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The Role of information communication technology policies in economic development: A Comparison of select Asian countries

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ABSTRACT

While the role of telecommunication networks historically, and today broadband and the Internet, have been theoretically linked to economic growth, the empirical results have been mixed, giving rise again to the "productivity paradox." Many governments, particularly those in Southeast Asia, have adopted aggressive policies to deploy broadband networks and to encourage the use of these applications. These, governments are motivated to promote broadband adoption in order to realize both economic and social benefits. This paper argues that countries (or territories), specifically, Korean, Singapore and Hong Kong have been able to realize these because of the comprehensive and aggressive policies pursued by these governments. There is some evidence to suggest that these governmental policies have been successful in achieving their stated goals.

Introduction

Despite the fact that currently, many countries around the world have modern telecommunications networks that support high speed broadband access to the home, broadband penetration rates still vary dramatically across these countries (Figure 1). A key factor explaining this difference in penetration rates are the government initiatives in the various countries, particularly in the more developed Asian economies, to establish national "information superhighways. In fact, the governments of South Korea, Chinese Taipei, Japan, Malaysia and Singapore, for example, have all launched "Version 6.0" of the National Information Infrastructure (NII) plan first deployed in the late 1980s (Pereira et. al., 2008; Pereira & Fife, 2010).

Governments develop national broadband networks for several reasons, including increasing productivity in the national economy, job creation as well as increasing the effectiveness of the health care system and education through tele-health and tele-education initiatives, respectively. Advanced telecommunication networks historically, and today broadband and the Internet, have been theoretically argued to enhance productivity by providing intelligent networks that can accommodate the converging voice, data and electronic commerce applications (Frieden, 2005). These infrastructures can provide a competitive advantage in the knowledge-based industries that include data processing, insurance, management, customer relationship management, and logistics and distribution. Such a competitive advantage in the area of information and telecommunications technology (ICT), when combined with a stable economy and favorable regulatory system, should translate to higher levels of Foreign Direct Investment (FDI). Indeed, endogenous growth theory argues that it is technology and human capital, when endogenously present, that contribute to continuous economic growth and therefore play an essential role in a country's development (Easterly, King, Levine, & Rebelo, 1994; Barro, 1997). Foreign direct investment (FDI) increases domestic capital formation, augments host country stocks of technology and managerial expertise, improves access to export markets, and provides a comparatively stable source of external financing (Matthews, 1999; Lehman, 2002).

The deployment of such networks, either directly through the use of tax dollars or indirectly by use of appropriate policies, such as spectrum allocation by fiat, thus would allow national governments to exploit the benefits of e-government This could encourage end-user adoption, by effectively lowering the usage cost of applications for the consumer, thus improving living standards and productivity enhancement. Specifically, tele-medicine would allow governments, particularly in developing countries

where “transactions costs are high because of logistical problems(Sein and Harindranath, 2004), to extend universal healthcare services to remote areas and provides, especially for developing countries, an economically viable means to increase the quality of medical services. Similarly, tele-education could provide governments with the means to increase the level of educational services to resource strapped inner-cities and the means to extend the learning experience to the homes.

This paper will review, briefly, the empirical literature on ICT infrastructure and economic growth, in general, and specifically on the role of ICT on economic in Singapore, Korea and Hong Kong. It will then examine the government policies of these countries in the past 30 years targeted specifically at building the ICT infrastructure and encouraging adoption. It will also analyze whether these government policies have been able to achieve their espoused economic, as well as social, objectives.

ICT and Growth

There has been a considerable amount of empirical work on the economic impact of telecommunications on growth. The methodologies that have been used vary on issues like data availability and different econometric specifications (Cardona et. al., 2013). The literature on the relationship between ICT adoption, and its predecessor, telecommunications networks, and economic growth spans some 40 years. While the theory of telecommunications infrastructure and ICT argues for a positive effect on a country’s GDP, over the decades, the empirical results have been mixed[1].

In one of the first studies, Hardy (1980), using a regressional study of some 60 countries found that of tele-density (telephone lines per capita), between 1960 and 1973, had a significant positive impact of on GDP per capita. Similarly, studies by Leff (1984), Cronin, Parker, Colleran, and Gold (1991), Norton, 1992, Madden & Savage (1998), Dutta, 2001; Lehr, Gillett, Osorio, and Sirbu (2006), Sridhar and Sridhar (2004), Duggal, Saltzman, and Klein (2007), Greenstein and McDevitt (2009) Seo, Lee, and Oh (2009),and Nadiri & Nandi (2011), Jorgenson et al. (2003a, 2008), and Martínez et al. (2010) statistically significant causal relationship between productivity growth and telecommunication infrastructure, including broadband in later studies, for countries at different levels of economic development. For example, Nour (2002) studied the impact of ICT expenditures on growth in 7 Middle East and North African (MENA) countries and found evidence of the expected positive effect of ICT investment on economic growth. Similarly, Datta and Agarwal (2004), studying the role of telecommunication

[1] Koutroupis (2009) and Cardona et. al. (2013) provide comprehensive reviews of the literature on ICT and growth

infrastructure on long-run economic growth for a sample of 22 OECD countries, find telecommunications is both statistically significant and positively correlated with growth in real GDP per capita growth for these countries. In this respect, Madden and Savage (1998) further argue that improving the chronic underinvestment in the telecommunications infrastructures of Central and Eastern European countries may ultimately improve the channel between aggregate investment and growth, economy-wide. In a more recent study, Vu (2011) analyzing the effect of ICT penetration on economic growth on a panel set covering 102 countries over the period 1996–2005, concludes that internet penetration has had an important marginal effect on growth.

However, Dewan and Kraemer (2000) using a sample of 36 countries over the period of 1985–1993 and find evidence for positive relationship between ICT and growth only for developed countries. They argue that is dichotomy can be explained by, among other factors, the lack of the right environmental conditions such as basic infrastructure, business practices, and appropriate government policies in developing countries. Similarly, Roller and Waverman (2001) find a strong causal relationship between telecommunications infrastructure and productivity, however, they indicate that this occurs only when telecommunications services reach a certain threshold, which is near universal levels, a finding that is also supported by Pohjola (2001). In this respect, Madden and Savage (2000) point to the absence of investment data for many developing countries and questions the practice of using main telephone lines to measure the stock of telecommunications capital since the accuracy of this proxy has not been subject to careful statistical scrutiny. However, using tele- density and the share of telecommunications investment in national income as telecommunications capital proxies, they find a positive cross-country relationship between telecommunications capital and economic growth. As their study illustrate, the measurement of the effect of telecommunication infrastructure and ICT is challenging for several reasons including the general challenge in measuring impacts of any kind, as demonstrating the impact of one factor on another can be difficult because a positive correlation cannot readily be attributed to a cause and-effect relationship (CEPAL, 2008B), and the nature of ICT itself, as an enabling technology, implies that its effects will be indirect. As such, the use and impacts of ICT are ubiquitous yet difficult to measure. It is not ICTs per se that have an effect on the economy and society but how they are used to transform organization, processes and behaviors. (OECD, 2007).

