## Chapter 10

# Korea, India, and China—Investing outward helped digital firms develop and compete globally

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## Summary

This case study highlights the integration and upgrading in the digital economy global value chain (GVC) in three countries—the Republic of Korea, India, and China. It shows that two elements are critical to a country's participation in the high-value-added segments of the digital economy GVC: outward foreign direct investment (OFDI) and human capital and research and development (R&D) capacity. First, all three countries tapped into their own large pools of graduates in science, technology, engineering, and math (STEM) areas and successfully established domestic industries. Then leading domestic companies, pushed by competitive pressure from foreign investors when inward FDI was liberalized, invested overseas to explore new markets and compete internationally. Korea and China also invested determinedly in R&D and provided proactive government support for OFDI using a combination of financial and fiscal measures, provision of information, development assistance programs, and international investment agreements, in addition to the overall liberalization of OFDI regulations. India established software technology parks and provided software export credit and credit guarantees. Some firms from Korea, India, and China managed to expand and have become significant players in certain segments of the digital economy GVC.

## The digital economy global value chain

### Introduction to the digital economy global value chain

There is no universally accepted definition of the digital economy. However, a general distinction is made between narrow and broad definitions of the term. Narrow definitions refer only to the information and communication technology (ICT) sector, which includes telecommunications, the internet, information technology (IT) services, computer hardware, and software (Zhang and Chen 2019). The broad definitions refer to the digital economy as "the entirety of sectors that operate using Internet Protocol–enabled communications and networks," irrespective of which network they use and for what purpose (Lovelock 2018, 6).

For this case study, the digital economy is conceptualized as a GVC made up of various production segments that enable firms to store, collect, interpret, organize, transmit, and exchange data (figure 10.1). The firms in this GVC can be broadly divided into ICT goods firms and ICT services firms. Three main market segments make up the ICT goods part of the digital economy GVC: servers, IT components, and IT devices. ICT services include software, IT services, and telecommunications and infrastructure services (Frederick, Bamber, and Cho 2018). Such ICT services also include four digital services segments: internet platforms, e-commerce, digital content, and digital solutions (UNCTAD 2017).

Some companies that have integrated themselves into the digital economy GVC were established decades ago as electronics hardware or operating software firms. To upgrade within the GVC, these firms needed to build their digital portfolios of intellectual property and domain expertise. They grew organically by spending relatively high shares of their revenue on R&D (PwC 2018). Mergers and acquisitions and investment in start-ups (venture capital investment) are also common growth methods (Frederick, Bamber, and Cho 2018).

However, the digital economy GVC is mainly characterized by new types of firms and new sources of revenue. The agents of change are a combination of start-ups that provide new digital technologies, suppliers that embrace new opportunities to move up the value chain, and customers who are not just on the receiving end of a product or service but actively co-creating it (UNCTAD 2017). Revenue sources, especially in the consumer segments, are often closely tied to advertising. For example, Google and

**FIGURE 10.1 The digital economy global value chain**

| | Role | Broad segment | Specific segment | Firm examples |
|---|---|---|---|---|
| ICT Goods | Data storage | Servers | Data storage hardware | HPE, Inc., IBM, Inc. |
| | Local data collection and use | IT components (chips, sensors) | IC firms (fab and fabless) | Intel, Inc., Qualcomm, Inc., Samsung, Inc. |
| | | IT devices (computers, phones) | Electronics manufacturing | Apple, Inc., Dell, Inc., Lenovo, Inc., Samsung, Inc. |
| ICT Services | | Operating software | Software (operating) | Apple, Inc., Microsoft, Inc. |
| | | Application software | Software | Citrix, Salesforce, SAP, SAS |
| | Data services (data interpretation, organization, management and transmission) | IT services | IT consulting, BPS, BPO | Accenture, Inc., IBM, Inc., Infosys, Ltd. |
| | | Database software | Data storage software (middleware) | GE, Inc., Oracle, Inc., Siemens, Inc. |
| | | Telecommunications | Internet service providers | AT&T, Inc., Huawei, Inc., Verizon, Inc. |
| | Digital services (electronic delivery of information across multiple platforms and devices) | Internet platforms | Search engines, social networks | Facebook, Inc., Google, Inc., Tencent, Inc. |
| | | Digital solutions | E-payments, cloud (IaaS, PaaS) | AWS, Inc., Google, Inc., Microsoft, Inc., PayPal, Inc. |
| | | E-commerce | Internet retailers, other e-commerce | Amazon, Inc., Alibaba, Inc., TripAdvisor, Inc. |
| | | Digital content | Digital media, games, information, and data | HBO, Inc., Netflix, Inc., Tencent, Inc. |

*Sources:* Adapted from Frederick, Bamber, and Cho (2018) and UNCTAD (2017).
*Note:* BPS = business process solutions; BPO = business process outsourcing; IaaS = Infrastructure as a Service; IC = integrated circuit; ICT = information an communication technology; PaaS = Platform as a Service.

Facebook earn most of their revenue from targeted advertising using user-created data (83 percent and 99 percent, respectively) (Wallach 2020).

The United States is the dominant player in the digital economy GVC. Of the top 100 digital multinational corporations (MNCs) by sales or operating revenues, two-thirds are US firms, 23 are European, and 4 are Japanese (UNCTAD 2017). For ICT MNCs, the picture is more heterogeneous: whereas the United States leads with 21, a larger number of firms are from East Asia: Japan (15); Taiwan, China (14); China (6); India (5); and Korea (4) (UNCTAD 2017).

## The roles of Korea, India, and China in the digital economy global value chain

Korea is a leading player in the ICT hardware segment of the digital economy GVC, focusing on four key activities. The first is semiconductors, which accounted for 7.8 percent of its gross domestic product (GDP) and 17.3 percent of its exports in 2019.[1] Korea is home to Samsung Electronics and SK hynix; these two companies held 73 percent of the global dynamic random-access memory and 44 percent of the NAND flash memory markets (US ITA 2020). The second relates to wireless communications devices, for which Samsung Electronics and LG Electronics hold 13.3 percent and 8.7 percent of global 5G patents, respectively, making Korea the top country in 5G patents (Statista 2020). Third is flat panel displays, with LG Display alone enjoying a global market share of 27 percent in 2019 (Statista 2020). The fourth sector is consumer electronics. Korea is a global leader in televisions, handsets, and other consumer electronics components through Samsung Electronics, LG Electronics, and LG Display.

India is a leading player in the IT services segment of the digital economy GVC. In fiscal year 2019/20, India's IT and business process management (BPM) industry revenue was about US$191 billion, about 7.4 percent of India's GDP. More than 77 percent of the revenues derived from export (US$141 billion), accounting for 55 percent of global BPM market share (IBEF 2021). India's BPM industry is expected to grow to between US$205 billion and US$250 billion by 2025 according to McKinsey Global Institute estimates (MGI 2019b). In recent years, India has also become an important center for the industrial internet of things (IIoT).[2] All major global industrial firms with IIoT platforms are present in India and collaborating with major Indian IT firms to build applications for their platforms (Frederick, Bamber, and Cho 2018).

