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Information and Communication Technology (ICT) and Singapore's economic growth

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ABSTRACT

Singapore's remarkable success in economic development has been strongly associated with the country's vigorous efforts to embrace the Information and Communication Technology (ICT) revolution to promote economic growth. This study provides a comprehensive investigation of the contributions of ICT to Singapore's economic growth during the 1990–2008 period. It documents three key findings. First, there is a strong positive association between the intensity of ICT use and value-added and labor productivity growth at the sector level. Second, ICT investment contributed approximately 1 percentage point to Singapore's GDP during 1990–2008, and its role in driving economic growth has become increasingly important over time. Third, the contribution of the ICT manufacturing sector to Singapore's growth was notable, but it was on the decline and faced difficult restructuring challenges. This paper also provides valuable policy lessons and strategic insights for governments in both developed and developing countries that aspire to embrace ICT to promote economic growth.

1. Introduction

Embracing global trends and proactively seizing opportunities brought about by emerging technologies has enabled Singapore to achieve outstanding economic performance since its independence in 1965. With its per capita GDP growing at an average rate of more than 6% per year in the past four and a half decades (1965–2010), Singapore has transformed itself from a third world country into a prosperous developed nation.[1] In achieving and sustaining this success, Information and Communication Technology (ICT) has been a top priority and strategic lever of Singapore's development strategy and policy. Examining the contributions of ICT to Singapore's growth provides valuable insights and policy implications for efforts to embrace ICT to promote economic growth.

There has been a rich literature examining the contributions of ICT to economic growth at the national level.[2] These studies, however, primarily focused on the US and European countries.[3] Initiated by the pioneering studies of Jorgenson and Stiroh (1995, 1999) and Oliner and Sichel (1994, 2000), a large volume of studies on this topic has emerged. Examples of such studies include Jorgenson (2001), Stiroh (2002), Oliner and Sichel (2003), Jorgenson et al. (2003a, 2008), and Martínez et al. (2010) on the US;

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[1] In 2010, Singapore's per capita GDP was PPP $56,694, ranking third among the 183 economies listed in the World Economic Outlook Database-September 2011 of the International Monetary Fund (available at http://www.imf.org/external/pubs/ft/weo/2011/02/weodata/index.aspx).

[2] Van Reenen et al. (2010) and Cardona et al. (2013) provided excellent surveys of the effects of ICT on economic and productivity growth.

[3] It is worth noting, however, that Jorgenson and Vu (2005, 2010, 2011) and Vu (2011a) provided a broad picture of the contribution of ICT investment to economic growth in more than 100 economies worldwide.

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Oulton (2002) and Correa (2006) on the UK; Jorgenson and Motohashi (2005) on Japan; Jalava and Pohjola (2002, 2007) on Finland; Atzeni and Carboni (2005) on Italy; Martínez et al. (2008) on Spain; Antonopoulos and Sakellaris (2009) on Greece; Colecchia and Schreyer (2001), Van Ark et al. (2002), Daveri (2002), and Timmer et al. (2003) on EU economies; Jorgenson (2003) on the G7 economies; and Dimelis and Papaioannou (2011) on industry-level comparisons between the EU and the US.

This paper examines the contributions of ICT to growth in Singapore, where ICT diffusion and production have been promoted with rigorous policy initiatives. Three factors motivate this study. First, Asia is a vibrant region for ICT diffusion and production, but research on the contributions of ICT to growth is scarce. Therefore, there is a need for studies on this topic in countries of the region, especially for those where high-quality data are available, such as Singapore. Second, Singapore has been highly proactive and effective in embracing ICT to foster economic growth. Examining the case of Singapore can provide a comprehensive understanding of the contributions of ICT to growth, which come from ICT use, ICT investment, and ICT production. Third, the fluctuation in the performance of Singapore's ICT manufacturing sector and its rapid structural change provide valuable policy insights into the challenges faced by the government in its efforts to promote this industry.