This paradox is also reflected in a study by Hassan (2005) who, using a panel data of 95 countries and 8 MENA countries between1980–2001 period, finds a positive effect of ICT infrastructure on growth

for the all countries sample, but not for the MENA countries. This finding is supported by Sassi and Goaid (2012) in a more recent study. Similarly, Lee, Gholami, and Tong (2005) focus on the causality effect between ICT investment and growth in 20 countries. They show that ICT investment boost growth only in developed countries while the causality is from growth to ICT investment in developing countries.

Fahadi, Ismail & Fooladi (2012), in examining the effect of ICT on growth for 159 countries over the period 2000 to 2009, find a positive relationship between growth rate of real GDP per capita and ICT use index (as measured by the number of internet users, fixed broadband internet subscribers and the number of mobile subscription per 100 inhabitants). They also find that the effect of ICT use on economic growth is higher in high income group rather than other groups, and conclude that countries seek to enhance their economic growth, they need to implement specific policies that facilitate ICT use.

Wong (2002) in comparing the subsample of Asian versus non-Asian countries, found that the Asian countries as a group exhibit a higher disparity in ICT diffusion, in fact wider than the disparities in their GDP per capita, than the non-Asian ones, after controlling for their level of economic development or competitiveness. In particular, the more advanced countries of the region (Japan and the four Asian NIEs -Singapore, South Korea, Hong Kong and Taiwan) have achieved, as a group, above-norm ICT diffusion intensities, while the six less developed Asian nations significantly under-perform relative to their level of economic development and competitiveness. More significantly, they find this disparity to be uniformly higher relative to the competitiveness index of these countries. Vu (2013) shows that Singapore's economic growth is attributable to its ICT policies.

Similarly, Kuppusamy, Pahlavani and Saleh (2008) show that ICT has had positive and significant long-run effect on the economic growth of Australia, Malaysia and Singapore between 1992 and 2006, and argue that this result is due to the government policies and strategic directions undertaken in Australia, Malaysia and Singapore aimed at increasing ICT diffusion and creating innovative business markets to produce new products and services. However, in the Philippines, Indonesia and Thailand, they find ICT did not contribute significantly to economic growth over the sample period in these countries, given that the ICT adoption rate was moderate or low and the rate of technology transfer in these economies was also low. Particularly for Indonesia, the results are not surprising, given that the country is heavily reliant on the agricultural sector.

While there may be some ambiguity in the causal effects of government ICT policies on economic growth, there is some indications that there is a high correlational relationship between broadband/Internet penetrations rates, foreign direct investment and growth, as shown in Figure 2.

Overview of Government Policies

SINGAPORE

The government of Singapore has been particularly aggressive in promoting the deployment of new technologies and broadband access, as manifested in several initiatives, which are discussed below. Singapore initiated its strategy to embrace the ICT revolution to promote economic growth and development in the early 1980s. 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, as shown in Table 1 that set out the main points of focus and priorities to support the country's ICT readiness and realize its ICT-enabled potential

Given Singapore's lack of natural resources, its government has pursued an international-oriented business focus for a number of years. One result of this plan is that the total production of U.S. MNC affiliates constituted some 13% of Singapore's Gross Domestic Product (GDP). Altogether, there over 7,000 MNCs located in Singapore (Lim, 2006).

The Singapore government has been most aggressive in promoting the deploying of new technologies and broadband access. Relatively high labor costs in Singapore, as shown in Table 2, coupled with a high employee turnover rates, particularly in the IT sector, manpower shortage and high overall cost of doing business in Singapore has been motivating the government (Lim and Teo, 2000).

One of the first two Singapore government initiatives was the deployment of TradeNet, and the Singapore ONE program. TradeNet, which facilitates trade documentation online, processes 99% of all trade permit declarations, and is used by over 2,400 companies. This service has reduced processing time from several days to five minutes. TradeNet Plus, a more complete and efficient version that

incorporates other online features, such as payment and insurance, is expected to further reduce processing time to between one and three minutes. Furthermore, it is estimated that this generates annual savings of some S$2.8 billion (Shih, 1999, p.2).

The Singapore ONE (One Network for Everyone) program, is a high-speed optical fiber network that manifests the government's IT2000 master-plan, a blue-print to deploy IT in almost every government department with the end goal of transforming the state into an "intelligent island" (Economist, 2000). The IT2000 master-plan was designed to allow all of Singapore's over 800,000 households to connect to a hybrid-fiber co-axial network, irrespective of whether they intended to subscribe to the various services (Cable and Satellite Asia, 1997). In this respect, the Singapore government's eCitizen Center, an integrated service delivery system, was designed to ensure that the public sector operated, and was seen to operate, as a single entity. This particular project is aimed at bringing together useful services and delivering them to Singaporeans in convenient and easily accessible packages.

A third government initiative seeks to raise the percentage of small and medium-sized enterprises (SMEs) conducting e-commerce to twenty-five percent within three years' time. According to a survey conducted late in 1999 by the Singapore IT Federation, while 91 per cent of the top 1,000 companies already had Internet access, only 4 per cent of the 92,000 SMEs were conducting e-commerce (Raj, 2000, p.7). Sixty-six per cent of SMEs with sales below $1 million cited lack of in-house IT skills and infrastructure, inadequate knowledge of e-commerce, and low budgets as barriers to implementing e-commerce (Koh, 2000, p.14). As such, the Economic Development Board (EDB) provided assistance up to 50 per cent to support their external consultants' costs in formulating a business plan or business collaboration venture, conducting feasibility studies, or providing assistance in implementation, up to a maximum limit of S$250,000 (Lee, 2000, p.71). The government also deployed a three-year, $11.7 million plan to prod the city's growing logistics industry into doing more with the Internet.

The Singapore government's GeBIZ initative was attempt to create a one-stop, round-the-clock centre for the government's business dealings. The first phase was launched in April 2000. GeBIZ enables the financial systems of ministries and the procurement applications to work together. Trading partners can find invitations to tender and purchase orders on the site. Suppliers can also submit invoices, check payment status, post their catalogues and bid for contracts. Currently, purchases are

capped at S$30,000 (US$17,341), but the Ministry of Finance estimates that once new payment and security systems are introduced, 80% of all government procurement will transfer to GeBIZ.

In June 2006, the Singapore government launched its latest 10 year masterplan, dubbed iN2015 (Intelligent Nation 2015). Designed to run through 2015, the objectives were to i) establish an ultra-high speed, pervasive, intelligent and trusted infocomm infrastructure; ii) develop a globally competitive infocomm industry; iii) develop an infocomm-savvy workforce and globally competitive infocomm manpower; iv) To spearhead the transformation of key economic sectors, government and society through more sophisticated and innovative use of infocomm[2].