China is a leading player across a range of segments of the digital economy GVC. The first is ICT hardware. China accounts for 32 percent of global ICT goods exports (Zhang and Chen 2019). It produces 90 percent of the global supply of personal computers, 90 percent of mobile phones, and 70 percent of televisions (MGI 2019a). In recent years, China has also become a leader in drone manufacturing. Dajiang, one of China's leading companies in the industry, accounts for 50 percent of the drone market in North America (Zhang and Chen 2019). The second segment is financial technology, in which China accounts for more than 70 percent of global valuations. Alipay and WeChat Pay, two popular third-party payment applications, are increasingly expanding overseas and are now accepted at physical retailers in 28 countries (Zhang and Chen 2019). A third area relates to e-commerce. China accounts for more than 40 percent of the global e-commerce market, up from 1 percent about a decade ago. Some Chinese e-commerce companies, especially Alibaba, are venturing abroad (MGI 2017). The fourth area involves internet platforms and digital content. Although most of China's digital content firms are still domestically oriented, a small number have become global lead firms, such as Tencent in the video game industry (Casanova and Miroux 2019). The video platform TikTok has become one of the most popular social media applications in the world, reaching more than 2 billion downloads as of April 2020 (Leskin 2020).

## The development of Korea's digital economy global value chain

Korea's early electronics industry developed in the 1960s and 1970s through a combination of proactive government support and partnerships with foreign firms (Lim 2016). During this period, the major products Korea produced included consumer products and the localization of noncore components. Total ICT goods exports increased from US$3.5 million in 1966 to US$1.8 billion in 1979.

Starting in the 1980s, the country's priorities shifted from consumer electronics to the ICT sector. The government dramatically scaled up innovation capacity for ICT by investing 3 percent of Korea Telecom's revenues in R&D. It provided key infrastructure for informatization and e-government, and worked with the private sector to identify and promote new engines of growth. As a result, Korea developed an early lead in key digital infrastructure, developing a digital switching system in 1982 and 64K digital random-access memory in 1983 (third in the world, after the United States and Japan). Korean firms diversified their products and developed core components and materials. They continued to pursue a fast follower-innovator strategy and aggressively invested in R&D and volume production.

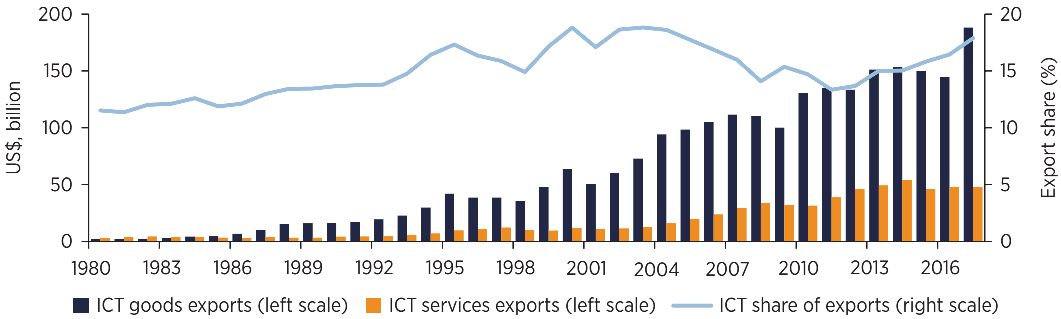
Joint efforts by the government and the private sector helped elevate Korea's electronics industry to world-class status by investing in core competencies and quality improvement. During this phase, ICT goods exports grew from US$2 billion in 1980 to almost US$190 billion in 2017. The country's ICT services exports also expanded rapidly, rising from US$3 billion to US$10 billion between 1980 and 2000, and then to almost US$50 billion by 2017. Combining goods and services, ICT exports grew from 11 percent of Korea's total exports in 1980 to 18 percent in 2017 (figure 10.2).

### Building human capital and research and development capacity

A focus on higher education was an important pillar of Korea's rise in the digital economy, with considerable investment in human capital development by the Korean government. Korean households simultaneously devoted much of their resources to education, thereby fueling a drastic expansion in school enrollment. The country's tertiary gross enrollment ratio increased from less than 7 percent in 1971 to 95 percent by 2015, and the number of students in higher education jumped from 201,000 to 3.3 million over the same period (Mani and Trines 2018; UIS 2021).

As soon as Korea formulated its electronics industry promotion strategy in 1968, the government also began establishing and reinforcing electronics-related departments

**FIGURE 10.2 The Republic of Korea's information and communication technology goods and services exports**




*Source:* World Bank calculations based on Atlas for Economic Complexity data.
*Note:* ICT goods are defined as Standard International Trade Classification codes 75–77. ICT services include information technology and communication services. ICT = information and communication technology.

at universities. The Korea Advanced Institute of Science was created in 1973 to produce top-quality scientists and engineers. The government also enacted the Support of Specific Research Institutes Act, under which it provided public funding to specific research institutes and joint management bodies. These institutes and joint management bodies were, in turn, required to give priority to R&D and technical support requests from the government.

Korea also established industry-specific research institutes to drive innovation in the electronics industry. The Korea Electronics Technology Institute, the Korea Electric Research and Testing Institute, and the Korea Electronics and Telecommunications Research Institute were established in 1976. The Korea Electronics Technology Institute greatly expanded R&D activities in computer and semiconductor fields, and the other two organizations made significant contributions to the development of electronic communications equipment (Lim 2016).

The Korean government urged the country's large industrial groups, known as *chaebols*, to invest heavily in R&D with a focus on applied technologies, while shielding them from competition by restricting FDI inflows in the early stages of development (Dayton 2020; Nicolas, Thomsen, and Bang 2013). Chaebols such as Samsung Electronics and LG Electronics engaged in numerous corporate-academic collaborations to conduct cutting-edge research and apply frontier knowledge in their products. As a result, Korea's R&D expenditure as a share of GDP was 4.8 percent in 2018, second only to Israel at 4.9 percent.[3] This expenditure was also exceptionally high relative to the country's income level. Korea's systematic attention to and high spending on R&D has been a crucial factor in creating an innovative economy and enabling its success in the electronics industry (Dayton 2020).

## The role of outward foreign direct investment

Korea's policy approach to OFDI has evolved strategically over time, reflecting the needs of its economy at different stages of development. The export boom in the

1980s encouraged OFDI liberalization, but active OFDI promotion only began in the 1990s. Korea's membership in the Organisation for Economic Co-operation and Development in 1996 prompted free capital movements and led to liberalization of both inbound and outbound FDI. In the late 1990s, the Korean government began to actively promote OFDI, with even more proactive policies following the global financial crisis of the late 2000s. The government provides three types of OFDI support: financial support, information provision, and overseas investment services:

1. *Financial support* is mainly provided by the Export-Import Bank of Korea through loans to firms investing abroad. The loans cover up to 80 percent of total capital invested abroad (or 90 percent for small and medium enterprises). The Korea Export Insurance Corporation provides export credit insurance and helps firms abroad that suffer from expropriation, war, breach of contract, and risk associated with remittance transactions.

