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The role of ICT in Korea's economic growth: Productivity changes across industries since the 1990s

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ABSTRACT

This paper investigates the hypothesis that technological convergence has been a major driving force for the recent productivity increase in Korea. Based on the dynamic panel data of Korean industries, the direct impact of information and communication technology (ICT) on labor productivity is assessed through growth accounting, and the indirect network effect of ICT on industrial total factor productivity (TFP) is estimated. The results confirm the essential role of broadband networks for successful convergence. The policy implications for the regulatory change are drawn from the empirical analysis.

1. Introduction

The productivity impact of information and communication technology (ICT) varies widely depending upon the sample countries and periods. Even in the U.S. economy, where ICT has been pervasive over time,[1] the role of ICT in promoting the overall efficiency of economic growth remained controversial until recently. Gordon (2000) emphasizes that the computer hardware industry is not large enough to generate spillover effects throughout the U.S. economy, arguing that the deflator adjustment and business fluctuations tend to overstate the role of ICT. On the other hand, Oliner and Sichel (2000) explain that the share of the ICT industry, especially computer hardware, software, and network equipment, has grown rapidly enough to transform the U.S. economy into a knowledge-based information economy.

The recent development in econometric research helped to resolve the productivity paradox, paving the way to examine the diffused impact in more precise terms. Basu and Fernald (2007) explain that ICT has the property of general purpose technology, which requires complementary investment for industry-specific application and innovation. They claim that the productivity surge in sectors using ICT during the 2000s resulted from the massive investment in ICT after the mid-1990s. In a similar vein, Oliner, Sichel, and Stiroh (2008) emphasize the role of complementary and concurrent investments in intangible capital such as firm-specific organizational and human capital.

In their influential papers on the productivity impacts of intangible capital, Corrado, Hulten, and Sichel (2009) and Corrado and Hulten (2010) report that information technology (IT) equipment and software (SW) contributed almost twice as much to the growth of labor productivity over the period of 1995 to 2003 as compared with earlier decades (1973 to 1995). Jorgenson,

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[1] Corporate investments in IT surged between 1994 and 2005, from about $3500 to $8000 per worker (U.S. Bureau of Economic Analysis). During the same period, the annual productivity growth in U.S. companies roughly doubled after plodding along at about 1.4 percent for nearly 20 years (see McAfee & Brynjolfsson, 2008).

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Ho, and Stiroh (2008) estimate the contribution of ICT to labor productivity growth in the U.S. economy[2] and claim that productivity growth has been extended to both non-ICT and ICT-using sectors. In contrast to earlier research using data from the 1990s, ICT-producing industries show a smaller increase in TFP than industries that use ICT.[3]

The positive impact of ICT on productivity growth is not limited to the U.S. economy. As the price of sophisticated ICT equipment and SW became more affordable, the diffusion process accelerated over time in most developed economies. Technological convergence between ICT and other industrial technologies has been further stimulated by the convergence of ICT technologies (ICT convergence) such as the mobile Internet.[4] The rapid expansion of broadband Internet and mobile infrastructure brings forth network economies and mediates ICT applications across various segments of the growing economy. Moreover, once the technological convergence strengthens the competitiveness of sectors that use ICT, the demand for ICT-intensive investment goods grows, building a virtuous circle of cumulative effects between the two sectors.[5]

According to the OECD report,[6] Korea has built extensive broadband Internet networks and become one of the leading countries in ICT development. Over the past decade, the average GDP and export share of ICT-producing industries in Korea amounted to 8 and 35 percent, respectively. Although Korea's growth rate decreased from 8 to 4 percent per annum after the financial crises starting in the late 1990s, the leading export industries such as automobile, shipbuilding, steel products, and chemicals, not to mention the ICT-producing industries such as semiconductors and mobile handset equipment, have greatly strengthened their international competitiveness in the past decade. In the absence of an underlying driving force that stimulates technological convergence and a productivity increase, such a gain in international competitiveness might not have been realized during the mid-2000s when the Korean won appreciated substantially against the Japanese yen and U.S. dollar threatening export markets.

The Korean government recently began to acknowledge the importance of ICT diffusion and technological convergence. The government announced the so-called *Future Strategy for IT Korea*, which coordinates the ICT policy directives of the Ministry of Knowledge and Economics and Korea Communications Commission. It outlines a set of candidate industries that will benefit the most from technological convergence, emphasizing the role of the software industry as a vehicle for industrial competitiveness. The policy priority also includes the security and speed of Internet service.[7] The shift of the policy directive from the network infrastructure to the application of ICT, however, is likely to bring important changes in the regulatory regime of the network industry and requires a comprehensive assessment of the source and impact of technological convergence.

In the current paper, the authors estimate the determinants and impacts of technological convergence using the industry panel data of Korea starting in the late 1990s, when Korea launched both its stabilization policy and structural adjustment process to overcome financial turmoil. Despite financial difficulties in the 1990s, Korea managed to invest heavily in ICT infrastructure to build a dynamic comparative advantage for the coming decades.[8] The success of such a policy mix was bound to be dependent on the broad, efficient diffusion of ICT throughout the economy.

This paper begins with an explanation of the concept of technological convergence and recent examples of ICT applications in the automobile and shipbuilding industries. These examples illustrate the important role of the network infrastructure in technological convergence. This paper then assesses the productivity growth across industries through growth accounting and finds that the capital deepening of ICT equipment and SW has positively impacted labor productivity in Korea. The spillover effect of ICT development is examined through its impact on TFP growth. The sensitivity analysis confirms that the TFP growth of industries that use ICT is favorably affected by technological convergence. In the final section, the authors present the concluding remarks and draw policy implications.

2. Technological convergence and infrastructure development

2.1. Technological convergence

Rosenberg (1963) once observed that existing machine tool techniques in the automobile industry adapt to the production of new products, and important features of the automobile manufacturing process itself are actually transferred and embodied

[2] See also Jorgenson, Ho, and Stiroh (2007) and Stiroh and Botsch (2007). For an earlier report on productivity estimation for the 1990s, see Oliner and Sichel (2000) and Stiroh (2002a).

[3] The slowdown in the ICT-producing industry in the 2000s was led by the burst of the dot-com bubble at the turn of the millennium.

[4] Henten, Samarajiva, and Melody (2003) and OECD (2003b) present a formal definition of ICT convergence. As a result of ICT convergence, many types of services (data, voice, and video) are offered over the same platform. Competition among the compatible platforms becomes intense, resulting in rapid expansion of the economy-wide information network. The concept of technological convergence, or a convergence between two different industrial technologies, was introduced much earlier Rosenberg (1963) and Lei (2000). The current paper later illustrates how it is mediated by ICT convergence.

[5] See Röller and Waverman (2002) for an earlier study on the importance of reaching a threshold level of telecommunication infrastructure in economic development.

[6] See OECD (2003a) for a list of leading countries in ICT development.

[7] See the report by the Ministry of Knowledge and Economy (2009), Republic of Korea.

[8] According to Young (1995), Krugman (1994), Kim and Lau (1994), and Sarel (1996), economic growth in developing countries in East Asia was mostly driven by the quantitative growth of inputs such as labor and physical capital in manufacturing industries until the 1980s. In the absence of technological accumulation, such quantitative growth inevitably faces a limit and becomes unsustainable. The financial crisis in the late 1990s revealed such a limit to quantitative growth in Korea. The hypothesis examined in this paper is whether Korea has benefitted from ICT in managing the successful transition toward technology-led growth.