It was hoped that through this plan, the lives of the citizens would be enriched and that Singapore's economic competitiveness would be enhanced, and there would be increased innovation and growth(IDA, 2006): In this respect, the Singapore government also established benchmarks to allow it to gauge if it was achieving its goal: to establish Singapore as first in the world in harnessing ICT to add value to the economy; a two-fold increase in value-added of the ICT industry to S$26 billion; a three-fold increase in ICT export revenue to S$60 billion; the creation 80,000 additional jobs; a 90 per cent rate of home usage for broadband; and the achievement of 100 per cent computer ownership for all homes with school-going children (Business Wire, 2006). Table 3 suggests that the government has been successful to some extent in achieving its goal. The government accomplished these goals through programs and initiatives that included for example, the CXO program, which facilitated strategic discourses among key decision makers, CEOs, CIOs and CFOs and the iEnterprise Challenge Program which focused on developing innovative products and solutions as reference projects, which has had a strong impact across various sectors, while simultaneously creating new intellectual property (Lim, 2006). Similarly, Figures 3 and 4 illustrates some success in the government's goal of increasing the size of the IT sector in Singapore and stimulating IT exports.

KOREA

Like Singapore, the Korean Government has taken a strongly proactive approach to promoting an information society for all of its people, businesses and industries. In all of its endeavors, the government's overarching objective has been to utilize ICT to enhance the quality of life in Korea.

[2] InforComm Development Authority, Singapore. Master Plan.

By many account, Korea has developed an extensive broadband and Internet network, and has become one of the leading countries in ICT development (OECD, 2003). 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 of the late 1990s, the leading export industries such as automobile, chemicals, semiconductors and mobile hand set equipment, have greatly strengthened their international competitiveness in the past decade (Jung et. al., 2013). The Korean government recently began to acknowledge the importance of ICT diffusion and technological convergence. The government announced the so-called Future Strategy for 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. 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.

The Korean Government's approach to promoting ICT in general and the broadband market in particular, has been to formulate strategic development frameworks through the use consecutive Informatization Master plans which run over a number of years. Through each framework, the Government has outlined broad policy objectives, and has laid out a number of supply and demand-side supporting policies, including for example:

- plans for public investment in broadband infrastructure and incentives for private investment;
- initiatives to aggregate and expand demand for broadband services;
- policies to promote universal access to broadband; and
- various supporting industrial policies.

The Government has also implemented an Informatization Promotion Fund to finance projects which foster the use of information. The fund includes contributions from both the Government and the private sector, through spectrum licensing fees, revenue-based contributions from operators and earnings from the operation of the fund, including loans. Between 1993 and 2002, the total value of the Informatization Promotion Fund was $7.8 billion US, of which almost half came from the private sector

Korea's focus on promoting information and communication technologies began in the mid-1990s, with the establishment of the Ministry of Information and Communication (MIC) in 1994, and the announcement of its overall broadband strategy, the Korea Information Infrastructure (KII) in 1995. Korea's broadband market is currently an open market, free of regulation and controls over licensing and pricing. The incumbent telecom provider, Korea Telecom, has been completely privatized as of May 2002 (Lee, 2002).

One aim of the KII initiative was to stimulate private sector investment and competition in the broadband market, by lowering the regulatory barriers to entry. A second aspect of the initiative was for the Government to provide a high-speed network that would serve as a public backbone, providing broadband services to 30,000 government and non-profit organizations, as well as to research institutes, and to around 10,000 schools (Lee, 2002). The government has achieved its ambitious goal of providing provide high-speed internet to every household in Korea.

The Korean Government is continually revising its strategies, due in part to rapid changes in technological innovation and market demands (Lee and Chan-Olmsted, 2004), and putting forth new initiatives in its wide-ranging telecommunications efforts. In December of 2002, Korea announced its e-Korea Vision 2006 plan. This initiative, with a focus on improving the quality of Korean citizens' lives, had five objectives (NIA, 2008).

- *"Efficient Knowledge Government" to Serve the People"*

The first was to maximize the opportunity for and ability of all Korean citizens to utilize the information society and communication technologies in order to actively participate in the information society. The government provided increased opportunities for Internet access for all, and by establishing a lifelong education system available through online learning .The objective was to establish an intelligent administrative procedures by providing one-stop customized services, such as birth registration, sharing administrative information and providing public information in a much larger scale so as to achieve a creative and efficient government (e-Korea Vision 2006, 2002).

- *"People Prospering Through Digitalization" to support a Facilitated Market Economy*

The second objective was to strengthen the country's level of global economic competitiveness by promoting "informatization" within all Korean industries. This objective also had an environmental component: the use and application of ICT will enable improvements in the ecological system and ensure the conservation of a clean and natural environment by strengthening environmental policy functions, while its use in the realm of transportation will relieve traffic problems and reduce logistics costs (e-Korea, 2002).

- "Trusted Information Society" to Actively Support Welfare System

The third objective was to realize a more efficient and transparent government structure through "informatization," by offering more online public services in the areas of education, culture, and social welfare.

- "Creative Soft-Power" to become A Brain Power Nation

The Ministry's fourth objective was to facilitate continued economic growth by promoting the IT industry in general, and both core and new technologies in particular. The government achieved this through the building of a value-creating knowledge infrastructure that would serve as a nation-wide base for utilizing knowledge.

- "Cutting-edge Infrastructure for Digital Convergence" to Become a Mature Country

The goal was to become a leader in regional technological cooperation, by establishing a system that promotes ICT collaboration within the Asia-Pacific region (e-Korea, 2002).

In 2004, the MIC developed the IT 839 Strategy, with overarching economic goal, among others to see Korean GDP per capita grow to US $20,000. The exploitation and utilization of ICT was and is seen as crucial to increasing GDP growth (Ministry of Information, Republic of Korea, 2004). The IT 839 strategy also seeks to establish and promote new and cutting-edge technologies, including a Broadband Convergence Network, Internet Protocol version 6, and new services, such as WiBro, Digital Multimedia Broadcasting, Home Network Service, Telematics Service, and Internet Telephony (VoIP). These services,

available over a converged network, will ensure Internet access at any time in any place (Ministry of Information, 2004).

The importance of foreign direct investment in the Korean economy can be seen in the table below. With policy reforms to allow increased foreign participation in the Korean economy, including the purchase of troubled corporations, the value of FDI between 1997 and 2000 quadrupled and share increased from 2% of business financing to 13%. In 1998, FDI was equal to some 14.8% of Total Gross Domestic Investment in the Korean economy. Though there has been some fluctuation in investment levels over recent years, 2004 data show a strong resurgence in foreign interest in Korea's economy. In addition to the MIC's overall policy plans, the Korean government has launched a number of specific broadband-related initiatives, many of them with an eye to bridging the digital divide. Among these has been the Public Fund Program, wherein the government provided low-interest loans to providers to ease the financial burden of bringing access networks to small and medium sized cities.

An additional initiative the government has taken to close the digital divide was to provide 3,000 free internet access points in public places, such as post offices and community centers. The government has also provided PCs and Internet infrastructure to schools. Further, within the context of its "Plan for Promoting ICT Use and Distributing PCs to Children of Low Income Families," the government provides discounted ICT access and a PC to those who otherwise could not afford it (ITU, 2003). Figure 5 suggest some success in the Korean government's policy in encouraging

Further, the government has launched IT literacy programs, targeted at social groups that traditionally did not have access to computers or the Internet, such as housewives, the elderly, and prisoners. More than eight million people were trained between 2000 and 2002. The government has also started offering high school education programs that are broadcast over the Internet, increasing the demand for PCs and Internet connectivity in family homes (ITU, 2003).