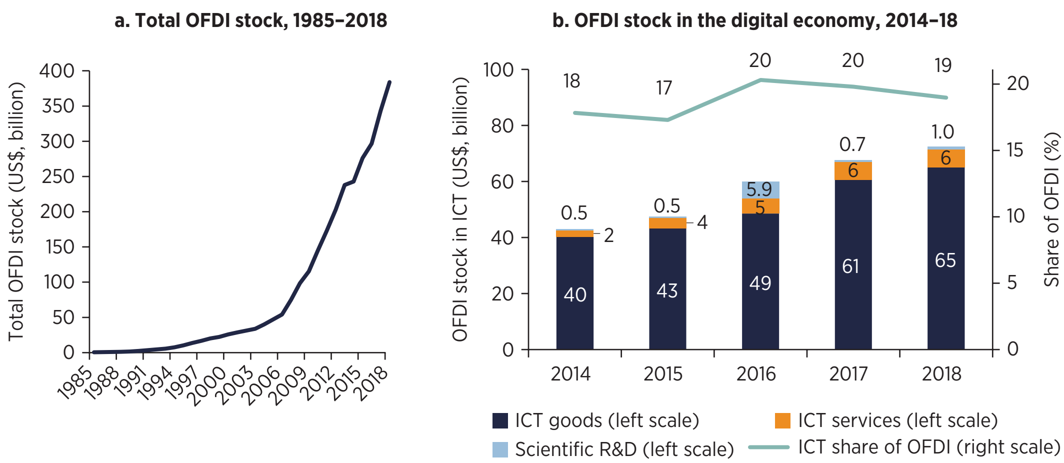
2. *Information provision* comes from the Ministry of Economy and Finance, which runs an overseas direct investment information network website and provides information on host countries' FDI procedures and investment-related features and on Korean overseas companies. The Ministry of Economy and Finance and the Korea Overseas Investment Information System also run several websites to share OFDI information and provide consulting services for Korean firms interested in investing abroad (Kim and Rhee 2009).

3. *Overseas investment services* come from the Korea Trade-Investment Promotion Agency (KOTRA). KOTRA provides comprehensive supportive services; it helps Korean firms expand their business in overseas markets, spreads foreign market information, and offers business consulting services. The government also encourages cooperation among Korean firms to form Korean business associations abroad and to build regional co-logistics centers to be shared among Korean firms (Nicolas, Thomsen, and Bang 2013).

Korean firms invested abroad for a variety of reasons. Firms faced a saturated domestic market and intense competition in industries such as electrical appliances, which placed pressure on firms to go abroad for higher profits. Firms report that OFDI was preferred over exports to reduce transaction costs in foreign markets (Kim and Rhee 2009). In addition, operating closer to overseas customers was seen to help firms respond quickly to consumer needs and to access design facilities. For example, Samsung Electronics built design centers in China, Italy, Japan, the United Kingdom, and the United States to cater to local market tastes. Finally, concerns about increasing labor costs at home led some Korean firms to invest abroad (Fung, Garcia-Herrero, and Siu 2009; Nicolas 2003).

As a result of both government support and business need, Korea's total stock of OFDI grew rapidly, from US$25 billion in 2000 to US$384 billion in 2018 (figure 10.3, panel a). A sizable share of this OFDI is in ICT goods, ICT services, and scientific R&D—growing from US$43 billion in 2014 to US$73 billion in 2018. The majority of OFDI is in ICT goods, but a growing share is in ICT services (figure 10.3, panel b). Overall, OFDI played a crucial role in Korea's advancement in the digital economy GVC (Nicolas 2003).

**FIGURE 10.3 Outward foreign direct investment in the Republic of Korea**




*Source:* World Bank calculations using Organisation for Economic Co-operation and Development foreign direct investment statistics.
*Note:* ICT = information and communication technology; OFDI = outward foreign direct investment; R&D = research and development.

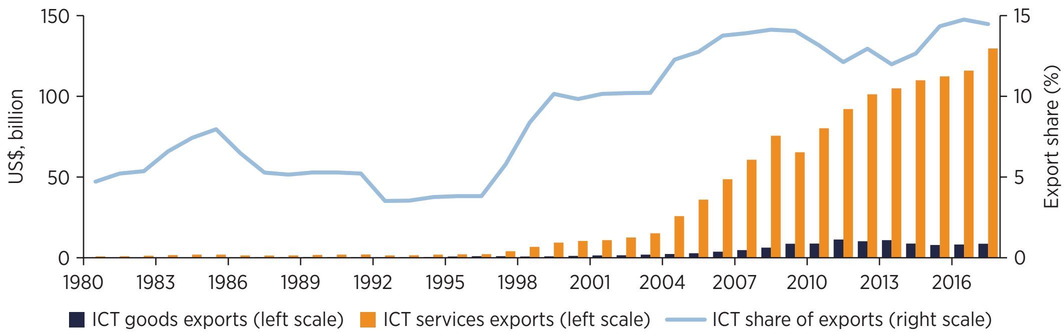
## The development of India's digital economy global value chain

The rise of India's ICT sector is generally considered to have started in 1988, when the government established software technology parks in 39 locations. At each park the government provided IT and telecommunications infrastructure, tax benefits, and satellite uplinks, as well as import certifications and market analysis to foreign investors (Couto and Fernandez-Stark 2019). After India's 1991 balance of payments crisis, the government abolished industrial licensing, removed entry barriers, created exemptions from corporate taxes, liberalized trade, and devalued the rupee, among other measures. In addition, software exports by MNCs registered with the Department of Electronics were provided with export promotion benefits, such as export shipment credit and credit guarantees, similar to those given to manufacturing exporters (Kathuria 2010).

India's integration into the digital economy GVC accelerated in the 1990s when the country began to provide simple IT support services to global clients, particularly in the United States. From about US$50 million in exports in the late 1980s, the industry grew by 50–60 percent annually in the mid- and late 1990s (Bhatnagar 2006), reaching US$10 billion in 2000. Since then, growth has been even more pronounced, shooting up to US$130 billion in 2017. At the same time, ICT goods exports increased, rising from US$1 billion in 2000 to US$9 billion in 2017. In total, exports from the digital economy sectors grew from less than 5 percent of India's total exports in the 1980s to about 15 percent in 2017 (figure 10.4).

Years of significant investment in IT higher education have endowed India with a large number of well-trained, low-cost, English-speaking software professionals.

**FIGURE 10.4 India's information and communication technology goods and services exports**




*Source:* World Bank calculations based on Atlas for Economic Complexity data.
*Note:* ICT goods are defined as Standard International Trade Classification codes 75–77. ICT services include information technology and communication services. ICT = information and communication technology.

This cadre of professionals proved highly opportune when the IT boom in the late 1990s resulted in a huge shortage of suitable personnel, which had been exacerbated by the Y2K problem.[4] India's software engineers were thus available on short notice to execute short-term projects and lower-end jobs such as coding and data conversion (Fernandez-Stark, Bamber, and Gereffi 2011).

As a result, MNCs were eager to set up IT, BPM, and R&D centers in India, which in turn benefited local companies through linkages and spillovers (Couto and Fernandez-Stark 2019). Driven by high-quality talent, synergies with traditional sourcing operations in the area, and lower operating costs, India's IT services sector emerged as one of the leading global players across all segments in the late 2000s.

