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Does "birds of a feather flock together" matter—Evidence from a longitudinal study on US–China scientific collaboration

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ABSTRACT

China's status as a scientific power, particularly in the emerging area of nanotechnology, has become widely accepted in the global scientific community. The role of knowledge spillover in China's nanotechnology development is generally assumed, albeit without much convincing evidence. Very little has been investigated on the different mechanisms of knowledge spillover. Utilizing both cross-sectional data and longitudinal data of 77 Chinese nanoscientists' publications, this study aims to differentiate individual effects from the effect of international collaboration on the research performance of Chinese researchers. The study finds evidence in support of the "birds of a feather flock together" argument – that China's best scientists collaborate at international level. It also finds that collaboration across national boundaries has a consistently positive effect on China's nano research quality with a time-decaying pattern. Language turns out to be the most influential factor impacting the quality or visibility of Chinese nano research. Policy implications on research evaluation, human capital management, and public research and development allocation are also discussed in the end.

1. Introduction

Evidence is accumulating that China is an emerging scientific powerhouse in terms of research output. The findings of numerous studies are robust despite their diverse search strategies (Adams & Wilsdon, 2006; Frietsch, Tang, & Hinze, 2007; Kostoff, 2012; Youtie, Porter, Shapira, Tang, & Benn, 2011; Zhou & Leydesdorff, 2006). Measured by the number of research articles, China is now the world's largest producer of such output (Kostoff, 2012). In terms of citations, the relative quality of China nano-research is also increasing every year. When benchmarked with US data, in 1990 the difference of median citations per article between the US and China was 9; in 2009 the statistics dropped to 0. By the end of 2009, 20% of China's nano research published in 1990 received zero citations, in contrast to 4% of US cohorts. In 2009, the difference in articles from the two countries receiving citations reduced from 22% to 0.96%.[1] In light of both countries' huge investments in nanotechnology, the existence of the Chinese diaspora,[2] and the growing phenomenon of reverse immigration, this narrowing gap in the number of citations likely stems from unbalanced knowledge spillover *cross national borders*, albeit without much supporting evidence.

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[1] These numbers were calculated based on the Georgia Tech Nanotechnology Publication Database (1990–2009), which was updated in January 2010.

[2] There is no one agreeable definition of Chinese diaspora (Ma & Cartier, 2003; Lever-Tracy, Ip, & Tracy, 1996; McKeown, 1999). The Greek term diaspora means the widespread scattering of seeds. Under the context of globalization, it refers to ethnic Chinese and their descendents who retain cultural and/or language ties with mainland Chinese but do not live in China. For more details please refer to International Encyclopedia of the Social Sciences. <http://www.encyclopedia.com/doc/1G2-3045300323.html> Accessed on September 29, 2012.

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The impact of international collaboration on research performance is not a new topic, having been extensively explored in prior studies. In spite of the rich volume of results in the literature, they are in disagreement (Tang & Shapira, 2012). Since the seminar work of Katz and Martin (1997), the amount of evidence supporting the positive *correlation* between collaboration and research performance has been accumulating. Chinchilla-Rodríguez, López-Illescas, and Moya-Anegón (2012) found a positive impact of international collaboration on both output and citations in the field of biomedical science. Based on a bibliometric analysis on seven top library and information studies journals from 1990 to 2008, Sin (2011) claimed that internationally co-authored articles were positively related to citation counts. Hu, Carley, and Tang (2012) underscored the importance of international collaborative activities in Canadian nanotechnology research development. Another recent study led by Abramo, D'Angelo, and Solazzi (2011) demonstrated the positive relationship between the degree of international collaboration and the quantity and quality of Italian university researchers. Notable studies reporting similar findings also include Persson, Glanzel, and Danell (2004), Barjak and Robinson (2007), He, Geng, and Campbell-Hunt (2009) and Abbasia, Altmannb, and Hossaina (2011).

Conflicting evidence has been reported recently. For example, Leimu and Koricheva (2005) found that internationally co-authored articles do not receive more citations than domestically co-authored papers in the field of ecology. In a comparative study conducted by Duque et al. (2005), they found that in the context of developing countries, collaboration is not related to increment in productivity. Findings in support of the trade-off effect of foreign collaboration on quantity and quality have also been reported. Using panel publication data of 110 top US universities, Adams, Black, Clemmons, and Stephan (2005) confirmed empirically the existence of quantity–quality tradeoff of research enterprises, i.e. international collaboration was positively correlated with research visibility but negatively correlated with productivity. Barjak (2006) suggested a curvilinear relationship between the extent of collaboration scope and research productivity. In another study focusing on the research output of 80s laboratories within one large European university, Carayol and Matt (2004) reported no evidence of the impact of international collaboration on research productivity.

Table 1 summarizes the methods and results of some selected work whose findings on the effects of general scientific collaboration and international collaboration in particular were inconclusive in terms of both direction and impact on research performance.

Prior research, while insightful, suffers from four interrelated, mutually influencing drawbacks. One is the ignorance of self selection when individual heterogeneity is not controlled for in most studies. If the saying "birds of a feather flock together" has any validity, then higher research performance, i.e. more publications and greater citations, do not necessarily result from the event of collaboration. Second, but also related, is that many studies focus on only aggregate-level analysis rather than individual-level analysis. Among those research adopting micro-level analysis, the omission of variables in model specification is problematic. As noted by Garfield, the founding director of the Institute for Scientific Information Philadelphia, a citation itself is a function of many other variables in addition to scientific quality (Bornmann, Mutz, Neuhaus, & Daniel, 2008; Egghe & Rousseau, 1990; Garfield, 1972; Moed & Van Leeuwen, 1996). It is for this very reason that more recent studies have begun to adopt statistical modeling to exclude competing explanations (Beirlant, Glänzel, Carbonez, & Leemans, 2007). Unfortunately, important variables such as language, size of the scientific communities, and collaboration scope are still missing. The third problem is that many studies have adopted cross-sectional data rather than dynamic longitudinal data. The few that have adopted longitudinal data have all assumed a constant impact of collaboration over the years, which is highly inconsistent with absorptive learning and knowledge accumulation. Finally, as illustrated in Table 1, in addition to various disciplines, the studied country context seems also related to the mixed results pertaining to collaboration. In the case of China, while the role of international collaboration in scientific development is widely assumed (Appelbaum & Parker, 2008; Jin, Rousseau, Suttmeier, & Cao, 2007; Suttmeier, 2008), empirical evidence of such collaboration remains sparse. Therefore, to fill some research gaps in this domain, this article utilizes both cross-sectional data and a unique panel publication dataset of a special group of Chinese nanoscientists to explore factors influencing the research quality of Chinese nanotechnology.

2. Hypotheses

International collaboration occurs when participants in different countries work together (Sonnenwald, 2008). Following common practice, international collaboration is measured by joint publication between researchers from different countries (Katz & Martin, 1997). In this vein, this research considered that US–China scientific collaboration occurred when scholars from the US and China co-published articles in research journals. Given that the US has been the number one knowledge producer in nanotechnology (Kostoff, 2008; Kostoff, 2012; Youtie, Shapira, & Porter, 2008) and building upon past studies, the first two hypotheses follow:

H1. US–China collaboration positively impacts the quality of China's nanotechnology research.

H2. US–China collaboration has a larger positive impact on the quality of China's nanotechnology research than does international collaboration without US involvement.

The above hypotheses test the impact of international collaboration on research quality under a strong assumption of a constant effect over the years. However, it is reasonable that the accumulation of knowledge and collaborative experi-