Beyond government initiatives, Korean culture has played a large role in determining ICT adoption. Some cultural characteristics prevalent in Korea include a high valuation placed on family relationships, social advancement, (as well as on social status in general,) and on learning and education (Davies, 2006). These cultural values promote hard work and personal development, and education is seen as a key means for achieving economic and social success. Another cultural characteristic at play is

the “copycat syndrome” or “keeping up with the Joneses,” by which if one household subscribes to broadband Internet service, other households in the neighborhood will subscribe to an equal or superior service in order to maintain their social standing (Davies, 2006). Both of these social characteristics have promoted the adoption of ICT within the Korean society.

In terms of the benefits of ICT, however, as mentioned above, one of the government’s key objectives is to ensure that ICT will make a significant difference in the daily lives of its citizens. To this end, the government has implemented numerous ICT-oriented public services, such as e-Health, eTransport, eLearning, with positive results (Davies, 2006, p.8). The government’s promotion of ICT development is also expected to stimulate job creation.

South Korea, already one of the most wired countries on Earth, has announced a 1.6 trillion won ($1.7 billion) plan to roll out a next-generation 5G wireless service fast enough to download full-length films in a second. The science ministry said it aims to implement the technology within six years.

In 2007, the Korean government launched the U-Korea Master Plan, designed in part to build the “World’s Best Digital Government inside the People (Ministry of Government Administration and Home Affairs, 2007). The vision consists of five strategies and four specific tasks that will realize four goals: customer-centric customized citizen services, system-based government innovation, preventative system for a safer society, and sustainable advancement of e-government, as shown in Table 5 .

HONG KONG, SAR

Hong Kong’s Special Administrative Region (SAR) has one of the world’s most sophisticated and advanced telecommunications networks, which is crucial for Hong Kong to maintain its status as a leading business, financial and industrial center. Sizeable investments in communications technology have made the telecom market in Hong Kong highly efficient and cost effective for the manufacturing industry. An advanced network, together with a wide range of professional and high value-added manufacturing support services, ample supply of skilled and low-cost workers from China and other Asian-Pacific countries, all coupled with the cross-border production competence of Hong Kong companies, has positioned Hong Kong as a control center in global production and sourcing (Chan et al., 2000, p.288).

Hong Kong boasts what is widely considered the world's freest economy, as well as a highly skilled workforce fluent in English, the lingua franca of the business, legal and technology industries. The government of Hong Kong has been one of the leading investors in its IT sector through its resource allocation, e-government program, its implementation of information systems and procurement arrangements, as well as through administrative adoption. The government's investment in this industry has averaged HK$ 4.6 billion per year (Digital 21 Strategy, 2004).

The city launched its bid to privatize and de-monopolize local and long-distance telephone services in 1995 and 1998, respectively. By 2001, all telecom services and infrastructures were liberalized, which resulted in wider choices and a higher quality of services at more competitive prices. Today, Hong Kong has one of the most advanced and competitive telecom markets in the world, with six major mobile operators competing to serve Hong Kong's market, none of them dominating (Xu, 2006). In fact, with a penetration level of 123 mobile phones per 100 inhabitants, it may not be an exaggeration to claim that Hong Kong has the highest level of telecom competition as well as adoption of mobile technology, in the world (Xu, 2006).

The government's policies and the drive toward market liberalization created a great deal of pressure for innovation. As a result, Hong Kong's former telecom monopolist became the first provider in the world to launch Interactive Television (Video-On-Demand) service commercially in 1998, and was also the first to offer Internet Provider Television (IPTV) service. In 2006, they launched a mobile real-time TV broadcasting service as well (Yan, 2006). The people of Hong Kong have benefited in numerous ways from the government's promotion of competitive policies: Hong Kong was the world's first city to fully digitize its telecommunications networks. It was also the first economy in the world to incorporate fixed-line number portability, and third in the world with fixed-line mobile number portability.

Against this background, the government's first Digital 21 IT Strategy was published in 1998. It was revised and updated in 2001, and then again in 2004. The plan is a comprehensive strategy to bring Hong Kong into the 21st Century as a global leader in e-business, new technologies, and the information economy. The government's vision is that it should be an effective facilitator to promote innovation and the development of industry, as well as to ensure that the entire community will benefit from IT development, by taking measures to bridge the digital divide. Two flagship programs of the Government's Digital 21 Plan are the Cyberport and the Science and Technology Park. Both of these

industrial clusters provide high technology-focused valued-added to Hong Kong's overall economy, with the larger concept of attracting leading IT companies and a critical mass of professional talent into Hong Kong.

The Cyberport is a high-technology multimedia hub designed to attract the research and development sectors of major high-tech companies. The Cyberport's Phase 1 occupancy rate has already reached 80 percent, attracting such big name tenants as Microsoft, and GE Information Services. The Cyberport is designed to be more than a workplace, as it incorporates both a world class living and working environment, and attracts businesses from many industries, including entertainment, communications, advertising, sales, trading, and finance (MAIT, 2005).

The Science and Technology Park focuses on four sectors: ICT, electronics, biotechnology and precision engineering. It is equipped with broadband networking and wireless LAN, laboratories and support centers.

Hong Kong's economy benefits from its status as a major global financial services center as well as a trade, commerce, transportation and logistics hub. All of the sectors comprising these industries are major users of IT, which has helped provide the impetus for Hong Kong to be at the forefront of the IT development and innovation, as well as for the government to facilitate and augment this process. Hong Kong SAR's banking sector is the second largest in Asia, after Japan, and in terms of total bank assets to GDP it is only matched by Singapore.

The Cyberport high-tech zone project is widely considered to have failed to fulfill its potential. However, the government is hoping to turn around performance by providing additional financing. Cyberport's Strategic Plan for 2014-2017 announced the plan to inject HKD200mn to support ICT industry development, up from HKD121mn 2010-2013. Cyberport, owned by the Hong Kong SAR Government, supports the ICT industry as a regional hub and promoting collaboration between startups, as well as providing seed funding through its incubation program. By the end of 2013, more than 180 companies and 5,000 professionals worked in the Cyberport Park (Business Monitor, 2014)

Hong Kong's trade and financial community is extremely "IT oriented." The Hong Kong Trade Development Council (HKTDC) promotes Hong Kong's goods and services by serving as an information

broker and matchmaker among traders, exporters, manufacturers, buyers, and service providers. With the advent of the World Wide Web, the HKTDC introduced a host of electronic advertising and publishing activities to take advantage of the Web's instantaneous, low-cost information distribution to a wide on-line audience.

Besides using the Internet for web browsing, there is an increasing trend by Hong Kong corporations to use the Internet as the backbone to develop intranets for mission critical applications, including dynamic access to data bases, and functional applications such as purchasing, trading, and inventory control. The rapid growth of the Internet and intranets is generating rapid expansion in LANs (IMF, 2002). Hong Kong has a high level of LAN penetration - approximately 70% of all corporations.

Hong Kong's economy has witnessed remarkable growth in FDI inflows over the past few decades. Global FDI inflows rose substantially in 2005, up 29% from 2004, as Hong Kong maintained is number two position (behind China) as East Asia's leading regional FDI target.