In addition, a number of Indian IT professionals who had worked in the United States returned to India, bringing with them managerial expertise and good business connections, and successfully created their own IT firms. These firms have evolved into India's well-known leading firms such as TCS, Infosys, and Wipro (Fernandez-Stark, Bamber, and Gereffi 2011). Notably, foreign ownership of software operations in India was quite small—in 2010, fewer than one-fifth of Indian software companies were majority foreign-owned (Kathuria 2010).

Having developed experience in dealing with complex IT systems, several Indian companies became internationally competitive and opened offices abroad, offering a wider range of services, such as executing large and complex projects involving integration, IT strategy, and end-to-end solutions (Jalote and Natarajan 2019). Leading firms, now MNCs themselves, were quick to realize that demand for low-end services had limited value added; they thus diversified into other domains such as insurance, finance, and customer support, as well as R&D offshoring (Couto and Fernandez-Stark 2019).

In recent years, India has become a hub for technologies related to IIoT and Industry 4.0. More than 1,250 global companies have set up their own centers across all industries, and are starting to drive digital engineering work from their Indian development centers (Jalote and Natarajan 2019). The country is home to the largest IIoT labs for several firms outside of their home countries, including Siemens, SAP, and Bosch (Frederick, Bamber, and Cho 2018). For example, Bosch has 15,500 R&D

associates in India, which makes it the largest R&D campus outside of Germany, with 22 percent of its R&D employee count; the campus is focused on developing data mining and software solutions (Bosch 2019).

## Building human capital and research and development capacity

Beginning in the 1960s, the Indian government's public investments in technical education provided the foundation for the growth of the IT industry. In collaboration with leading universities in the United States, the government created a series of elite institutes for higher education in engineering and management, which proved pivotal in developing a large, well-trained pool of engineers and management personnel. In addition, the government eased policies regarding the ability to establish private education institutions to help fill the skills gap. It also helped create and expand computer science departments in existing engineering colleges and introduced quality-control systems for engineering colleges and other IT-training institutions (Bhatnagar 2006).

By 1997 India had set up more than 600 institutions for degree qualification in engineering and another 1,135 institutions granting engineering diplomas. By 1999 the higher technical education system produced more than 250,000 scientists and technologists a year, including more than 10,000 doctorates awarded in various disciplines (Kumar 2014).

The Indian government also facilitated India's brain gain during the 2000s. Expatriates who had been living in the United Kingdom and the United States were returning to India, attracted by high salaries and entrepreneurship opportunities, but only enabled by the lifting of restrictions related to visas, investment, and the purchase of property by Indian nationals who were citizens of other countries (Couto and Fernandez-Stark 2019).

R&D has been gaining in importance to India's participation in the digital economy GVC as the country continues to upgrade and compete in knowledge-intensive services. R&D expenditure by both private Indian firms and the government has traditionally been low in India compared with other countries, and has been dominated by the government (Kumar 2014). As of 2018, Japan's and China's R&D spending of 3.3 percent and 2.2 percent of GDP clearly outranked India's 0.6 percent. This spending difference can be at least partly explained by the country's service focus, as opposed to a product focus, which would require greater investment in R&D (Bhatnagar 2006).

However, although the relatively low investment in R&D was not a significant impediment early on, the IT industry's shift toward the adoption of new technologies such as artificial intelligence, automation, and cloud computing, among others, is making R&D an increasingly important factor for the competitiveness of Indian firms (CTIER 2016). Because of India's comparatively low public R&D spending, the country will continue to rely on foreign R&D for the bulk of cutting-edge innovation, given the gap between indigenous and multinational innovation (Branstetter, Glennon, and Jensen 2019).

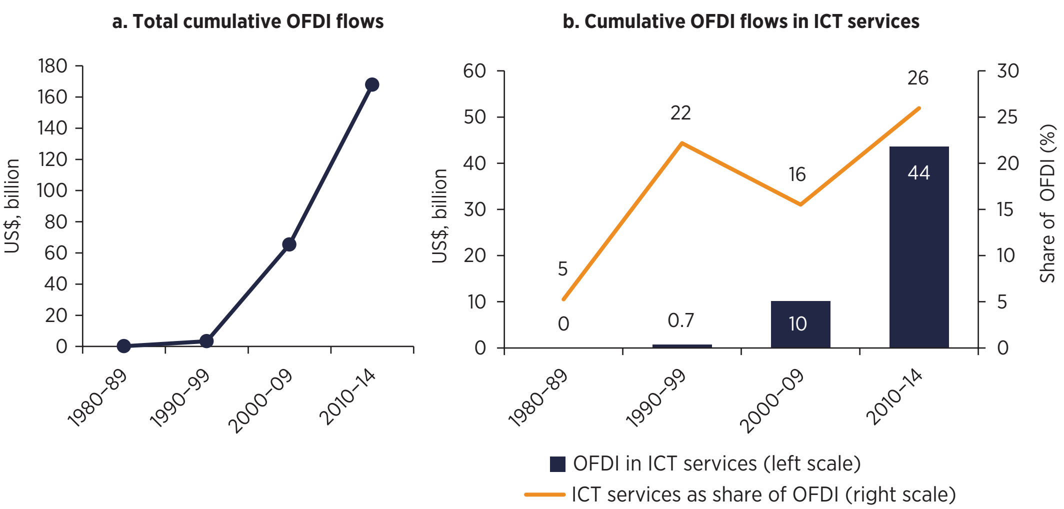
## The role of OFDI

Starting in 1992, India's government gradually liberalized its formerly restrictive OFDI policy regime, with the aim of achieving technological upgrading and internationalization of leading Indian companies (Pedersen 2010). Liberalization measures included instituting automatic approval procedures, removing the prohibition on majority ownership of foreign entities, and gradually increasing the amount of OFDI allowed under the automatic route to 100 percent of a company's net worth in 2004 and subsequently to 400 percent today (Kathuria 2010). All of these measures, coupled with the opening up of and hence the increased competition in Indian domestic markets,[5] as well as the liberalization of trade and investment regimes in overseas markets, led Indian firms to expand abroad (Sauvant and Pradhan 2010).

OFDI from India increased significantly after 2000 (figure 10.5, panel a). ICT companies took a strong lead in OFDI after having developed competitive advantages such as the knowledge and skills gained as an outsourcing destination for several years and the exposure to intense competition. OFDI in ICT increased steeply, from US$743 million in 1990–99 to US$10.1 billion in 2000–09, which further rose to US$43.6 billion, or 26 percent of the total India OFDI, in the following five-year period (figure 10.5, panel b). This performance marks the industry as the most globalized and internationalized sector in India (Pradhan 2017).

OFDI has allowed Indian IT firms to access new markets, skills, and technologies, and to enlarge the global scale and scope of their operations. Indian companies predominantly established greenfield subsidiaries in other countries to provide services on site closer to the customer and to seek out new business opportunities (Couto and Fernandez-Stark 2019). In addition, Indian firms had also been aggressively acquiring overseas strategic assets (Pradhan 2007). For example, Wipro in 2007 acquired the US-based business process outsourcing company Infocrossing for US$600 million, one of the largest acquisitions by an Indian company in the United States at the time, to obtain Infocrossing's five data centers in the United States to be able to become a full-service company (Ruet 2010).

