



Does the concentration of scientific research funding in institutions promote knowledge output?

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ARTICLE INFO

Article history:

Received 8 February 2017

Received in revised form 17 June 2018

Accepted 7 September 2018

Keywords:

Basic research

Funding concentration

Knowledge output

ABSTRACT

Basic research is the main powerhouse of a country's potential for continuous economic growth, and national-level scientific research funding is an important source of capital that supports this basic research. Given these observations, this paper takes micro-level data from projects funded by the Department of Management Sciences in the National Natural Science Foundation of China between 2006 and 2010 to examine the relationship between the efficient use of research funding and the level of concentrated funding in certain research institutions. In contrast to the positive externalities produced by the concentration of R&D activities, our study finds that the accumulation of scientific research funding at the institution level is negative correlated with the knowledge output of the principal investigators of projects within the research institution. We explore the sources of the negative correlation and discuss some policy implications.

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1. Introduction

Basic research is an important pillar of sustainable innovation capacity and economic competitive advantage in a country. In contrast to research and development (R&D) activities, the results of basic research have stronger externalities. Therefore, relying solely on market mechanisms to encourage sustained basic research often leads to market failure, which is why basic research heavily relies on government financial support (Pavitt, 2000; Salter & Martin, 2001; Toole, 2012). China is no exception. Based on data published by Supervisory Committee of the National Natural Science Fund of China (NSFC), the Chinese government's total financial allocation to the natural sciences in 2003 was 2.05 billion yuan: 1.8 billion yuan went to the NSFC itself, and 180 million yuan to the National Science Fund for Distinguished Young Scientists. In 2015, these figures were even higher: total financial allocation to the natural sciences was 22.22 billion yuan, with 21.41 billion to the NSFC, and 729 million to the National Science Fund for Distinguished Young Scientists. In comparison to 2003, these figures were 10.85, 11.86 and 4.05 times higher, respectively¹. This increase alone shows that the Chinese government has been investing funds

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¹ Source of data: 2003 and 2015 Annual Reports of the National Natural Science Fund Committee, calculations by author; <http://www.nsf.gov.cn/nsfc/cen/ndbg/2015ndbg/05/01.html>

of considerable size for the growth of basic research. In the process of continuous increases in scientific research funds, the distribution of China's scientific research funding has shown distinct characteristics of funding concentration at the research institution level. A significant Matthew effect has been produced. Using the 2015 NSFC General Program projects as an example, in the 111 undertaking institutions with funding over 20 million yuan, the number of projects in the top five institutions accounted for 17.34% of total projects and their funding accounted for 17.05% of total funding from the NSFC that year. Projects in the top ten undertaking institutions accounted for 28.62% of the total number of projects, while funding accounted for 28.29% of total funding. If we include undertaking institutions that received one type of project funding but was under 20 million yuan (864 institutions), the degree of concentration would be even higher².

The concentration of scientific research funding in certain institutions is inevitable in one sense. Reform of the national research funding system, for example, exacerbates this. Since China began reforming its science and technology system in 1985, a major feature has been gradually changing the national research funding allocation system into one that is competition and merit-based. This method makes it possible for funding to become concentrated. Outstanding research institutions are more competitive in terms of access to financial support, and the accrued experience of receiving funding is also conducive to the next successful application, therefore generating the Matthew effect. A second source of the inevitability of funding concentration is international experience. The concentration of scientific research funds is an established fact that holds strong universal significance (Ebadi & Schiffauerova, 2016). Price (1963) had observed concentrated research funding as a measurable phenomenon in as early as 1960s; he called it "non-democracy" in scientific activity. In May 2014, well-known Chinese-American scholar Xie Yu of Michigan University published a paper in *Nature* highlighting the growing trend of inequality in scientific research activities. He discovered that the Gini coefficient of scientific research funding in the United States rose from 0.75 in 1990 to 0.81 in 2010, an increase of 0.06 over the span of 20 years (Xie, 2014).

In that case, does the concentration of research funding at the institution level benefit the efficacy of the knowledge production of research personnel within the research institution? Namely, would it bring about positive spillovers of knowledge output? To the best of our knowledge, though the role of public funding on academic output has been explored extensively, both in advanced economies (Cowen & Tabarrok, 2016; Ebadi & Schiffauerova, 2016; Jacob & Lefgren, 2011; Luukkonen, 2014) and in developing economies (Benavente, Crespi, Garone, & Maffioli, 2012; Fedderke & Goldschmidt, 2015; Saygitov, 2014), research that focuses on concentrated scientific research funding in institutions mainly simply describe the Matthew effect and make comparisons across different countries. Such research includes topics like the analyzing the ratio of research institutions to funding allocation (Zhi & Meng, 2016), or whether receiving funding would impact the rate of applying for future funding and the amount of funding obtained (Arora & Gambardella, 2005). Some studies explore the impact of concentrated fund on knowledge output at the individual level. For example, Larivière, Macaluso, Archambault, and Gingras (2010) examined the distributions of three different indicators (funding, publications, and citations) and found little correlation among them. Only 3.2% of researchers can be consistently classified as "elite" (top 10%) researchers by all three indicators. Using data from Canada, Beaudry and Allaoui (2011) found positive correlations between the funding amount and the number of publications, but there was no significant correlation between the funding amount and the number of citations. Mongeon, Brodeur, Beaudry, and Larivière, (2016) found that the impact of funding on research outcomes tended to exhibit diminishing marginal return, i.e., the most-funded researchers often were not the best-performing researchers. The diminishing return of funding on research output has also been discovered through other studies (e.g., Heale, Shapiro, & Egri, 2004; Fortin & Currie, 2013).

Following the studies that have examined the marginal effects of research funding at the individual level, this study explores the relationship between concentrated funding at the institution level and the knowledge output of individual principal investigators (PIs). We take a full sample set of data from the Department of Management Sciences of the NSFC between 2006 and 2010 to measure the relationship between the concentration of research funding in institutions and the knowledge output of research personnel within the institution. In contrast to the literature on the positive spillover effects of concentrated R&D activity (see Hall, Mairesse, & Mohnen, 2010; Bloom, Schankerman, & Van Reenen, 2013), we discovered that the concentration of scientific research funding does not show positive relationship with PI's Chinese language knowledge output. On the contrary, it produces a negative relationship with the research personnel's publication of Chinese language research papers, which exists even after taking into account the impact of the paper. This type of negative correlation is even more obvious in the PIs and research institutions for which funding are the most concentrated.

This paper attempts to contribute to the existing literature in the following ways: First, we analyze the spillover effects of knowledge output from institutions with concentrated funding from the perspective of research efficiency of research personnel within the institution; to a certain degree, this helps to enrich existing work done on concentrated research funding and the consequences of the Matthew effect. Second, this study assesses the efficiency of funding use from a novel perspective. Previous research has mainly studied the distribution of NSFC funding (Wang & Du, 2014; Zhang, Tang, & Liu, 2011), or examined the efficiency of funding use at the individual level (Liu, Chen, & Yuan, 2014; Zhang, Gai et al., 2015). This study, on the other hand, explores the relationship between institution-level funding concentration and the knowledge output of PIs within the research institution, and examines the spillover effects of funding concentration in certain research

² Source of data: 2015 NSFC Project Funding Statistical Information, edited by the NSFC Committee, calculations by authors.

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