ICT R&D and Technology Knowledge Flows in Korea

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ABSTRACT

This study measured the R&D outcomes of Korea’s firms by analyzing the changes and patterns of technology knowledge flows and tried to see whether the outcomes of ICT R&D were better than those of non-ICT R&D. Using the registered patent data from 2008 and 2009, the authors computed the technology cycle time (TCT) and various centrality indexes with social network analysis (SNA), a popular method in patent citation analyses (PCA). In particular, the authors developed a technology spillover network and industry absorption network for the SNA. Having done these analyses, this study additionally conducted a confirmatory statistical test to compare ICT R&D with non-ICT R&D in terms of their performances. The authors found that Korea’s ICT R&D has achieved higher levels of technology development speed, technology spillover and industry absorption when compared to non-ICT segments. The authors were also able to determine which particular ICT R&D is in an important position in terms of technology knowledge flows.

KEYWORDS

ICT R&D, Industry Absorption Network, Knowledge Flow, Patent Citation Analyses (PCA), Social Network Analysis (SNA), Technology Cycle Time (TCT), Technology Spillover Network

INTRODUCTION

It is no secret that the ICT industry has been a principal force behind the economic growth in Korea for the last couple of decades. According to the International Telecommunication Union (ITU)’s ICT development index that is annually announced, Korea has been ranked no lower than first or second since 2010 (http://www.itu.int/net4/ITU-D/idi/2017/). However, at the same time, there still remains a question of whether Korea has secured its fundamental competitiveness based on ICT innovations. It has been widely pointed out that the weakness of Korea’s ICT industry lies in its overreliance on a small number of industry sectors. For example, three items (semiconductor, cell phone and display) account for almost 70% of its total ICT exports. Except with semiconductor-related products, Korean firms have needed to pay significant amounts of royalties to overseas licensors for ICT products (http://www.etnews.com/20141222000050).

With such a confusing evaluation of the ICT development status in Korea, private firms as well as public sectors and universities were estimated to spend a huge amount of money for R&D investment

DOI: 10.4018/JDM.2018100103

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to increase their innovativeness and competitiveness. According to the Ministry of Science and ICT, Korea’s total amount of R&D expenditure was approximately 70 billion US dollars as of 2017, which was ranked number 5, following the U.S., China, Japan, and Germany. In terms of R&D expenditures as a percentage of GDP, Korea’s 4.55% was number 1, surpassing number 2 Israel’s 4.25%.

The real impact of R&D on technological knowledge flow has yet to be analyzed. How R&D is absorbed in industries also needs to be studied. This study measured the outcomes of technological knowledge acquired from R&D processes. Particularly, this study examined whether ICT R&D showed a different pattern of performances than non-ICT R&D. Despite previous studies on ICT R&D investments, little is known about the differential impact and flow of technological knowledge acquired from ICT R&D compared to non-ICT R&D.

ICT sector invests heavily in R&D and is highly innovative. The outcome of ICT R&D affects the whole economy (OECD, 2005). ICT R&D is the backbone of the global digital economy and constitutes a key driver of productivity growth in a knowledge-based economy. It is clear that the ICT R&D innovation positively affects non-ICT sector as well, thanks to its knowledge spillovers (Khosrow-Pour, 2017). This is why most of the countries spend 20-40% of total R&D on ICT sectors (OECD, 2005). In case of Korea, ICT R&D investment accounts for more than 50% of total R&D expenditure steadily since 2011 (https://www.mist.go.kr). However, comparison between ICT R&D and non-ICT R&D in perspective of knowledge flow is yet to be explored.

R&D investment priorities would better be determined based on the nature of knowledge flows and their characteristics such as the centrality and the rapidity. If a certain sector has better knowledge flows (i.e., more strongly and positively affects other sectors), the priority needs to be given to that industry. For that purpose, this study tried to empirically confirm whether ICT R&D would show higher outcomes in perspective of knowledge flow. Also, the authors intended to see which particular ICT industries are in important positions.

The authors measured the outcomes of knowledge acquired from ICT R&D from three perspectives: technology cycle time (TCT) to measure the technology development speed, technology spillover effect, and industry absorption effect with social network analysis (SNA), a popular method in patent citation analyses (PCA). The paper is organized as follows: it began with discussing literature on connections between technology knowledge performances and R&D outcomes. Next, data and methodology, including a description of TCT and various centrality indexes by the SNA, were presented, followed by the results of the findings. Finally, based on the conclusions, a new focus for future research was suggested.

BACKGROUND

Knowledge Flow and R&D

A knowledge-based economy is defined as an economy in which the performance or production of knowledge are the core driving forces of growth in all industries (Chiang, Terence, Barron, and Storey, 1992; Syu and Lang, 1991). Knowledge capital is a more important source of value creation than natural or capital resources and is a measure of competitiveness (Foray and Lundvall, 1996). Technology innovation is achieved through active knowledge flow between knowledge actors (Oliver, 2013). Therefore, knowledge flow has been recognized in the literature as important in innovation and in economic development (Martín-de Castro, 2015). Knowledge flow is an intrinsic part of innovation, as learning and feedback effects arise as new knowledge spreads to enhance industrial innovation (Robertson and Patel, 2007).

Research on knowledge flow from R&D investments has been conducted since the late 1990s. Park (1995), Jaffe and Trajtenberg (1999), Branstetter (2001), Kaiser (2002), Park and Yoon (2014), Hájek and Stejskal (2018), and Zhou, Pan and Urban (2018) have addressed knowledge flow, such as the form of knowledge sharing and the factors, scope, and impact of knowledge flow. More specifically,
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