**FIGURE 10.5 Outward foreign direct investment in India, 1980–2014**




*Source:* World Bank calculations based on Pradhan 2017.
*Note:* ICT services include information technology and communication services. ICT = information and communication technology; OFDI = outward foreign direct investment.

The majority of overseas investments by Indian IT services companies were in developed countries (close to 70 percent), with the United Kingdom and the United States being the two major hosts (Pradhan 2007). Because of the nature of software—requiring effective integration between different types of services and involving trade secrecy and protected data—almost all investments were majority owned (Pradhan 2007).

More recently, Indian IT companies have been investing in new technologies to expand to new lines of business and to new markets. Based on CBInsights' analysis of 51 acquisitions by major Indian IT companies between 2012 and 2017, acquisitions are particularly prominent in companies working in data management (18 percent), the internet of things (10 percent), cybersecurity (10 percent), artificial intelligence (8 percent), and payment and invoicing (6 percent) (CBInsights 2017). Indian companies tend to acquire rather than make venture capital investments, with the exception of Wipro and Infosys, which, in addition to making acquisitions, have also been active venture capital investors and built their own corporate venture capital arms (Frederick, Bamber, and Cho 2018).

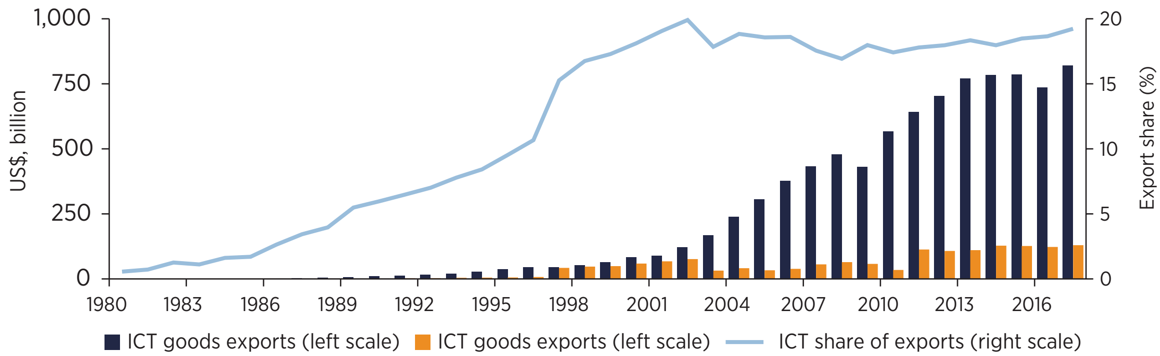
## The development of China's digital economy global value chain

China's journey entering and upgrading in the digital economy GVC began in the 1980s, when it successfully attracted export-oriented FDI through incentives and infrastructure provision, often using special economic zones. This strategy allowed it to develop a competitive ICT hardware industry focused on low-skilled and low-value-added components and parts assembly (Ning 2009). The technology, knowledge, and market access that foreign MNCs brought to China, with the assistance of government policies, helped upgrade the competitiveness of domestic firms by transferring technology through joint ventures, forward and backward linkages, spillovers, competition effects, industrial structure expansion, and labor spin-offs (Chen 2018).

Since the early 2000s China has extended its status as the global leader in select segments of the ICT hardware industry, especially in the computer and peripheral equipment segment and the communication equipment segment. In 2004, China surpassed the United States as the world's leading ICT goods exporter, with US$240 billion in ICT goods exports. In recent years, ICT goods exports have continued to expand, rising to US$820 billion in 2017 (figure 10.6).

During this time, China also developed the world's largest telecommunications market, which, unlike the country's ICT hardware industry, was dominated by state-owned enterprises (WTO Secretariat 2006). Other segments of China's digital economy remained small and focused on the domestic market, but as time went on their growth rates picked up. China's software industry, which barely existed before the 1990s, exhibited a steady 30 percent growth rate from 1992 to 2000. However, unlike Europe, India, and the United States, China developed only a limited range of IT service providers during this period (WTO Secretariat 2006). E-commerce in China took off in 1999 as a wave of dot-com start-ups went public on the NASDAQ stock exchange (Qiang 2007). The country's ICT services exports have also grown continuously, rising

**FIGURE 10.6 China's information and communication technology goods and services exports**




*Source:* World Bank calculations based on Atlas for Economic Complexity data.
*Note:* ICT goods are defined as Standard International Trade Classification codes 75–77. ICT services include information technology and communication services. ICT = information and communication technology.

from about US$59 billion in 2000 to US$130 billion in 2017. Concurrently, China saw a significant rise in ICT exports, growing from less than 1 percent in the 1980s to 11 percent in 1996, and still rising at almost 20 percent of total Chinese exports (figure 10.6).

The rise of China's digital economy firms can be explained by both structural and policy factors. The relevant structural factors include China's market size (McCarthy 2020), growth in digital adoption, inefficiencies in traditional sectors (MGI 2017), and strong manufacturing base. Chinese policy makers at various levels of government have adopted a combination of measures aimed at supporting its domestic digital firms. On the one hand, Chinese authorities gave domestic digital firms space to experiment and innovate in its large domestic market under low levels of regulation (MGI 2017), learning and upgrading their capacity gradually before they could compete at the frontier. On the other hand, foreign firms are perceived to have disadvantages in China, including limited market access, insufficient intellectual property protection and enforcement, internet control and censorship, and subsidies for Chinese firms (Ferracane and Lee-Makiyama 2017; USTR 2018). Although this protection provided domestic firms with a first-mover advantage, it may have been counterproductive. Jiang et al. (2018), for example, find that Chinese technology spillovers were largest in sectors that were more open, and positive technology externalities were dampened in industries with many prohibitions on types of foreign investment.

## Building human capital and research and development capacity

Building on earlier reforms, in the mid-2000s the Chinese government, using a wide array of policy instruments, set out to build an enterprise-centered technology innovation system that would make China one of the world's leading R&D hubs.

Under the 2006 Medium- to Long-Term Plan for the Development of Science and Technology, Chinese policy makers set out to (a) build an innovating-based economy by fostering indigenous innovation capacity, (b) foster an enterprise-centered technology innovation system and enhance the innovation capabilities of Chinese firms, and (c) achieve major breakthroughs in targeted strategic areas of technological development and basic research (OECD 2007). The plan committed China to achieving four broad objectives by 2020: allocating 2.5 percent of GDP to R&D, sourcing 60 percent of growth from the contribution of scientific and technological progress, basing 70 percent of production on homegrown technologies, and raising the share of strategic and emerging industries to 15 percent of GDP (Chen and Naughton 2016).