Hong Kong's culture is characterized by industriousness, and by individuals who desire to better themselves (MAIT, 2005). As was mentioned in Korea's case above, such characteristics may promote the adoption and acceptance of new technologies, as these are seen as methods for increasing efficiency, tools for learning, and as an opportunity to show that one owns and knows how to use the latest device. A great proportion of Hong Kong's population has realized the benefits of the government's pro-technology efforts. Broadband is now available to over 95 percent of households and to more than 98 percent of business buildings. The PC penetration rates in 2006 stood at 71 percent for households and 88 percent for businesses, while internet penetration rates held at 65 percent for households and 83 percent for businesses (CEPAL, 2008). The mobile penetration rate of 123 percent was mentioned above, while 70 percent of Internet users had used e-government services.

Despite this level of technological progress, the government still acknowledges that it must go further in order to bridge the digital divide within its borders. In order to ensure that the entire community will benefit from IT development, the government has begun collaborating with both industry and NGOs in order to introduce a wide range of measures to further enhance residents' quality of life.

The “IT Honk Kong” campaign was designed as a result, to promote IT adoption in the greater community. It consists of free courses providing IT training, free talks in libraries, district promotional activities and infotainment programs for citizens. Other initiatives include providing public computers with Internet access at convenient locations, computer recycling for the needy, financial assistance to people with disabilities for the purchase of computer facilities to enable working from home, and the installation of devices in public computers so that they may be accessed by the blind and visually impaired (Digital 21 Strategy, 2004).

Effectiveness of Government Policies

Singapore

A recent survey of businesses (IDA, 2013) illustrates the effectiveness of the government’s policy in spurring ICT adoption in businesses, particularly in SMEs over the past decade, or so, as shown in Figure 6 and 7. The effects of the Singapore government’s policies is also illustrated n in Table 8 and 9 which show Singapore consistently ranking in the top 5 positions in global information technology adoption and global competitiveness. This is also true for Hong Kong and Korea, which consistently rank in the top 10 positions.

Korea

The Korean government’s overarching ICT objective: to create an information society, has been marked by its strong and continually renewed commitment. The results have been remarkable: one decade after the announcement and implementation of its initial ICT plan, the country now ranks at or near the top of almost any global-level survey measuring broadband use, uptake, or readiness, or of ICT penetration and e-Government, as shown in Tables 8 and 9.

To the extent that one of the stated goals of the NII initiatives of the governments of Singapore, Korea and Hong Kong were to increase FDI in their respective economies, then there is some evidence that they have been successful, as shown in Tables 10 and 11. In fact, generally, the investment flows to many of the East Asian economies have been directed at creating export-oriented industries (Fan and Dickie, 2000). As Table 10 illustrates, the role of FDI in the economies of Hong Kong and Singapore are

extremely significant, and the FDI stock as a percentage of the GDP of these countries are much higher than most other countries.

Conclusions

Over the past three decades, the empirical literature on ICT infrastructure deployment and its effect on economic growth tends to highlight the paradox between growth and ICT deployment; for some countries ICT deployment has led to growth, while in others, particularly developing countries, it has not. While measurement and variable definition issues could account for this ambiguity in results, the empirical results also show that there has been a positive effect of ICT investment and growth for the Newly Industrialized Countries (NIE), specifically Korea, Hong Kong, and Singapore. These governments have deployed high-speed networks largely for clear economic reasons: to encourage foreign direct investment and to realize multiple benefits from transforming their economies to technological, information-based ones. This paper has examined the ICT-related policies implemented in these countries and has shown these countries have been successful in achieving economic growth by establishing comprehensive and deliberate policies national policies, which included establishment of clear objectives and benchmarks. Furthermore, to encourage adoption of IT applications and services, these government policies included financial grants and incentives, available to both business and residents.

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Table 1
Singapore's ICT Strategy and Policy Initiatives 1980-2015[3]

Period	Name	Priorities/Program	E-government Initiatives
1980-1985	National Computerization Plan	Computerizing civil service	Civil service computerization program
1986-1991	National IT Plan	Extending government systems to private sector, eg. Tradnet	
1992-1999	IT2000	Transforming Singapore into an intelligent island	
2002-2003	Infocomm 21	Developing Singapore as a global Infocomm Capital, e-Economy and e-Society	E-government Action Plan
2003-2006	Connected Singapore	Unleashing potential of Infocomm to create new values, realize possibilities and enrich lives	E-government Action Plan II
2006-2015	iN2015 Intelligent Nation	Leveraging Infocomm for Innovation, integration and Internationalization	igov2010 egov2015

[3] Vu (2013).

TABLE 2
Indexes of Hourly compensation for Production Costs In Manufacturing for Select Countries[4]

	1990	2000	2005	2006	2007	2008	2009
United States	100	100.00	100.00	100.00	100.00	100.00	100.00
Canada	111	75.86	90.15	97.42	101.29	101.46	88.26
Japan	85	102.89	85.95	81.10	76.07	86.25	90.55
Korea, South	25	39.75	50.87	58.53	61.63	50.47	42.35
Mexico	11	18.16	18.04	18.65	18.64	18.98	16.05
Hong Kong	22	28.00	24.00	n.a.	n.a.	n.a.	n.a.
Portugal	24	23.77	31.47	32.48	34.67	37.97	35.62
Singapore	25	47.57	44.56	45.92	49.85	58.49	52.18
Taiwan	26	29.65	26.67	26.86	25.96	26.94	23.13

[4] U.S. Bureau of Census, Statistical Abstract of the United States 2012, Washington, D.C. U.S.A., 2014.

Table 3[5]
Residential ICT Statistics, Singapore.

Percentage of Households	2003	2010	2011	2012	2013
Access to 1 Computer at Home	51%	32%	31%	25%	21%
Access to 2 or More Computers at Home	23%	52%	55%	60%	66%
Households with Access to Internet	65%	82%	85%	84%	87%
Households with Broadband	40%	82%	85%	84%	87%

[5] InfoComm Development Authority, Singapore (2013). Annual Survey for the InfoComm Industry, 2013." IDA, Singapore

Table 4
National Information Infrastructure Master -Plans 1996-2015

Year	Initiative
1996 - 2000	First National Informatization Promotion Plan
1999 - 2002	Cyber Korea 21
2002 - 2006	e-Korea Vision 2006
2003 - 2007	Broadband IT Korea Vision 2007
2006 – 2015 2006 – 2010 2011 - 2015	U-Korea Master Plan Phase 1 Phase 2

Table 5
U-Korea Master Plan

4Goals	9 Agendas
1) Offer Customer-Centric Customized Citizen Services by integrating services with focus on citizens and businesses	1.Integration of Services Delivery System enabling easier public access 2. Integration of Business Information Services for enhanced corporate Competitiveness
2) Accelerate System-based Government Innovation by building intelligent administration service system	3. Digital Government Network for facilitating multiagency collaboration 4. Transparent Policy Decision Making Systems and enhanced sharing of administrative information
3) Enhance Preventative System for a Safer Society by delivering real-time information network for public safety	5. Enhanced National Defense and Safety Management Systems 6. Intelligent Public Order Management System
4) Lay Groundwork for Sustainable Advancement of e-Government by enhancing infrastructure for e-Government	7. Stronger Information Security and Privacy Protection for enhanced public trust in e-Government 8. Universal e-Government Services 9. Enhanced Sharing of Information Resources for stronger e-Government infrastructure

