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Information and communication technology and economic growth in India

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ABSTRACT

This paper examines the sources of economic growth in Indian economy since the 1980s, with particular focus on the role of information and communication technology (ICT). The impact of ICT on economic growth is analyzed via two main channels. The direct contribution of ICT investment to aggregate economy and manufacturing growth, and the indirect impact of ICT on Total Factor Productivity Growth (TFPG) in ICT using and ICT producing sectors. The results suggest an increasing role of ICT investment in driving aggregate economic growth in India, though largely limited to the service sector. Moreover, the economy has not been successful in spreading the ICT spillover effect across the board, thus limiting the productivity gain from ICT use. Whereas we see an improving productivity growth in ICT using market services and their contribution to aggregate productivity growth, the manufacturing sectors lags quite behind. Indeed, India's export oriented ICT sector has helped gain efficiency improvement in its fast growing service economy, while there is still large potential for ICT use in the manufacturing sector. The paper opens further avenues for improving the data on ICT investment, and also stresses the need for more detailed sectoral analysis of the impact of ICT on economic growth, treating computer related and software services separately.

1. Introduction

The role of Information and Communication Technology (ICT) in speeding up economic growth has been empirically established in the context of several mature economies (see for instance Inklaar, Timmer, & van Ark, 2008; Jorgenson, Ho, & Samuels, 2011; Jorgenson & Vu, 2011, 2013; Jorgenson, Ho, & Stiroh, 2005; Jorgenson, 2001; van Ark, Inklaar, & McGuckin, 2003).[1] Investment in ICT has helped firms reduce the cost of communication and coordination substantially and also to increase their efficiency and productivity by facilitating better organization of production. ICT investment, which consists of physical capital (hardware and communication equipment) and intangible capital (software), contributes to economic growth directly via improved productivity and growth of industries that produce ICT goods and services, and indirectly via improved quality of investment and productivity of industries that use ICT assets in their production (van Ark, Gupta, &

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[1] It is often argued that the productivity differences between the United States and the European countries observed during the mid-1990s is largely driven by the faster accumulation of ICT capital in the United States, particularly in the market services sector (van Ark et al., 2003).

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Erumban, 2011). [2] This supply-side productivity gain also nurtures increased welfare, in addition to any direct welfare effect that could be achieved by increased production of ICT. However, the role of ICT in improving productivity and growth, and thereby the standard of living in emerging economies is hardly explored. This paper is an attempt to quantify the impact of ICT use on productivity and economic growth in India.

Economic growth in India during the last decade[3] has bypassed any other country of the similar economic situation, except China.[4] The role of productivity in this growth surge has been examined by many studies in the past, primarily in the (formal) manufacturing sector (see Kathuria, Rajesh Raj, & Sen, 2014; Das & Kalita, 2011 for recent evidence). However, analysis of productivity dynamics in ICT sectors, and in particular the contribution of ICT investment to economic growth and productivity in India in general is hard to find.[5] Liberalization of the Indian economy in the early 1990s, to some extent conceded with the widespread ICT revolution, and the country has benefitted from this revolution, given its large English speaking pool, low unit labor cost and the availability of qualified engineers and programmers. Ever since the opening up of the economy in the 1990s, India has been a major player in ICT industry, in particular in the software segment. In addition to creating high value jobs for programmers, managers and analysts, software revolution in India has indeed helped introduce innovative entrepreneurship and governance models within the software industry (Arora & Athreye, 2002). Obviously, the improved governance and organization will be reflected in the efficiency of software sector, but is also expected to have impact on other sectors of the economy. In this paper, we examine the contribution of ICT to economic growth in India – both direct and indirect – using a growth accounting approach. The paper differs from previous research on productivity in India in that we use detailed industry level data to understand the growth process in India, with a focus on the role of ICT. More importantly, we use better measures of capital and labor inputs that take account of heterogeneity among different types of capital assets and different types of labor (also see Erumban, Das, & Aggarwal, 2012).