To further these objectives, the Chinese government has introduced more than 170 policies supporting science, technology, and innovation (STI) since 2011. These policies span socioeconomic objectives (productivity, diversification, human capital, entrepreneurship, and inclusion) and STI objectives (research excellence, technology transfer, and R&D and non-R&D innovation). They also use a wide range of instruments, including fiscal incentives, grants, loan guarantees, vouchers, equity, public procurement, technology extension services, incubators, accelerators, competitive grants and prizes, science and technology parks, and collaboration networks. The approach seems to favor financial instruments over regulatory, advisory, and other types of support, suggesting that the main market failure that the authorities seek to address is the lack of funding and access to finance. The Chinese government's volume of support for business R&D is close to the Organisation for Economic Co-operation and Development median, much higher than what China's level of income would suggest. Tax incentives account for about half of the total value of the support (OECD 2017).

Complementing China's large and growing expenditure on R&D are investments in the development of human resources in science and technology. Students in science and engineering (S&E) account for about half of all bachelor's degrees awarded in China, and in 2014 Chinese S&E graduates numbered almost 1.5 million—more than the combined total of S&E graduates in the United States and the eight European Union countries with the highest number of S&E bachelor and doctoral degrees awarded that year. In addition, more than 3,000 of these graduates received doctorates, more than in the United States and three times more than in India. Training at western and Japanese research institutions, and the connections forged there, have contributed greatly to the quality of China's research human capital. Today, China is a global innovation hub, boasting among the world's highest numbers for STI spending and patent applications (World Bank Group 2020).

These advances helped enable Chinese firms to become outward investors in the first place, and they also enabled Chinese firms and the Chinese economy more broadly to benefit from OFDI, as several studies have confirmed (Huang and Zhang 2017; Li et al. 2016).

## The role of outward foreign direct investment

In the 1980s and 1990s, OFDI played a limited role in the development of China's digital economy. Until the mid-1980s, only state-owned enterprises were allowed to invest abroad, and case-by-case approval was required for all investment. The government then partially extended the right to apply for permission to invest abroad (OECD 2008). Until the late 1990s, however, controls on financial outflows remained tight in response to the state's losses from speculative investments in real estate and stock markets in the early 1990s, and to prevent capital flight during the East Asian financial crisis (Wang and Gao 2019). China's average total OFDI flows from 1992 to 1999 remained low at US$2.7 billion (Wang and Gao 2019).

In 2000, the Chinese government began to embrace the liberalization and promotion of outward investment as a development strategy. With the 10th Five-Year Plan on Economic and Social Development, China formalized its "Going Out" strategy, listing OFDI as one of the four key thrusts that would enable the Chinese economy "to adjust itself to the globalization trend" (Sauvant and Chen 2013). In a number of subsequent pronouncements and policy documents, the government further elaborated this strategy and repurposed its OFDI policy and regulatory frameworks in light of two objectives: to help Chinese firms become more competitive internationally, and to assist the country in its development efforts by using OFDI to achieve economic restructuring. In pursuit of these objectives, China's regulatory framework for OFDI has moved "from restricting, to facilitating, to supporting, and finally to encouraging OFDI" (Sauvant and Chen 2013, 1).

Following its "Going Out" strategy, China has incrementally streamlined and liberalized its OFDI regulations. It gradually simplified approval procedures and documentation requirements, decentralized authority from national regulators to their provincial counterparts (MOFCOM 2004; NDRC 2004), and gradually loosened restrictions on the use of foreign exchange for OFDI. To that end, the government abolished compulsory repatriation of overseas profits, and in 2006 eliminated the long-imposed quota of US$5 billion per year on foreign exchange allocated to OFDI (OECD 2008). Importantly, under the 2014 Catalogue of Investment Projects Subject to the Approval of Government, the general framework for OFDI was changed from an approval-based system to a recording system (World Bank Group 2020). In that same year, the regulatory framework for OFDI matured to embrace corporate social responsibility when investing abroad, such as minimizing the environmental and social impacts of investment on host economies (Perea and Stephenson 2018).

In addition to liberalizing its OFDI regulations, the Chinese government has directly supported and encouraged OFDI. Sauvant and Chen (2013) identify five ways in which the Chinese government supports OFDI (box 10.1).

OFDI flows from China rose from less than US$2 billion in 2000 to US$146 billion in 2015. In 2016, Chinese OFDI flows reached two milestones: they became the second highest in the world, after those from the United States, and they overtook FDI flows into China for the first time (Perea and Stephenson 2018). The digital economy makes up an important share of the total increase in OFDI. Manufacturing OFDI (led by ICT-related products) rose from US$2 billion in 2005 to US$30 billion in 2017 (figure 10.7, panel a). Similarly, OFDI for ICT services and R&D grew from less than US$30 million in 2005 to a high of US$23 billion in 2016 (figure 10.7, panel b). Not only has OFDI in ICT goods and services expanded rapidly, but it has also exceeded 20 percent of total OFDI every year since 2015 (sum of panels a and b in figure 10.7).

Government support proved to be an important factor in China's rising OFDI flows. In a 2011 survey of Chinese outward investors conducted by the China Council for the Promotion of International Trade, 55 percent of firms identified China's "Going Out"

## BOX 10.1 Chinese government support for outward foreign direct investment

The Chinese government supports outward foreign direct investment (OFDI) through a number of measures:

- *Financial and fiscal measures.* The Export-Import Bank of China and other state-owned commercial banks support OFDI by offering low lending rates, flexible terms, and a fast approval process for OFDI projects. In 2003, a Special Fund of Lending for Investment Overseas was established to extend special financial services (including discounted lending rates) to large-scale business groups possessing sufficient capital, technology, management skills, and brands to invest abroad (CDB and EXIM 2006). Another fund established by the Chinese Ministry of Finance and the Ministry of Commerce (MOFCOM) provides direct subsidies to OFDI projects that, among other criteria, build foreign research and development centers (Ministry of Finance and MOFCOM 2012). A number of tax incentives to support OFDI were granted by the State Taxation Administration, including a special corporate income tax rate for high-technology enterprises (reduced from 25 percent to 15 percent) (STA 2011). In addition, a new foreign exchange policy was introduced in 2011 that allows Chinese firms to directly use yuan to invest abroad if certain conditions are met (PBC 2011).

- *Provision of information.* MOFCOM, the National Development and Reform Commission, and the Ministry of Foreign Affairs jointly publish an annual OFDI Guidebook that lists current investment opportunities by country, industry, and project. MOFCOM also provides information through its global commercial consulate offices and offers services such as the collection of information and statistics and decision-making support (MOFCOM 2020).

