Technological Forecasting & Social Change xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

Relating science and technology resources integration and polarization effect to innovation ability in emerging economies: An empirical study of Chinese enterprises

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ARTICLE INFO

Keywords:
Integration
Scientific and technological resources
Polarization effect
Concentration
Factors of production
Economic activities

ABSTRACT

Based on general theoretical analyses of the integration of scientific and technological resources and polarization effect, we proposed a research model to explore the relationship between the integration of scientific and technological resources, polarization effect, and enterprise's innovation ability in emerging economies, specifically using the data from Chinese enterprises. We empirically found that polarization effect can be used as the intermediary variables between the integration of scientific and technological resources and enterprises' innovation ability. The results provided important insights to enterprises in emerging economies about utilizing the polarization effect of the integration of scientific and technological resources to improve innovation capability.

1. Introduction

Scientific and technological resources have become one of enterprises' strategic resources in the knowledge economy (Lima, 2016). Enterprises are increasingly competing on innovation ability (Hoyland et al., 2014; Wang et al., 2016). Researchers have shed light on the relationship between the integration of scientific and technological resources and the enterprise's innovation ability. Some believed that the integration of scientific and technological resources has a direct impact on enterprise's innovation ability. For example, David (2013) conducted an empirical research about the entrepreneurial environment, scientific and technological resources integration, and innovation performance. In other words, enhancing the integration capability of scientific and technological resources can improve the enterprises' innovation performance. Zhang (2008) analyzed the relationship between the integration of scientific and technological resources and the agricultural enterprises' innovation performance with three technological innovation modes. Specifically, he stated that the resource integration can strengthen the efficient production and flow of innovation elements in enterprises' innovation systems, optimize the efficiency of scientific and technological resources, and improve the innovation ability. Other scholars believed that the relationship between the integration of scientific and technological resources and the enterprise's innovation ability is adjusted by their related factors. For example, Barney (1991) proposed that the environmental dynamics change is the regulated variables of such relationship. Aviv et al. (2013) examined the influence of the government's macroeconomic regulation and control on the relationship.

Additionally, Christer (2010) and Li (2010) utilized the influence path to explain the relationship between the integration of scientific and technological resources and the enterprise's innovation ability by setting up a systematic theoretical framework based on the resource-based view and the growth pole theory. The growth pole theory states that growth does not occur in all places at the same time. It firstly appears in some areas or the growth pole with different strength, then spreads through different channels, and has different ultimate impact on the entire economy. It includes two processes, namely diffusion effect and polarization effect. It argues that scientific and technological resources integration must be converted into an ability which can affect the innovation. The ability includes both diffusion effect and polarization effect. Therefore, as a dynamic process, scientific and technological resources integration is not just directly related to corporates' performance. Based on its direct impact on innovation, the integration must also produce an ability before it can have a profound impact on innovation.

The interpretation framework proposed by Li (2010) provides a new research idea to analyze the relationship between the integration of scientific and technological resources and the enterprise's innovation

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http://dx.doi.org/10.1016/j.techfore.2017.09.009
Received 25 November 2016; Received in revised form 2 September 2017; Accepted 9 September 2017

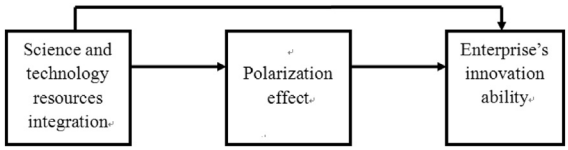

Fig. 1. The conceptual model: The influence path based on polarization effect.

ability. Both diffusion effect and polarization effect of the resources integration play a key role in the influence path of the resource integration for the enterprises' innovation. However, the existing literature has ignored the direct analysis of the effect process factor. Although Li (2010) implemented an empirical analysis of the effect on the conduction of the diffusion effect, the conduction of the polarization effect has not yet been empirically tested.

We applied the concept of polarization effect from the economics to study the specific enterprises in emerging economies. We also empirically analyzed the indirect effect of scientific and technological resources integration on the enterprises' innovation ability by collecting data from scientific and technological enterprises in Jilin Province, China. Our conceptual research model is shown in Fig. 1.

2. Literature review

2.1. Scientific and technological resources integration and dimensions

Science and technology resources can directly or indirectly promote the science and technology development and ultimately boost the economic development. They are also considered as an important part of knowledge resources due to their knowledge characteristics. Enterprises have to solve their internal problems through the resource integration (Xu, 2015). It is impossible to find a solution without an integrated thinking (Ricardo et al., 2010). The integration of scientific and technological resources can achieve management innovation and resource integration (Chen, 2008). Zawislak et al. (2012) found that the integration of scientific and technological resources is the key for the enterprises' innovation ability transiting from technological development to trading capacity.