Table 6
Global Information Technology Report Ranking[6]

Rank	2007	2008	2009	2010	2011	2012	2013	2014
1	Denmark	Denmark	Denmark	Sweden	Sweden	Sweden	Finland	Finland
2	Sweden	Sweden	Sweden	**Singapore**	**Singapore**	**Singapore**	**Singapore**	**Singapore**
3	**Singapore**	Switzerland	US	Denmark	Finland	Finland	Sweden	Sweden
4	Finland	US	**Singapore**	Switzerland	Switzerland	Denmark	Netherlands	Netherlands
5	Switzerland	**Singapore**	Switzerland	US	US	Switzerland	Norway	Norway
6	Netherlands	Finland	Finland	Finland	Taiwan, China	Netherlands	Switzerland	Switzerland
7	US	Netherlands	Iceland	Canada	Denmark	Norway	UK	US
8	Iceland	Iceland	Norway	Hong Kong	Canada	US	Denmark	Hong Kong
9	UK	S. Korea	Netherlands	Netherlands	Norway	Canada	US	UK
10	Norway	Norway	Canada	Norway	S. Korea	UK	Taiwan, China	S. Korea

[6] World Economic Forum (2014). Global Information Technology Report, 2014.

Table 7
Global Competitiveness Index Ranking[7]

Rank	2008	2009	2010	2011	2012	2013	2014
1	US	Switzerland	Switzerland	Switzerland	Switzerland	Switzerland	Switzerland
2	Switzerland	US	Sweden	**Singapore**	**Singapore**	**Singapore**	**Singapore**
3	Denmark	**Singapore**	**Singapore**	Sweden	Finland	Finland	US
4	Sweden	Sweden	US	Finland	Sweden	Germany	Finland
5	**Singapore**	Denmark	Germany	US	Netherlands	US	Germany
6	Finland	Finland	Japan	Germany	Germany	Sweden	Japan
7	Germany	Germany	Finland	Netherlands	US	Hong Kong	Hong Kong
8	Netherlands	Japan	Netherlands	Denmark	UK	Netherlands	Netherlands
9	Japan	Canada	Denmark	Japan	Hong Kong	Japan	UK
10	Canada	Netherlands	Canada	UK	Japan	UK	Sweden

[7] World Economic Forum, (2014). Global Competitiveness Index Ranking.

TABLE 8[8]

Global Award for E-Government Systems in Korea

System	Ministry	Awarding Body	Award	Year
UNI-PASS	Korea Customs Service	UN	Best Practice in Anti-Corruption Forum	2001
		WCO	WCO Trophy for Intellectual Property Protection	2006
KONEPS	Public Procurement Service	UN	Public Service Award	2003
		OECD	Best Practice for Improving Transparency	2004
		WCIT	Global IT Excellence Award	2006
Home Tax Service	National Tax Service	OECD	Best Practice for e-Tax Administration	2006
e-People	Ministry of Public Administration and Security	World e-Government Forum	Top 10	2006

[8] National Information Agency, Korea (2008) Informatization White Paper, National Information Agency, Korea 2008

Table 9
E-government leaders in Asia[9]

		E-gov. development index		World e-gov. development ranking	
Rank	Country	2012	2010	2012	2010
1	Republic of Korea	0.9283	0.8785	1	1
2	Singapore	0.8474	0.7476	10	11
3	Israel	0.8100	0.6552	16	26
4	Japan	0.8019	0.7152	18	17
5	United Arab Emirates	0.7344	0.5349	28	49
6	Bahrain	0.6946	0.7363	36	13
7	Kazakhstan	0.6844	0.5578	38	46
8	Malaysia	0.6703	0.6101	40	32
9	Saudi Arabia	0.6658	0.5142	41	58
10	Cyprus	0.6508	0.5705	45	42

Rank	Country	E-government development index
1	Republic of Korea	0.9283
2	Netherlands	0.9125
3	United Kingdom	0.8960
4	Denmark	0.8889
5	United States	0.8687
6	France	0.8635
7	Sweden	0.8599
8	Norway	0.8593
9	Finland	0.8505
10	Singapore	0.8474

[9] United Nations, (2012). E-Government Survey, United Nations, New York.

TABLE 10[10]
Inward FDI Stock s Percentage of Gross Domestic Product

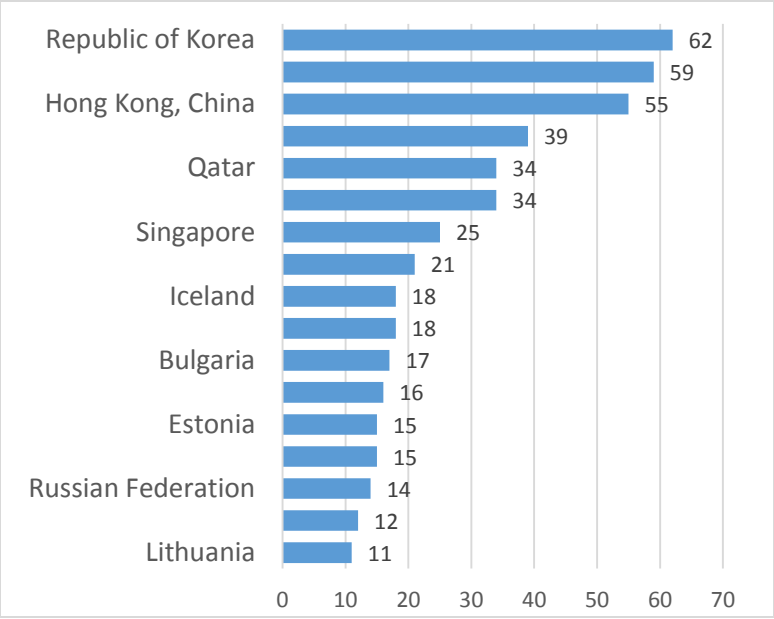
Region/Economy	1990	2000	2007	2008	2009	2010	2011	2012	2013
Hong Kong, China	262.3	286.6	579.8	398.3	464.4	508.4	476.2	515.0	548.5
Korea, Republic of	1.9	8.2	11.6	10.2	14.5	13.2	12.0	13.8	13.7
Taiwan Province of China	5.9	6.3	12.2	11.8	14.3	14.1	12.2	12.4	13.0
Indonesia	6.9	15.1	18.5	14.2	20.2	22.7	21.8	24.1	26.5
Malaysia	21.7	54.1	39.1	31.9	39.1	41.1	39.8	43.4	46.3
Myanmar	5.4	44.1	33.4	26.3	24.2	21.1	17.5	20.0	25.1
Philippines	6.7	17.0	13.7	12.5	13.6	13.0	11.4	11.5	12.0
Singapore	78.5	117.2	236.6	238.7	266.4	268.7	253.4	288.1	283.2
Thailand	9.3	24.7	36.9	33.3	39.3	42.2	43.7	48.1	47.9
Canada	19.4	28.8	35.6	29.1	40.0	36.7	33.2	34.6	35.3
European Union	10.5	27.6	44.4	36.5	45.5	44.7	42.3	48.1	49.4
South America	10.6	23.1	26.0	21.4	27.2	30.5	28.6	31.9	32.5
South-East Europe	..	14.6	34.6	36.4	45.1	51.7	50.3	58.5	61.9
South-East Asia	16.8	41.9	55.7	50.4	58.0	59.3	56.3	62.1	64.4
Asia	15.0	25.9	30.0	23.3	27.5	27.9	25.1	26.8	26.9

[10] UNCTAD 2014. World Investment Report, 2014. United Nations, Geneva 2014.

