

Mckenzie, D. (2011, May 25). Worrying too much about brain drain? *World Bank Blogs.* https://blogs.worldbank.org/allaboutfinance/worrying-too-much-about-brain-drain

Ministry of Education of the People's Republic of China. (n.d). *News*. http://www.moe.gov.cn/jyb_xwfb/

Miyagiwa, K. (1991). Scale economies in education and the brain drain problem. *International Economic Review*, 743–759. https://doi.org/10.2307/2527117

Pells, R. (2018, March 1). China's brain drain is ending. *Inside Higher Ed.* https://www.insidehighered.com/news/2018/03/01/experts-see-end-sight-chinas-brain-drain

Program of Global Experts Recruitment. (n.d). *Thousand Talents Plan*. http://www.1000plan.org

Roudgar, I., & Richards, C. (2015). The policy challenge of the global brain drain: Addressing the dilemmas of contributing push-pull factors. *International Journal of Public Policy*, *11*(1-3), 73–85. https://ideas.repec.org/a/ids/ijpubp/v11y2015i1-2-3p73-85.html

Shi, D.B., Liu, W.H., & Wang, Y.B. (2022). Has China's Young Thousand Talents Program been successful in recruiting and nurturing top Chinese scientists?.

http://dx.doi.org/10.2139/ssrn.4043516

Sun, Y., Guo, R., & Zhang, S. (2017). China's brain gain at the high end: An assessment of Thousand Youth Talents Program. *Asian Journal of Innovation and Policy*, *6*(3), 274–294. https://doi.org/10.7545/ajip.2017.6.3.274

Sun, Y.T., & Zhang Y.L. (2021). Haiwairencaiyinjinjihuateshengleweguodaxuekeyancanchuma? – yi "211"gongchengdaxuehuaxuexuekeweilie [Does overseas talent-attracting program increase the research output of Chinese universities? ——A study by taking the chemistry discipline of the universities of the "211 Project"]. *Science Research Management, 42*(10). 20–27. http://journal26.magtechjournal.com/Jwk3_kygl/EN/Y2021/V42/I10/20

Tharenou, P., & Seet, P. S. (2014). China's reverse brain drain: Regaining and retaining talent. *International Studies of Management & Organization*, *44*(2), 55–74. https://doi.org/10.2753/IMO0020-8825440203

Tian, F. (2013). Skilled flows and selectivity of Chinese scientists at global leading universities between 1998 and 2006. *Journal of Science & Technology Policy in China, 4*(2). 99–118. https://doi.org/10.1108/JSTPC-01-2013-0003

Todaro, M. P. (1977). *Economic development in the Third World: An introduction to problems and policies in a global perspective*. Pearson Education.

Way, S. F., Morgan, A. C., Larremore, D. B., & Clauset, A. (2019). Productivity, prominence, and the effects of academic environment. *Proceedings of the National Academy of* Sciences, *116*(22), 10729–10733. https://doi.org/10.1073/pnas.1817431116

Wong, K. Y., & Yip, C. K. (1999). Education, economic growth, and brain drain. *Journal of Economic Dynamics and Control*, *23*(5-6), 699–726. https://doi.org/10.1016/S0165-1889(98)00040-2

Yang, H.Q., & Chen, Y.A. (2013). The empirical analysis of evaluating the implement effect of introduction overseas high-level talents policy. *Science & Technology Progress and Policy*, 16. http://en.cnki.com.cn/Article_en/CJFDTotal-KJJB201316026.htm

Zha, Q. (2014). Will China excel in the global brain race?. *International Higher Education,* (75), 15–16. https://doi.org/10.6017/ihe.2014.75.5432

Zhu, J.W. (2019). The composition and evolution of China's high-level talent programs in higher education. *ECNU Review of Education*, *2*(1), 104–110. https://doi.org/10.1177/2096531119840869

Zweig, D. (1997). To return or not to return? Politics vs. economics in China's brain drain. *Studies in Comparative International Development*, *32*(1), 92–125. https://doi.org/10.1007/BF02696307

Zweig, D. (2006). Competing for talent: China's strategies to reverse the brain drain. *International Labour Review*, *145*(1-2), 65–90. https://doi.org/10.1111/j.1564-913X.2006.tb00010.x

Zweig, D., & Kang, S. (2020). America challenges China's national talent programs. *Center for Strategic and International Studies (CSIS).* https://www.csis.org/analysis/america-challenges-chinas-national-talent-programs

Zweig, D., & Wang, H. (2013). Can China bring back the best? The Communist Party organizes China's search for talent. *The China Quarterly*, *215*, 590–615. https://doi.org/10.1017/S0305741013000751

APPENDIX

APPENDIX TABLE A1. DESCRIPTIVE STATISTICS OF ALL FIVE WAVES

	Full sample (1)	Accepted (2)	Renounced (3)
Panel A. Total waves			
Number of publications	6.692	6.465	7.836
	(14.42)	(14.67)	(13.00)
Observations	9,834	8,206	1,628
Panel B. 1st wave			
Number of publications	7.145	7.136	7.191
	(8.698)	(8.732)	(8.535)
Observations	1,364	1,144	220
Panel C. 2nd wave			
Number of publications	7.031	6.389	9.280
	(9.675)	(8.209)	(13.39)
Observations	1,782	1,386	396
Panel D. 3rd wave			
Number of publications	8.391	7.468	15.20
	(22.70)	(21.81)	(27.52)
Observations	1,474	1,298	176
Panel E. 4th wave			
Number of publications	5.338	5.208	5.867
	(8.018)	(8.347)	(6.496)
Observations	1,562	1,254	308
Panel F. 5th wave			
Number of publications	6.249	6.340	5.716
	(15.76)	(16.77)	(7.385)
Observations	3,652	3,124	528

Note: Standard deviations appear in parentheses.