RESEARCH ARTICLE

The institutionalized stratification of the Chinese higher education system

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Keywords: Double First Class, elite university, higher education, nonelite university, Project 211, Project 985

ABSTRACT

To promote research excellence, China's government has been offering substantial financial support for a small group of selected universities through three national research programs (Project 211, Project 985, Double First Class). However, admission to these programs may not be completely merit based. Based on a statistical analysis of Chinese universities' scientific activities, this paper shows that this institutionalized hierarchy is not supported by empirical data on research performance, which contributes to inequalities and inefficiencies in Chinese higher education. To build and maintain research capacity, China must support meritocracy across the research system.

1. INTRODUCTION

China's research activities experienced rapid growth over the last 25 years, in parallel with the significant development of its economy. In 2017, China surpassed the United States to become the largest producer of scholarly papers (National Science Board, 2018). In addition to sizable investments—China is now the world's second largest R&D spender (Normile, 2018)—this growth in scholarly production can be associated with the creation, since the 1990s, of three national programs promoting university research (Project 211, Project 985, and Double First Class). These programs provide substantial financial support to a small group of selected universities that now represent the bulk of the research output of the country (57.5% of China's Web of Science [WoS] publications [National Bureau of Statistics of China, 2019]). However, these programs have also been criticized for lacking transparency in how universities are chosen for admission, as well as perpetuating inequalities in the Chinese higher education system (Qi, 2017). This paper describes the development and stratification of China's higher education system, with an analysis of universities' scientific output since the 1990s.

2. THE CHINESE HIGHER EDUCATION SYSTEM

Research in China is performed in an array of organizational settings: higher education institutions, scientific institutes, hospitals, and industry. As is common across most countries (Larivière, Macaluso et al., 2018), higher education contributes the largest share of China's basic research production, representing 83.5% of monographs and 75.5% of journal articles (National Bureau of Statistics of China, 2019) including 85.1% of WoS publications. Scientific institutes (e.g., Chinese Academy of

an open access journal

Citation: Shu, F., Sugimoto, C. R., & Larivière, V. (2020). The institutionalized stratification of the Chinese higher education system. *Quantitative Science Studies*, *2*(1), 327–334. https://doi.org/10.1162/qss_a_00104

DOI: https://doi.org/10.1162/qss_a_00104

Received: 6 May 2020
Accepted: 11 August 2020

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Handling Editor:
Lin Zhang

Science) contribute 9.4% of WoS publications (ISTIC, 2019) in China. There are many higher educational institutions producing this work: China boasts 2,688 higher education institutions, including 1,423 universities offering 4-year undergraduate programs and 1,388 colleges offering 3-year college diploma programs (Ministry of Education of China, 2019). Not all institutions, however, are given the same amount of resources.

Institutionalized stratification of Chinese higher education started in 1954, when six Chinese universities were designated by the Communist Party as the first group of elite universities ("重点大学" in Chinese). This group of elite universities increased to 16 in 1959, 64 in the 1960s, 88 in the 1970s, and to 99 in the 1980s. One common characteristic of elite universities is that they are generally administered by the Ministry of Education (MoE) or by the central government, while nonelite universities are managed by provincial or local governments. Elite universities have priority over nonelite universities to admit students, while nonelite universities can only admit the remaining students; they also benefit from preferential financial policies (Hu, 2011). Stratification of Chinese higher education crystallized in 1995 with the creation of Project 211 by the MoE, with the objective of creating 100 world-class universities by the beginning of the 21st century (Ministry of Education of China, 2000). The Chinese government offered preferential policies (such as the priority to admit the best students) and financial support to universities who were part of the group. Between 1995 and 2008, the 112 universities admitted to Project 211 received 70% of national research funding and 80% of doctoral students (Tang & Yang, 2008).