Table 11
Exports as percentage of GDP (in constant 1980 dollars)

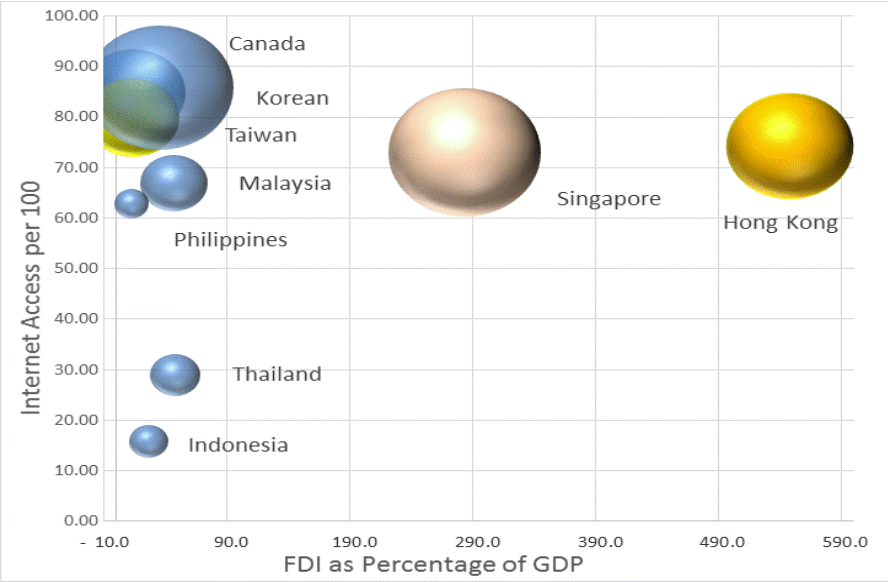
Country	**1980**	**1990**	**2000**	**2010**	**2011**	**2012**	**2013**
Australia	16.42	15.12	19.42	19.45	21.14	21.24	19.84
Brunei Darussalam	93.36	61.81	67.35	81.44	79.66	81.37	76.16
Hong Kong SAR	88.93	130.66	141.76	219.41	225.45	225.56	229.59
Japan	13.42	10.29	10.88	15.17	15.13	14.73	
Malaysia	56.69	74.47	119.81	93.32	91.61	87.14	81.87
Korea, Republic	30.19	25.89	35.01	49.42	55.75	56.34	53.92
Portugal	21.77	29.60	28.93	31.30	35.68	38.69	40.64
Singapore	202.05	177.15	189.18	199.26	200.19	195.08	190.52
Thailand	24.11	34.13	66.78	71.29	76.94	74.98	73.57
East Asia & Pacific (developing only)		20.28	33.17	35.20	35.00	33.51	31.49
East Asia & Pacific (all income levels)	23.99	20.60	26.36	32.55	33.29	32.54	

FIGURE 1[11]
Economies with more than 10% Broadband Penetration of Fiber to the Home/Building plus Local Area Networks, 2012 (in percentages)



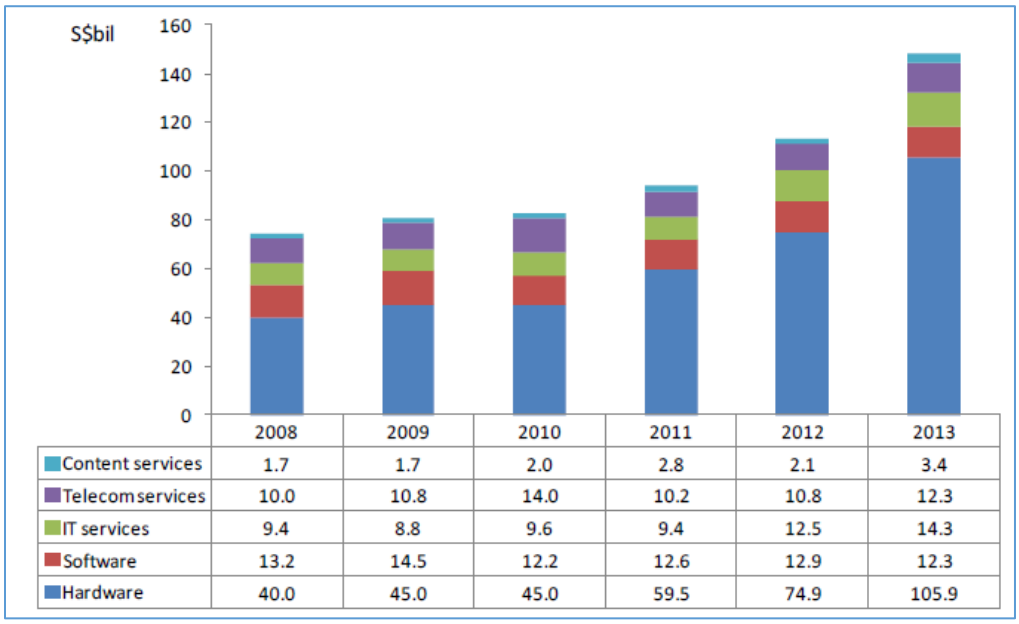
[11] UNCTAD 2013, Information Economy Report, 2013.

Figure 2
Internet Penetration, FDI and per Capita GDP[12]



[12] UNCTAD, World Investment Report, 2014; :ITU, Statistics

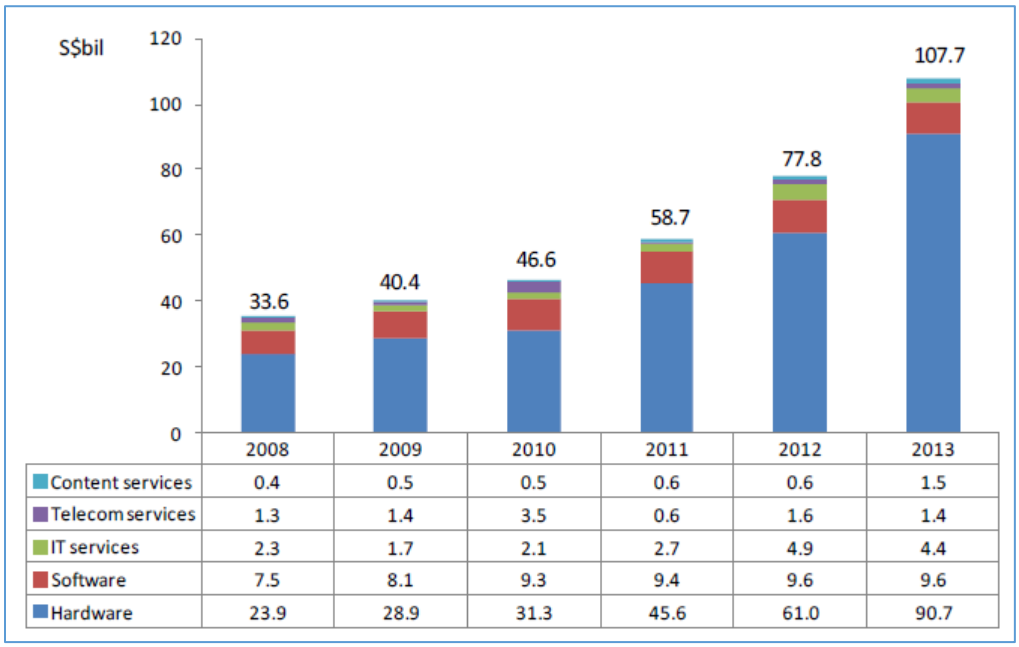
Figure 3
Infocomm Revenue by Segments 2008-2013[13]