This paper examines ICT development and growth in Singapore since 1980, with a detailed analysis of the period between 1990 and 2008, for which data on ICT investment and production are available. It is also worth noting that the in-depth analysis of the period 1990–2008 also provides meaningful insights because 1990 marked a milestone in Singapore's economic growth process. In the period prior to 1990, Singapore's economic growth was characterized by the government's export-led efforts to promote quantitative growth through the rapid accumulation of capital. Since 1990, the government has shifted its strategic focus to qualitative development to transform Singapore into a developed nation.[4] Furthermore, the period 1990–2008 was also characterized by the accelerating pace of globalization, fueled by the end of the Cold War in 1991, the rise of China and India, and the rapid penetration of the ICT revolution across nations.

This paper primarily uses data compiled from Singapore's Department of Statistics (DOS), of which the data from the I–O tables for 1995, 2000, and 2005 are particularly valuable.[5] Additional sources of data include the Ministry of Trade and Industry (MTI), Monetary Authority of Singapore (MAS), World Bank's World Development Indicators (WDI), and the EU KLEMS Project.

The remainder of this paper proceeds as follows. Section 2 introduces Singapore's strategy and policy initiatives in its effort to embrace the ICT revolution to foster economic growth. Section 3 presents evidence on the associations between ICT use intensity and growth at the sector level. Section 4 estimates the contribution of ICT investment, among other sources, to Singapore's economic growth. Section 5 examines the contributions of the ICT manufacturing sector. Section 6 summarizes the findings and draws policy lessons.

2. Singapore and the ICT revolution

Singapore initiated its strategy to embrace the ICT revolution to promote economic growth and development in the early 1980s, as soon as the first generation of personal computers demonstrated its substantial potential. This endeavor has been concentrated on two fronts: fostering ICT adoption and promoting ICT production. Singapore's achievements in these efforts are remarkable. However, some critical challenges have also emerged. This section highlights these issues.

2.1. Fostering ICT adoption

The efforts of the Singaporean government to foster ICT adoption can be characterized by two prominent features. One is a proactive ICT strategy with a clear master plan for each stage of development, and the other is the government's pioneering role in developing e-government that leverages ICT to enhance its efficiency and effectiveness.

Singapore's journey over the past three decades has evolved according to six master plans that set out the main points of focus and priorities to support the country's ICT readiness and realize its ICT-enabled potential (Table 1). The first master plan, entitled "National Computerization Plan", was implemented from 1980 to 1985 and focused on ICT capacity building, including computerization and ICT manpower, and investment in the ICT industry. The second master plan ("National IT Plan", 1986–1991) aimed to enhance communications between government agencies and businesses by extending the government's ICT system into the private sector. The third master plan ("IT2000", 1992–1999) embraced the emergence of the Internet with a focus on connectivity and Internet-enabled services. The fourth master plan ("Infocomm 21", 2000–2003) emphasized convergence, fostering the penetration of ICT across economic sectors and in society at large. The fifth master plan ("Connected Singapore", 2003–2006) sought to unleash the potential of ICT to create value and increase capabilities. The sixth master plan ("iN2015", 2006–2015) aspired to embrace ICT for innovation, social and economic integration, and international collaboration. With its effective strategies and vigorous implementation initiatives in fostering ICT adoption, Singapore has become a leading country in ICT-readiness and e-government performance.

2.2. Promoting ICT production

Singapore has proactively promoted ICT production, especially the ICT manufacturing sector. With strong support from the government through its industrial policy, the industry has rapidly expanded since 1980. The

[4] Ministry of Trade and Industry, *The Strategic Economic Plan Towards a Developed Nation*, Report of the Economic Planning Committee, 1991.

[5] The DOS produces Singapore's I–O Tables every five years. The I–O Tables since 1995 provide information related to the sales and purchase of the ICT sector. The I–O Tables for 2010 have not been published.