In 1998, Jiang Zemin, then Chairman of the People's Republic of China, created Project 985 to promote the development of a Chinese equivalent to the U.S. Ivy League (Jiang, 1998). The program started with nine universities in 2009 and added another 30 universities in the 2 following years. These 39 universities are all part of Project 211, but are provided with additional resources. In addition to Project 211 universities, a subset of universities owned by provincial governments signed cooperation agreements and received support from both their province and ministries of the central government; these are also recognized as elite universities. Prior to the launch of the Double First Class program in 2017, there were 141 elite universities (as shown in Figure 1) defined

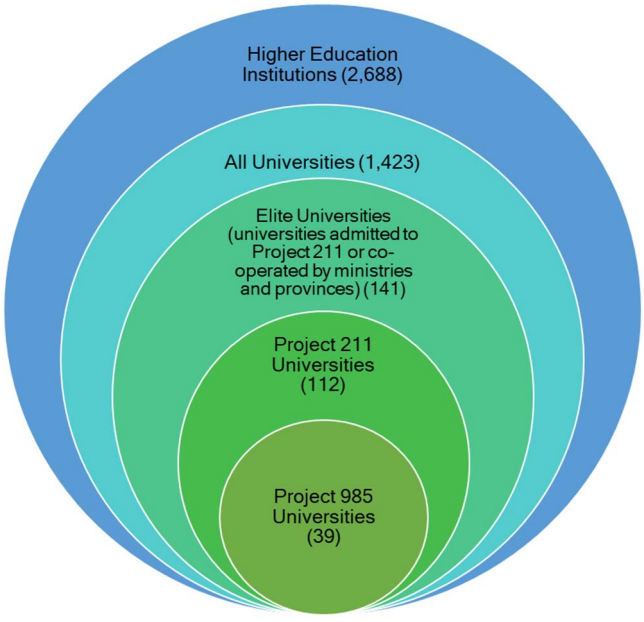

Figure 1. Hierarchy of China's higher education institutions.

by the MOE as "universities admitted to Project 211 or co-operated by ministries and provinces" (Ministry of Education of China, 1992–2017). These national programs are controlled by the MoE, and while inclusion is purportedly based on the quality of research, teaching, and reputation, the detailed methodology has never been revealed. Inclusion in those categories is also driven by geopolitics, as the MoE required that each province had at least one university in Project 211.

The Double First Class program ("双一流" in Chinese) was initiated by the Chinese government in 2017, aiming to build an excellent higher education system including both "First Class" universities and "First Class" disciplines, as both Project 985 and Project 211 officially concluded. However, the concepts of Project 985 and Project 211 are still used, not only in academe but also in industry, which uses graduation from Project 985 and Project 211 universities as a threshold in hiring (Hartog, Sun, & Ding, 2010; Mok & Jiang, 2017). As the "Double First Class" program is recent and our data ends in 2017, we do not focus on this new program but, rather, on those that existed prior to 2017.

3. THE BENEFITS OF THE ELITE

One of the strongest benefits of being classed as an elite institution is the influx of funds provided by the government. As Figure 2 shows, in 1991, research funding[1] per capita was, on average, $2,944 for elite universities and $1,026 for nonelite universities, with nonelite universities obtaining about 35% of the funding obtained by elite ones. Despite an increase in research funding over years, this ratio remained unchanged in 2016, with research funding per capita at $160,745 for elite universities and $57,296 for nonelite universities (Ministry of Education of China, 1992–2017).

Admission to the elite brings immediate benefits to the university. For example, in 2008, the last five universities were admitted to Project 211. As Table 1 shows, all five new elite universities experienced a radical increase in terms of research funding received after their admission to Project 211, ranging from 74.65% to 600.24%, which are much higher than the average increase rates of all elite universities (69.59%) and all nonelite universities (54.21%) in the same period.

Such advantages are also observed in terms of external research funding from research councils. According to the Natural Science Foundation of China (NSFC) (2008–2017), the average acceptance rates of applications from elite universities ranged from 20.3–30.6%, while the average acceptance rates of nonelite university range from 12.5–17.5%. This gap in acceptance rates has widened over time, from 59% in 2008 (20.3% vs. 12.8%) to 82% in 2017 (27.9% vs. 15.3%). However, the higher acceptance rate of applicants from elite universities does not convert into higher completion rate. In China, all NSFC-funded projects are evaluated after the funded period, and those that do not meet their objectives are graded as incomplete. While most projects are considered as complete, 13.6% of research projects (27,041 of 171,372) funded by the NSFC between 2003 and 2012 were considered as incomplete. The results show that researchers from nonelite universities are more likely to complete the projects for which they were funded: While only 8.3% of projects from nonelite universities remained incomplete, this percentage was 14.0% for elite universities (NSFC, 2008–2017).

