



An empirical study of university–industry R&D collaboration in China: Implications for technology in society



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ABSTRACT

This research investigates the growing phenomenon of university–industry (U–I) collaboration in high-tech strategic projects in China. After significant changes in the trading policies of 1978, China has gained heightened attention in technology and innovation. To achieve the stated strategic national goals, Research and Development (R&D) collaboration is essential. Organizations preferred to collaborate in order to share the burden of R&D costs and efforts. The academic outputs (research publications) of Chinese academic institutions and technology patenting ratio are increasing daily in China. These increasing numbers signal the importance of R&D. High-tech industries are inclined to share projects with universities. Foreign enterprises, state supported enterprises and local industry have played key roles to strengthening university–industry relationships.

This study explores the U–I collaboration patterns among Chinese universities and high-tech industry on the basis of quantitative analysis using a research instrument. This empirical study depicts a cross-sectional analysis of two subsets of the U–I population. The U–I relationship was demonstrated in terms of the determinants of R&D collaboration and the outcome of alliances. The results show that U–I collaboration is established and encouraged due to factors such as: R&D tendency, R&D risks, R&D promotion factors such as state incentives. Innovative incentives, technological gains and sharing R&D cost and efforts to optimize the R&D budgets are principal outputs of these coalitions. Practitioners and researchers also agree that strategically, U–I collaboration is an obligatory practice for China to achieve the goals of becoming a world innovation center. Considering and evaluating the R&D collaborative determinants based on their own experiences, the majority of the respondents suggested that U–I collaboration should be enhanced in or at least sustained at current levels in the future in order to continue this pace of development.

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1. Introduction

Industries are considered as major players in national economic growth and industrial innovations. The academy is a supporting “actor” in this drama. Industries based on scientific outputs are concerned with the distributed nature of the innovation process [1]. Universities support the industry for achieving new innovations by providing them competent personnel, the latest research results, an up-to-date knowledge-base and scientific research publications.

U–I collaboration is not a new concept and has gained more attention in recent years. Different factors of U–I collaboration have been observed. The literature strongly supports innovation as a major factor that triggers collaboration. Innovation has attained more attention by all types of enterprises due to globalization and commercialization. Technological complexities are the primary hindrance for innovation that drives firms to make joint R&D ventures. Numerous developed countries emphasize government participation in the innovation process [2] that leads to successful university–industry collaboration.

The economic expansion of China started with the opening-up policy in 1978. New firms were encouraged to

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invest in China. Many international brands started to expand their business in China. Due to mixed culture and races, business competition was increased. During past few decades, more innovations have been adopted to attain competitive advantages. This competition culture for technological innovations has triggered the business moguls to get benefits from an academic research and U–I collaborations have gained much attention in Chinese new developed industrial civilization. China has announced its National Program for Medium- and Long-Term Scientific and Technological Development 2006–2020. According to these guidelines, China recommends that large enterprises pay more attention to Research and Development (R&D) activities and establish R&D institutes. Lei [3] demonstrated that there was a large increase in U–I innovation using co-patent frequency. This increase in co-patent frequency is a sign of the increased tendency of U–I collaboration. Collaboration is also associated with knowledge flows [4] and similar collaboration in research publications has been observed during last few decades.

The aim of this research is to provide a broad analysis of influential factors and benefits of U–I collaboration in Chinese firms and academic institutions. Practitioners' perception for U–I collaboration can be different from the researcher due to different working environments, cultures [5], objectives and processes [6]. This empirical study identifies and characterizes the gap between these two approaches and determines the propensity of project managers and researchers for U–I collaboration. We have identified multiple factors that promote U–I collaboration in Chinese environment. These include: political stability, support from the state, openness, trust, goodwill, the degree of R&D collaboration, the level of R&D collaboration, the ratio between R&D employment and total employment, innovative tendency, organization size, documented key risks and communication. The next section of this article describes global U–I collaboration trends. Chinese U–I collaboration success stories are described in Section 3. This section describes new U–I collaboration trends in China. Research methodology and descriptive statistics used as analytical tools, are explained in Sections 4 and 5. The reliability analysis is described in Section 6. Section 7 is a factor analysis followed by Conclusions and recommendations.

2. U–I collaboration tendencies

Traditionally, universities are considered as research centers that support innovation. Many researchers have investigated the impact of a university on local development [7] in terms of its contribution to innovation [8,9]. Strategic alliances and collaboration endeavors have played a very significant role in the R&D organizations, especially in high-tech industries [10]. Considering the importance of U–I collaboration, developed countries have sought different mechanisms to promote U–I collaborations. The USA has 39 recognized federally funded research and development centers. The University of California, Stanford University, Princeton University are just some of the well-recognized universities in the US system that have established strategic relationships with various strategic and defense institutes [11]. Countries in the Organization for Economic Cooperation and Development (OECD) also encourage business-funded R&D in higher education and government

laboratories. The OECD has contributed 6.6% of industry funded R&D budgets to these efforts from 2002 to 2003 [12].

Different forms of collaboration and interaction among partners are described in the literature. Joint research collaboration, informal interactions in meetings/conferences for exploiting the opportunities of knowledge exchange and coordination are various methods typically used in the successful execution of R&D projects. Impersonal forms of exchanges as publications, face-to-face associations and arm's-length interactions are also useful ways to collaborate. Authors [13] have explained various forms of intersections to enhance collaborations; arm's-length, short term, targeted, open-ended, formal and informal interactions.

A variety of R&D collaboration determinants have been discussed by researchers [14,15]. These include hiring and payment of external R&D, innovation category, size of firm and its location [14,16,17]. Capabilities and competencies owned by a specific sector strongly affect the U–I collaboration process [18]. Prior collaboration ties [19], the aforementioned associations [20], trust between teams and partners [21], firms size, support from the state, engagement in innovative activities and the type of industry positively influence successful R&D collaboration with university [22]. According to Phene and others [23–25], geography is also an important factor and plays a key role in the creation of economical and institutional ventures to develop common institutional partnerships that can stimulate innovation. Sharing R&D risks and costs, identifying complementarities, the innovation tendency, protecting innovations and absorptive capacity also have been pointed out as prominent factors which positively or negatively affect collaboration [26,27].

3. Chinese U–I collaboration success stories

Significant economic and technological growth has been observed during the past three decades in China. One primary reason for this rapid growth is the policies of the National Program for Medium- and Long-Term Scientific and Technological Development 2006–2020. The aim was to inspire enterprises to conduct R&D activities and establish joint R&D centers that will stick various groups together from the academy, enterprises and scientific research institutes supported by the state. This policy was deployed to help China reach the forefront of research-led nations [28]. Lei explained U–I collaboration growth in terms of research co-patents and scientific researcher publications. In his research, based on patent analysis of Chinese patentees from USA firms, Lei [3] presented a comparison of co-patents applied by industry and university. He found that the frequency of U–I co-patent is higher than that of co-patents in industry and government. The co-patent number increases very rapidly from the year 2005 to 2009 showing an increasing trend in U–I collaboration. Fig. 1 shows the comparisons of different co-patents [3]. The scientific research publication graph of Chinese researchers also shows the increased tendency in research. Due to enhanced collaboration among U–I, more innovations are coming to the market. Fig. 2 shows the data from year 1996 to 2010. Scientific publications in China totaled 27,552 in 1996 and rose to 329,800 by 2010. On the other hand, USA is

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