According to the different classifications, resources integration of science and technology can be divided into different dimensions. Tiffany et al. (2003) pointed out the scale of science and technology resources integration, including human resources, financial resources, and material resources. From the resources plan perspective, David et al. (2007) identified two dimensions of resources integration, human resources integration and property resources integration.

Delvin et al. (2013) argued that the technological resources can be obtained from internal and external resources. Empirical studies have found that integration of internal resources and external resources is fundamental to the successful enterprise resource planning (Bi et al., 2014; Li et al., 2008; Niu et al., 2013; Xu, 2011; Xu, 2016; Xu and Viriyasitavat, 2014). Kaghan and Bowker (2001) stated that scientific and technological resources and social resources should be integrated for rational use of corporates' resources. Damien and Prakash (2007) indicated scientific and technological network resources are the channel connecting business with the world. Through the integration of scientific and technological network resources, their own resources create a higher value and improve technological resource integration efficiency. From a social point of view, the business integration resources include external resources and internal resources. Considered as part of corporates' social relations, technological network resources belong to external resources. Gkypali et al. (2017) concluded that internal R & D investments and various R & D collaborations should be balanced to improve innovation performance.

Patel and Pavitt (1997) proposed the heterogeneous enterprise technology concept which refers to companies with different types of technology. Wang et al. (2013) argued that the production technology heterogeneity is a major dimension of the integration of scientific and technological resources. Technology belongs to the scientific and technological resources. Thus, the technology heterogeneity is one aspect of the heterogeneity of science and technology.

In this paper, scientific and technological resources integration could be divided into three dimensions: 1) the scale of scientific and technological resources integration (IS); 2) the range of scientific and technological resources integration (IR); and 3) the heterogeneity of scientific and technological resources integration (IH). The scale of scientific and technological resources integration refers to the integration of scientific and technological human resources, scientific and technological financial resources, and scientific and technological information resources. Based on social research, the range of scientific and technological resources integration mainly includes the integration between internal technological resources and external scientific and technological resources. Current research on the heterogeneity of integration of scientific and technological resources mainly focus on the technical heterogeneity. Therefore, the heterogeneity of scientific and technological resources integration refers to the technology heterogeneity in this paper.

2.2. The polarization effect and dimensions

Researchers pointed out that economic growth didn't occur in all places at the same time. Researchers also emphasized that the polarization effect accelerate the development of growth pole due to a strong attraction of the growth pole's advanced industry. Richardson and Richardson (1975) stated that the polarization effect is generated due to inter-regional movement of goods and production factors to promote the rapid growth of enterprise and industry. In this paper, polarization effects will be divided into two dimensions: the concentration of factors of production (CFP) and the concentration of economic activities (CEA).

Production factors are generally divided into four types: labor, land, capital, and entrepreneurship. Production factors have narrow-sense and broad-sense. Narrow-sense refers to the basic material resources which are necessary for any goods and services production. However, broad-sense refers to the constituent elements of various levels of production entities (Xu and Xu, 2006). In this paper, related production factors mainly refer to the narrow-sense. The concept of production elements concentration is proposed to analyze polarization effects of scientific and technological resources integration (Xu and Xu, 2006). The concentration of production factors refers to the process in which the production of materials, labor, and commodity has increasingly been focused on a small number of large enterprises.

The economic activities mainly refer to the process of the labor and other production materials in exchange for goods and services. The main economic activities mentioned in this paper are production and operations management. By analyzing aggregate economic activities in United States, David and Johnston (1990) proposed that concentration of economic activities is economic activity concentrated in geography. Concentration of economic activity is a system power to improve efficiency and reduce cost via economies of scale and economies of scope. Yener (2014) argued that concentration of economic activities is economic activity accumulated in the space. Based on the new economic geography, relatively similar enterprises with larger concentration generate more revenues (Hafner, 2013). In this paper, concentration of economic activities is defined as production and operation activities in the enterprises' development process concentrating in space and geography.

2.3. Enterprise's innovation ability

Researchers have defined innovation ability differently. From the technical innovation perspective, Ghoshal and Bartlett (1988) defined innovation ability as the ability to product new products, new technology, and improve existing products and process. Adrienne and Paula