Elite universities also have advantages in terms of administration and international visibility: They have independence over the promotion of their professors, while promotion at nonelite universities is made by the MoE. This leads to a gap in the proportion of tenured professors (i.e.,

[1] "Research funding" is defined by the MOE as all investments received for research, which includes the funding from universities' own budgets, funding agencies as well as special contributions from the government and industry.

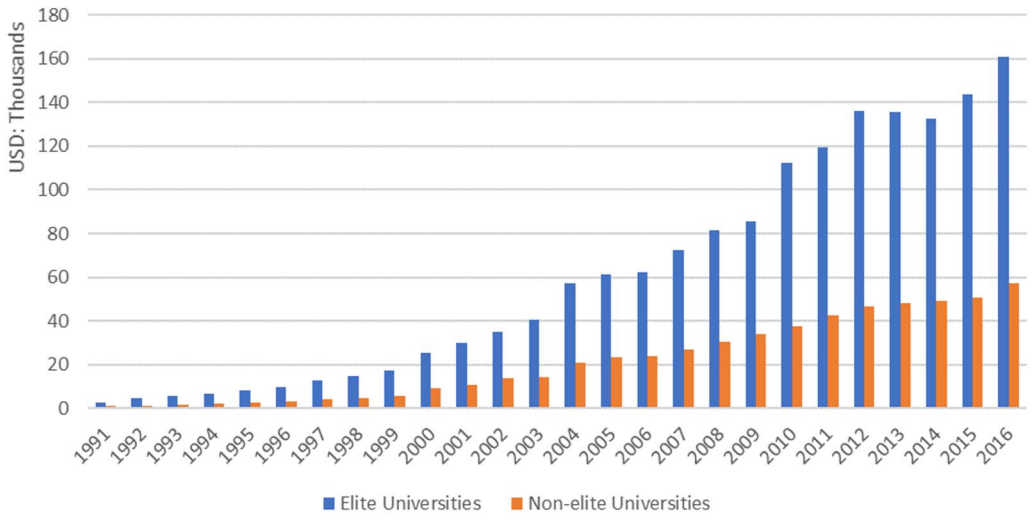

Figure 2. Research funding per capita in China's universities (1991–2016).

associate and full professors): In 1991, the proportion of tenured professors in elite universities was 50% higher than in nonelite universities (39.2% vs. 26.1%). This gap decreased to 42% in 2016 (63.0% vs. 44.5%). Professors from elite universities are also more likely to attend international conferences, as they are provided with adequate funding to cover travel costs. While 77.1% of professors from elite universities attended at least one international conference in 2016, this percentage was only 16.1% for nonelite universities. Similarly, 15.4% of elite university professors have visited a foreign institution as a visiting scholar, while only 5.9% of nonelite university scholars had the same experience (Ministry of Education of China, 1992–2017).

4. THE PERFORMANCE OF THE ELITE

The benefits provided to elite universities, however, do not translate into greater scientific production and impact. While elite universities received, on average, 2.3 times more funding per capita than their nonelite counterparts ($722,128 vs. $312,277 over the 2007–2016 period), their

Table 1. "Welcome bonus" for entering the "elite club"

	Research funding ($million)		
University	**2005–2007**	**2008–2010**	**Change (%)**
Tibet University	5.13	35.89	600.24
Hainan University	8.050	22.29	176.87
Ningxia University	5.47	15.04	174.75
Shihezhi University	14.53	28.69	94.53
Qinghai University	16.24	28.36	74.65
All elite universities	**14617.06**	**24788.98**	**69.59**
All nonelite universities	**6379.43**	**9837.91**	**54.21**

Source: Ministry of Education of China (1992–2017).