	2008	2009	2010	2011	2012	2013
Content services	1.7	1.7	2.0	2.8	2.1	3.4
Telecom services	10.0	10.8	14.0	10.2	10.8	12.3
IT services	9.4	8.8	9.6	9.4	12.5	14.3
Software	13.2	14.5	12.2	12.6	12.9	12.3
Hardware	40.0	45.0	45.0	59.5	74.9	105.9

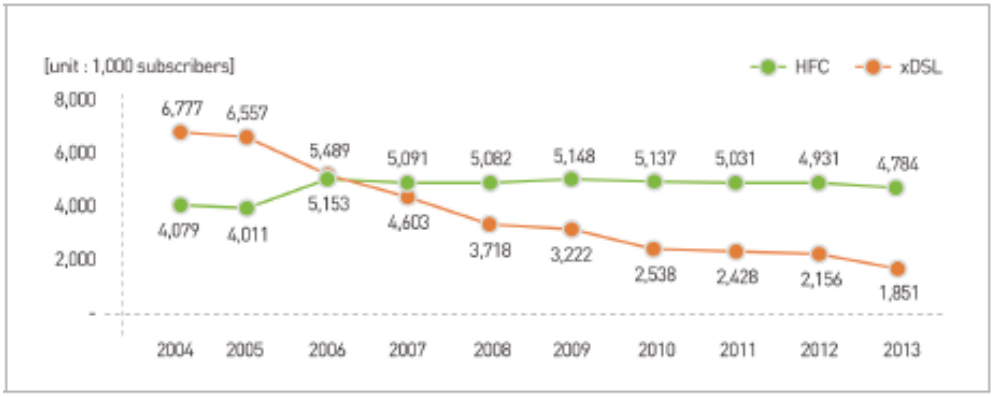
[13] InfoComm Development Authority, Singapore (2013). Annual Survey for the InfoComm Industry, 2013. IDA, Singapore.

Figure 4
Export Revenue by segments



	2008	2009	2010	2011	2012	2013
Content services	0.4	0.5	0.5	0.6	0.6	1.5
Telecom services	1.3	1.4	3.5	0.6	1.6	1.4
IT services	2.3	1.7	2.1	2.7	4.9	4.4
Software	7.5	8.1	9.3	9.4	9.6	9.6
Hardware	23.9	28.9	31.3	45.6	61.0	90.7

Figure 5
Number of Broadband Internet Subscribers by Access Technology



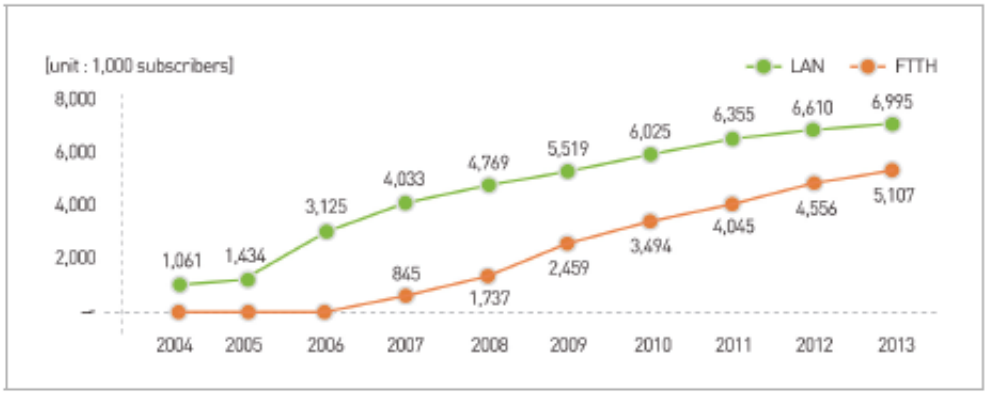
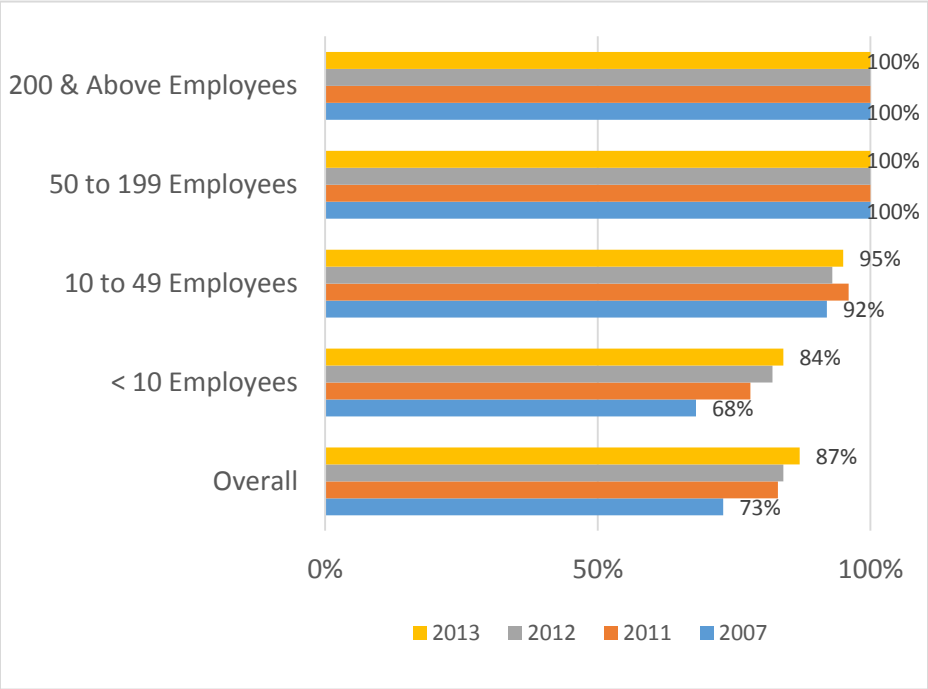


Figure 6[14]
Business Usage of Computers



[14] InfoComm Development Authority Singapore (2013).

Figure 7
Business Usage of Broadband Access 2007-2013