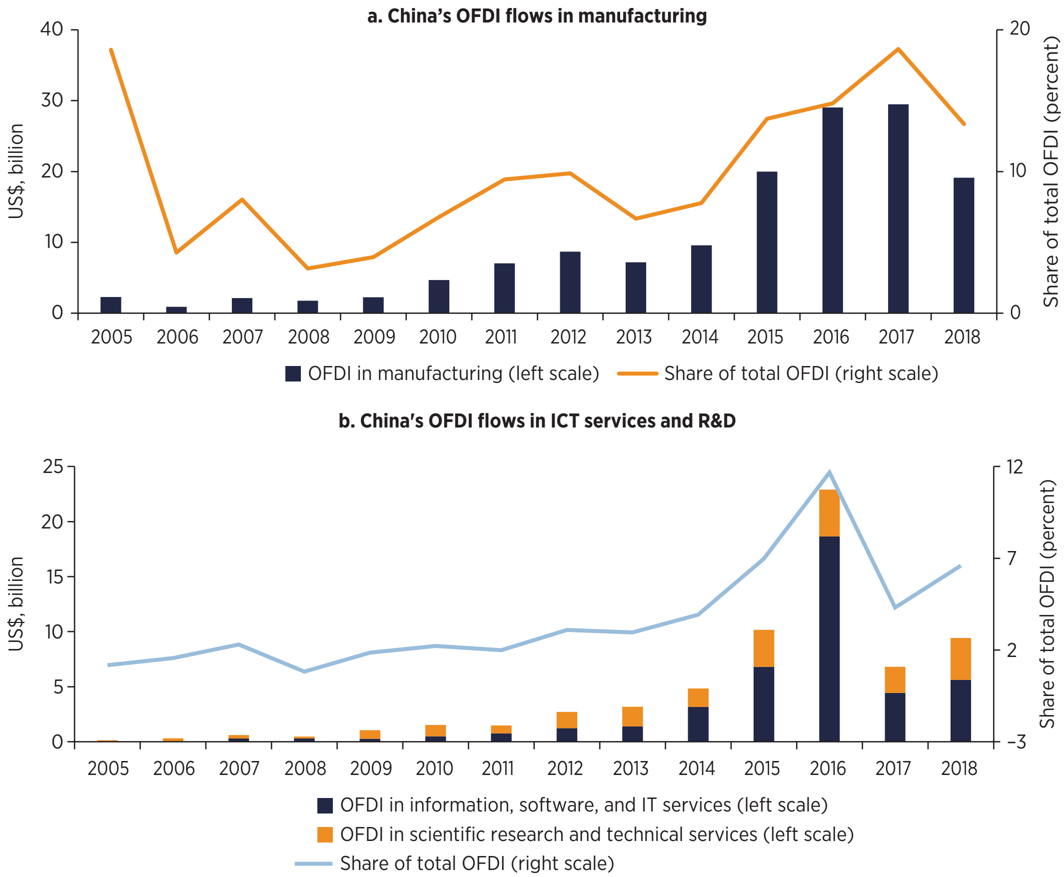
- *Development assistance programs.* Since 2006, the Chinese government has assisted in the construction of foreign economic and trade cooperation zones. These zones are designed to provide developed infrastructure to the firms operating within them, and they are mostly focused on export processing and scientific and technological projects.

- *International investment agreements (IIAs).* Since China began its IIA program in 1982, the country has signed more IIAs (146) than any other country except Germany (which has signed 201).[a] During this time, China's approach toward IIAs has undergone significant shifts. In its IIAs signed from 1982 to 1998, China limited substantive protections and access to investor-state dispute resolution, reflecting China's status during that time as a predominantly capital-importing country (Sauvant and Nolan 2015). In its IIAs signed between 1998 and 2008, China's consent to arbitration was often broadened given that its interest in protecting its investments abroad had increased (Sauvant and Nolan 2015). In IIAs signed subsequently, China developed a more balanced approach, both tightening admissibility requirements for investors' claims and increasing levels of substantive investment protection. The country's focus became to ensure that Chinese state-owned enterprises' investments were protected while also allowing sufficient regulatory flexibility (Sauvant and Nolan 2015).

- *Political risk insurance.* Chinese outward investors, and the institutions that finance their investment, may receive investment protection from the China Export & Credit Insurance Corporation (Sinosure). Sinosure offers insurance against the loss of capital and earnings abroad caused by several types of political risk, including expropriation, restrictions on the transfer and conversion of funds, damage from war, inability to operate because of war, and breach of contract.

*Source:* Based on Sauvant and Chen 2013 and Sauvant and Nolan 2015.
a. UNCTAD (United Nations Conference on Trade and Development), 2020, Investment Policy Hub (https://investmentpolicy.unctad.org).

**FIGURE 10.7 Outward foreign investment in China, 2005–18**




*Source:* Statistical Bulletin of China's Outward Foreign Direct Investment (several editions, 2006–18) (http://cdi.cnki.net/Titles/SingleNJ?NJCode=N2017120333).
*Note:* ICT = information and communication technology; IT = information technology; OFDI = outward foreign direct investment; R&D = research and development.

strategy as an important or very important factor in their decisions to invest abroad; in fact, they considered it more important than almost all other factors influencing OFDI decision-making (CCPIT 2012). A large majority, 74 percent, of respondents said that they had benefited from the government's OFDI policies. Moreover, a substantial amount of OFDI was financed by the government. Gallagher and Irwin (2014) estimate the total amount of OFDI financing provided by the China Development Bank and the Export-Import Bank of China at US$140 billion from 2002 to 2012, amounting to at least 30 percent of China's total OFDI.

OFDI has allowed Chinese firms to enter and upgrade in various segments of the digital economy GVC. It has also contributed to structural changes in China's economy through its home-country effects. Both outward investors and other firms in the digital sector have benefited from OFDI through a number of channels, including direct knowledge transfers (of technology, production techniques, and management skills), indirect knowledge transfers from related firms (including reverse spillover effects from developed to developing markets), labor mobility, competition effects, and scale and scope effects. A number of studies find positive home-country effects in economy-wide productivity (Zhao, Liu, and Zhao 2010), growth (Liu and Lu 2011), employment (Cozza, Rabellotti, and Sanfilippo 2015), exports (Wang and Zhang 2010), and innovation (Chen, Li, and Shapiro 2012; Chen and Tang 2014; Fu, Hou, and Liu 2018; Li et al. 2016; Mao and Xu 2014 ).

## A comparison of the three countries

This case study highlights the critical role of human capital—building absorptive capacity and indigenous innovation—in entering and upgrading along the digital economy GVC. The digital economy is one of the most knowledge-intensive sectors and is therefore greatly dependent on the level of technological capabilities. Investment in higher education in the STEM areas is critical. The examples of Korea, India, and China show that such investment in building a large skills pool is strategic, establishes the foundation, and helps give domestic firms a competitive edge in this GVC.

The three countries also seem to have motivated actors and technologies from both domestic and foreign markets to innovate in specific segments in the digital economy GVC. Although there are many commonalities in the three countries' experiences (for example, using inward FDI to jumpstart the industry, liberalizing OFDI to help leading domestic firms internationalize, and investing in human capital), distinct features shaped each country's path (table 10.1). Korea and China adopted more selective inward FDI policies and engaged in proactive OFDI promotion, whereas the Indian government was more hands-off with regard to OFDI. Korea spent most aggressively on R&D and achieved leading positions in several ICT goods segments. China also has relatively high R&D expenditure and is becoming a top player in multiple segments in both ICT goods and services. India currently invests less in R&D, partly because it specializes in ICT services that are less technology intensive, such as business process management. These differing experiences show again that the usefulness of the various approaches is partly based on GVC characteristics and partly on the general capacity that exists within local firms.