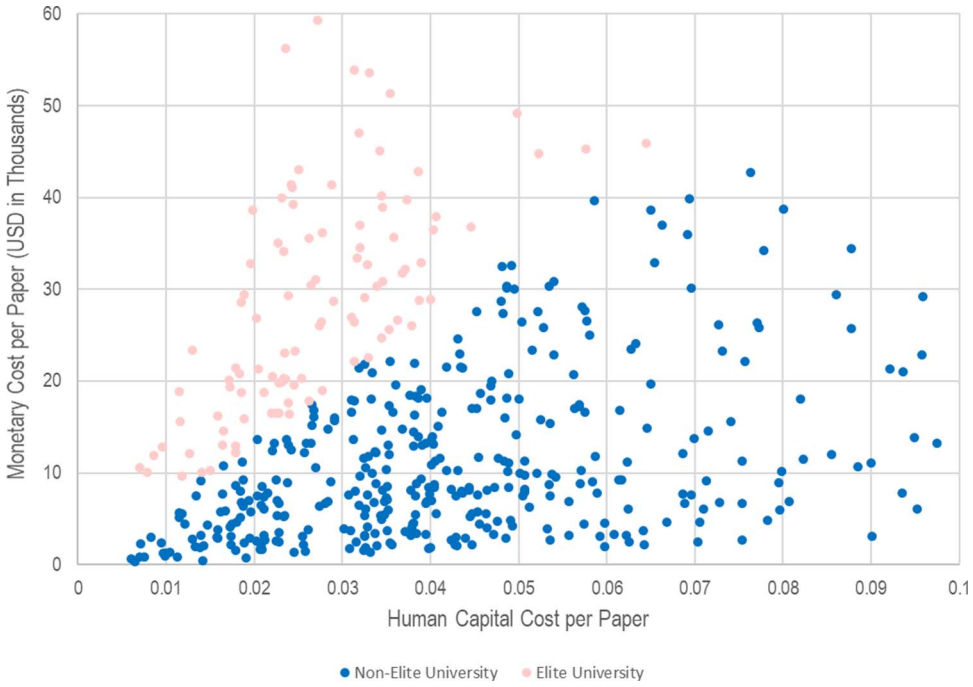

Figure 3. Cost per paper among Chinese universities (2007–2016).

number of papers per capita was only 19.4% higher than nonelite counterparts (40.777 vs. 34.153) and researchers from nonelite universities published, on average, a higher mean number of monographs per capita (0.583 vs. 0.364). This is also observed at the level of specific universities. Figure 3 presents, for both elite and nonelite universities, the monetary cost (research funding per paper) and the human capital cost (full-time equivalent per paper) of a single paper. Elite universities (red nodes) need much more funding to produce a single paper comparing with nonelite universities (blue nodes).

A further investigation was conducted regarding the research input and output of the subset of Chinese universities that published at least 2,000 research articles and at least 700 international papers indexed by WoS between 2007 and 2016 (N = 198 universities). This subgroup of very productive institutions contains as many elite universities (97 universities) as nonelite ones (101 universities). As shown in Table 2, while these 97 elite universities received, on average, 1.9 times more funding per capita than their 101 nonelite counterparts ($942,463 vs. $506,754 over the 2007–2016 period), their research outcomes per $1 million spending remain lower than nonelite counterparts. More specifically, elite universities publish fewer international papers indexed by WoS (9.671 vs. 13.283), a lower number of local Chinese

Table 2. Comparison between elite universities and nonelite universities in terms of research outcome per $1 million spending (2007–2016)

Group	Mean funding per capita	Mean number of international papers (WoS)	Mean number of international citations (WoS)	Mean number of papers in national (Chinese) journals	Mean number of monographs
Elite (N = 97)	$942,463	9.671	96.601	35.785	0.198
Nonelite (N = 101)	$506,754	13.283	96.797	82.057	0.388

Source: Ministry of Education of China (1992–2017).

papers (35.785 vs. 82.057), fewer monographs (0.198 vs. 0.388) (Ministry of Education of China, 1992–2017; Qiu, Tang et al., 2008–2017), and receive nearly identical citations per paper (96.601 vs. 96.797) (using citation data from WoS).

5. TOWARDS A ROBUST AND EQUITABLE HIGHER EDUCATION SYSTEM

Since the 1950s, the Chinese government has maintained a clear stratification in the higher education system, in which most of the resources are concentrated in the hands of a small number of universities. This stratification has put elite universities in a privileged position, in which they obtain the majority of government resources and their faculty have both better career advancement opportunities and greater access to the international community. Given this access to resources and preferential policies, elite universities are more likely to attract and retain elite scholars and, therefore, to preserve and accelerate advantages, leading to an institutionalized Matthew Effect (Merton, 1968).