As mentioned before, the impact of ICT on economic growth can accrue via various channels – both direct and indirect (see van Ark et al., 2011). For instance, rapid technological change in the ICT producing sector has helped improve the productivity in the ICT producing sector. This phenomenon, particularly in the United States, has led to significant drop in the price of ICT goods.[6] This price decline, leading to the substitution of other forms of capital by ICT[7], has helped firms gain better efficiency in organizing their production (see Jorgenson, 2001). The benefit of this price decline obviously has also reached most emerging economies including India, helping them accelerate the speed of ICT adoption.[8] The benefit accrued to ICT using industries emanates from increased labor productivity due to increased contribution of ICT capital deepening, but also via spillover effect that ICT capital brings on improving total factor productivity (TFP). This spillover could happen in various forms, such as network externalities, organizational changes and lower transaction costs (van Ark et al., 2011). In this paper, the effect of ICT use in India's aggregate economy is examined via two channels. An investment effect, where the more intensive use of ICT is expected to improve the contribution of capital to output growth in ICT using sectors (and thereby reflect in the aggregate economic growth); and a spillover effect where the use of ICT is expected to enhance total factor productivity in ICT using sectors. However, at the sectoral level, we examine only the latter (productivity effect), due to lack of ICT investment data at industry level. ICT producing sectors, in addition to the rapid technological change, further benefit from the increasing demand for ICT goods, as it helps them expand production, thus resulting in an increase in their direct contribution to aggregate economic growth. We also examine this direct effect of ICT, or the production effect, by analyzing the productivity in ICT producing sectors and their contribution to aggregate productivity and output growth.

While in the early phases, the declining prices of ICT goods have resulted increased use of ICT primarily in the United States and several European countries (Van Ark et al., 2003; van Ark, O'Mahony, & Timmer, 2008), the adoption and diffusion rates were quite low in many emerging economiesHowever, this trend has been changing since the mid-2000s, during which many emerging economies also started going digitally. Yet, in general our understanding of the impact of ICT on aggregate economic performance in emerging economies is very limited, primarily due to lack of appropriate data. Exceptions to this are De Vries, Mulder, Dal Borgo, and Hofman (2010) in the case of Latin America and Jorgenson and Vu (2005, 2011, 2013) in a more global context. This lack of data poses an additional challenge of constructing a consistent series of ICT investment for Indian economy. This study also takes a careful approach to construct a consistent database on ICT investment in India, while still leaving substantial room for further improvement.

[2] While much of the focus in the literature is on ICT's effect on bringing economic growth, there have been some efforts to look into the employment effects of ICT use. For instance evidence suggests that the increased use of ICT in production has increased demand for skilled workers (Michaels, Natraj, & van Reenen, 2014; Autor, Katz, & Krueger, 1998).

[3] See Verma (2012), Kochhar, Kumar, Rajan, Subramanian, and Tokatlidis (2006), Panagariya (2008), and Rodrik and Subramanian (2005) among others, for analysis of economic growth in India in the context of market reforms.

[4] Though India has witnessed a drop in economic growth since 2010, it had an impressive growth record during the preceding decade. A number of factors have been blamed for the recent slowdown including inflation, decline in currency, large fiscal and current deficit, and lack of labor and product market reforms. A recent study establishes a strong negative relationship between inflation and growth in India (Mohaddes & Raissi, 2015)

[5] An exception is a series of global studies by Jorgenson and Vu (2005, 2011, 2013).

[6] Feenstra, Mandel, Reinsdorf, and Slaughter (2013) argues that approximately 20 percent of US productivity growth was due to gains in the terms of trade, particularly in the ICT sector.

[7] Erumban and Timmer (2012) provides evidence on how innovation can lead to faster replacement of capital, by accelerated scrapping of existing assets resulting in creative destruction.

[8] Adoption is a term usually referred to the choice to acquire and use a new technology; in this case, information and communication technology.