## Conclusion

For countries aiming to stimulate their participation in the digital economy GVC, this case study suggests that governments should first and foremost invest in their country's human capital. The digital economy is one of the most knowledge-intensive sectors and is therefore greatly dependent on technological skills. Investment in tertiary education in the STEM areas is critical and will take time. The examples of Korea, India, and China show that such investment in building a large skills pool has, over time, established the knowledge skills foundation that gave domestic firms a competitive edge in this GVC.

**TABLE 10.1 Comparison of the three countries' approaches**

| | Republic of Korea | India | China |
|---|---|---|---|
| **Leading GVC segments** | ICT goods (semiconductors, wireless communication devices, flat panel displays, consumer electronics) | ICT services (business process management) | Both ICT goods (personal computers, mobile phones, televisions, drones) and ICT services (fintech, e-commerce, internet platforms, digital content) |
| **Building human capital** | • Large public and private investments heavily expanded the tertiary education enrollment rate<br>• Government established various electronics-related departments at universities<br>• Creation of multiple scientific research institutions focused on ICT goods– and ICT services–related R&D | • Public investment in technical education since the 1960s<br>• Creation of a series of elite institutes for higher education and management together with leading US universities<br>• Relaxed regulations on private education institutions to fill the skills gap<br>• Expanded computer science departments in universities<br>• Introduced IT training institutions | • Large investments in the development of human resources in science and technology<br>• Half of all bachelor's degrees in China awarded to students in science and engineering |
| **R&D investment** | • Government urged *chaebols* to invest heavily in R&D in ICT goods<br>• Chaebols engaged in numerous corporate-academic collaborations and invested in advanced countries to obtain cutting-edge technologies<br>• Second-highest R&D expenditure relative to GDP (4.8%) in the world | • Relatively low R&D investment (0.6% of GDP)<br>• R&D dominated by government<br>• Low R&D partly because of its services focus, which requires less investment in R&D than do ICT goods | • Established various research institutions since the 1950s<br>• Adopted a wide range of policies to support science, technology, and innovation, including fiscal incentives, grants, loan guarantees, vouchers, equity, public procurement, science and technology parks, and collaboration networks<br>• Relatively high R&D expenditure as a share of GDP (2.2%) |
| **Inward FDI policies** | • Selective promotion of inward FDI as part of overall industrial policy<br>• Restricted FDI inflows in ICT goods initially to protect domestic firms<br>• FDI not major engine of ICT goods industry but helped strengthen local firms' technological capacity | • The Liberalization, Privatization, and Globalization reforms in 1991 opened Indian economy to FDI<br>• IT, BPO, computer software and hardware, telecommunications were top FDI-receiving sectors<br>• Inward FDI instrumental in developing India's ICT services industry | • Liberalized FDI regulations since 1980s<br>• Selective promotion of FDI in manufacturing and export-oriented industries<br>• Large influx of FDI since the 1980s helped China develop a competitive ICT goods industry |
| **Outward FDI policies** | Proactive government promotion of OFDI since 1990s, with a range of financial support measures, information provision, and overseas investment services | Relatively hands-off, gradually liberalized OFDI policies since 1992 to help technological upgrading and domestic firms' internationalization | Liberalized OFDI in 2000, and encouraged OFDI through financial and fiscal measures, provision of information, development assistance programs, international investment agreements, and political risk insurance |

*Source:* World Bank.
*Note:* BPO = business process outsourcing; FDI = foreign direct investment; fintech = financial technology; GVC = global value chain; ICT = information and communication technology; IT = information technology; OFDI = outward foreign direct investment; R&D = research and development.

Proactive government support in R&D may also be needed to help domestic firms develop the necessary technology to engage in the digital economy. Through a wide array of policy instruments, particularly financial instruments, both Korea and China helped build the production and innovation capacity of local firms and enabled them to become leading R&D hubs. These support measures initially helped young digital economy firms better understand and absorb existing technologies in their sector. Over time, such R&D efforts also prepared the more competitive domestic firms to internationalize and make the transition into outward investors and MNCs themselves.[6]

This case study further shows that OFDI is an internationalization channel for the most competitive domestic firms. All three countries demonstrate a strong, positive link between rising OFDI and exports of ICT goods and services. Leading domestic firms chose to invest overseas (often in high-income countries using mergers and acquisitions and venture capital) to acquire strategic assets such as R&D and proprietary technology, globally recognized brand names, and established customer networks and sales channels. In parallel, they also invested in developing countries (commonly via greenfield FDI) to establish production facilities. Korean firms, for example, invested heavily in the United States to obtain advanced technology, and invested in low-cost countries to manufacture and sell their products (Kim, Driffield, and Love 2018). This approach helped the more productive domestic firms further develop their technological capabilities, expand their production networks and markets, and compete on a global scale.

For governments seeking to stimulate OFDI, liberalizing outward investment regulations is an essential first step. In all three countries, a boom in outward investment was preceded by the liberalization of OFDI rules. Yet, according to the International Monetary Fund's Annual Report on Exchange Arrangements and Exchange Restrictions database, 86 out of 192 countries had controls in place on OFDI in 2018 (IMF 2019). These controls are most commonplace in developing countries—58 percent of developing countries still control OFDI, whereas only 21 percent of high-income countries do so.

In addition, as shown for Korea and China, OFDI can be supported using a combination of financial and fiscal measures, the provision of information, development assistance programs, and international investment agreements. This combined approach of investing in building human capital, R&D, and supporting OFDI has helped Korea, India, and China become leading players in segments of the digital economy GVC.

Finally, similar to the other case studies in this report, the three countries' experiences also highlight the crucial role of inward FDI and more broadly the interactions with MNCs. In all three cases, MNCs were attracted by a number of tools, including the provision of infrastructure and incentives (for example, software technology parks in India). Technology, know-how, and market access that foreign MNCs brought to the three countries helped upgrade the competitiveness of domestic firms. The domestic firms then developed and accumulated knowledge about foreign markets and built networks and linkages before venturing abroad. Moreover, the types of investments the countries attracted in the digital economy GVC progressed over time from low-value-added goods production to high-value-added services and R&D, often performed in collaboration with local firms or research institutes.

## Notes

1. Ministry of Trade, Industry and Energy, https://www.trade.gov/country-commercial-guides/south-korea-information-and-communication-technology.
2. IIoT refers to the use of smart sensors attached to physical devices and real-time analytics to enhance manufacturing and industrial processes. IIoT falls across a number of segments of the digital economy GVC, including components, software, cloud systems, and IT services.
3. Based on World Bank World Development Indicators.
4. The Y2K problem was a computer flaw, or bug, that may have caused problems when dealing with dates beyond December 31, 1999. Global demand for IT professionals increased because of the need to remedy this issue.
5. The measures included removal of the restrictions on the growth of firms (such as the Foreign Exchange Regulation Act), the removal of the licensing regime, the dismantling of product reservation systems for publicly owned and small and medium enterprises, facilitation measures for foreign firms, and a massive reduction in import duties (Pradhan and Sauvant 2010).
6. The *World Development Report* (World Bank 2020) similarly emphasizes the importance of investment in R&D and human capital as a prerequisite for participation in knowledge-intensive GVCs such as the digital economy.

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