While previous studies attribute this Matthew Effect to the uneven distribution of scientific resources (Yang, Gu et al., 2015) or the bureaucratic administration in science (Shi & Rao, 2010), we argue that such cumulative advantages are rooted in the hierarchal structure of China's higher education system and its relationships with the political organization of the country. For example, university administrative ranks correspond to that of the government and, therefore, each administrative staff level, from department chair to university president, has its counterpart in the government. Therefore, the categorization of the universities has a strong effect on the political ties that university administrations can have. For example, the president of Peking University (an elite vice-ministerial rank university) is the counterpart of the vice-minister of the MoE, while the president of Guangzhou University (a nonelite department rank university) is the counterpart of the director of Guangdong Provincial Department of Education. Considering the hierarchical government administration in China (Cheng, 2017), universities with higher rank are more powerful than their lower ranked counterparts when negotiating with the government for extra funding and preferential policies, and lobbying science policies regarding national research projects.

Moreover, as elite universities are generally administered by the central government (while nonelite universities are managed by local governments), the administrative ranks of their staff are generally higher than their nonelite counterparts, which leads to a natural stratification in China's higher education system. Elite universities also have the advantage in their *guanxi* (one's close personal relationships) (Shi & Rao, 2010), having closer contacts with senior government officials who design and implement science polices. Indeed, elite universities benefit from their strong alumni network, as all 709 senior officials with ministerial rank and above in Chinese government are alumni of elite universities (Xinhua News, 2017). With this strong alumni network, elite universities can lobby the MoE or other ministries for preferential policies, helping them keep their elite statuses at the expense of nonelite universities. This is why these national research programs were criticized for lacking transparency and inequalities (Qi, 2017) as they are tailormade for elite universities.

Despite these advantages, elite universities strongly underperform relative to other high producing Chinese institutions. They publish on average, fewer articles—in both national and international venues—and fewer monographs. This suggests that the stratification of elite institutions is not meritocratic, but highly dependent on factors such as *guanxi*, bureaucratic power (Shi & Rao, 2010), geopolitics, and administrative ranks. The classification, therefore, lacks distinction. If anything, the elite classification is aspirational, rather than descriptive.

A new list of 42 "First Class" universities and 95 universities having "First Class" disciplines were announced by the Double First Class program in 2017, forming a new group of 137 elite

universities. All 39 universities included in Project 985 were admitted to the "First Class" universities and all Project 211 universities had "First Class" disciplines. It seems that the same story in the admission of Project 985 and Project 211 happened again; universities are admitted not on their research performance, but on their past classification. Although the detailed methodology has not been revealed, some clues showed that some elite universities were allowed to designate one discipline as the "First Class" discipline while other "First Class" disciplines were appraised by the Double First Class Selection Committee, which confirms the privilege of elite universities in China's higher education system again.

In summary, institutionalized stratification exists in the Chinese higher education system on which China's national research programs are based. If China hopes for these classifications to be meaningful, the admittance to the elite club should be both transparent and evidence based. Without this rigor, the artificial classification of research institutions in China is likely to continue to lead to inefficiencies and suppress innovation in the Chinese higher education system. Furthermore, although China used to have scarce resources devoted to science and therefore had to be selective in funding (Jiang, 2000), the government now invests more than 2% of GDP (World Bank, 2018). These resources should be spread meritocratically, so that China can realize its full scientific potential.

AUTHOR CONTRIBUTIONS

Fei Shu: Conceptualization; Formal analysis; Investigation; Methodology; Validation; Writing—original draft; Cassidy Sugimoto: Writing—review & editing. Vincent Larivière: Writing—review & editing

COMPETING INTERESTS

The authors have no competing interests.

FUNDING INFORMATION

We gratefully acknowledge support from the Social Science and Humanities Research Council Canada (SSHRC) under grant number 756-2019-0196.

DATA AVAILABILITY

Data used in this manuscript are partly subject to the Law of the People's Republic of China on Guarding State Secrets and cannot be made available in a data repository.

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