Chapter 3

Digital Platforms, Technology, and Their Macroeconomic Impact

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3.1. Overview of Digital Platforms

A digital platform is a digital marketplace that provides space for business and commerce between market players (Evans and Schmalensee 2007, Evans 2018).[1,2] Two-sided platforms link two different types of participants enabling them to gain through trade of goods and services or other forms of interaction (e.g., ride-hailing apps). Individually speaking, the two groups cannot capture the value created on their own. But as the number of people, participants, and transactions increases in the digital platform, the value of goods and services in these marketplaces rises, creating network externalities between the two types of participants. Multisided platforms involve more than two types of participants (e.g., content providers, search engines, and advertisers that connect users) and the network externalities are even larger.

As a business model, the mechanics of digital platforms are not new. Classified ads, for example, are an older, non-digital platform that uses printed information to advertise shopping malls, among other things, as a place for retail trade, leisure, and entertainment. Today, online platforms or digital marketplaces capture, transmit, and monetize digital information—including personal data—to support businesses and commerce (Evans and Gawer 2016).

[1] No agreed definition or universal consensus exists on how to classify different types of digital platforms. The business models digital platforms create may be called the "platform economy," "collaborative economy," "sharing economy," "gig economy," "on-demand economy," and "peer economy." In contrast, Kenney and Zysman (2016) view a "platform economy" or "digital platform economy" as a more neutral term. The authors argue that it encompasses the increasing number of digital activities in business and social media. For the authors, "platform" is merely a set of online digital arrangements with algorithms organizing and structuring social and economic activities and transactions.

[2] This chapter was prepared as a background paper for ADB (2021).

By and large, such marketplaces or platforms allow technologically mediated transactions, linking various groups and providing patrons a space to conduct activities or transactions (Koskinen, Bonina, and Eaton. 2019).

Chapter 3 of this book describes the scope, coverage, and comprehensive definition of the digital economy and platforms, and the difficulty in measuring their activities and contribution of the digital economy.

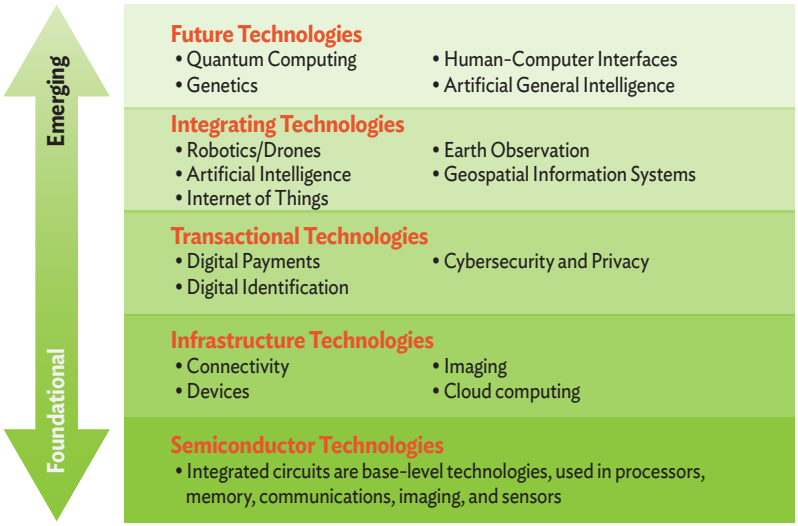
3.2. Key Technologies Driving the Growth of Digital Platforms

Digital platforms rely on a few enabling technologies that governments and development organizations should understand if they intend to provide appropriate support. Investments in these frontier and innovative technologies, alongside more advanced and effective design of policies and regulations, are crucial to successfully leveraging the digital economy for sustainable development (ADB 2021).

Five groups of key technologies drive digital platforms: (i) semiconductor technologies, (ii) infrastructure technologies, (iii) transactional technologies, (iv) integrating technologies, and (v) future technologies that will be important as future enablers of the digital economy (Figure 3.1). All these technologies are evolving rapidly, so development planning needs to be proactive. These categories, names, and definitions are not scientifically formulated and will vary depending on the relevant perspective. They can change.

The foundational nature of semiconductor technology is a useful starting point. Gordon Moore, former chief executive officer of Intel Corporation, observed in 1965 that semiconductors were doubling in complexity every 18–24 months. This exponential growth—Moore's Law—has improved semiconductor technology over 10 million-fold over the past 50-plus years (Figure 3.2). Improvement may be slowing, but it still represents the fundamental basis of most technological breakthroughs that underpin microprocessors, memory, communications, sensors, and imaging.

Figure 3.1: Technologies Shaping the Digital Platforms



Source: Abell (2020).

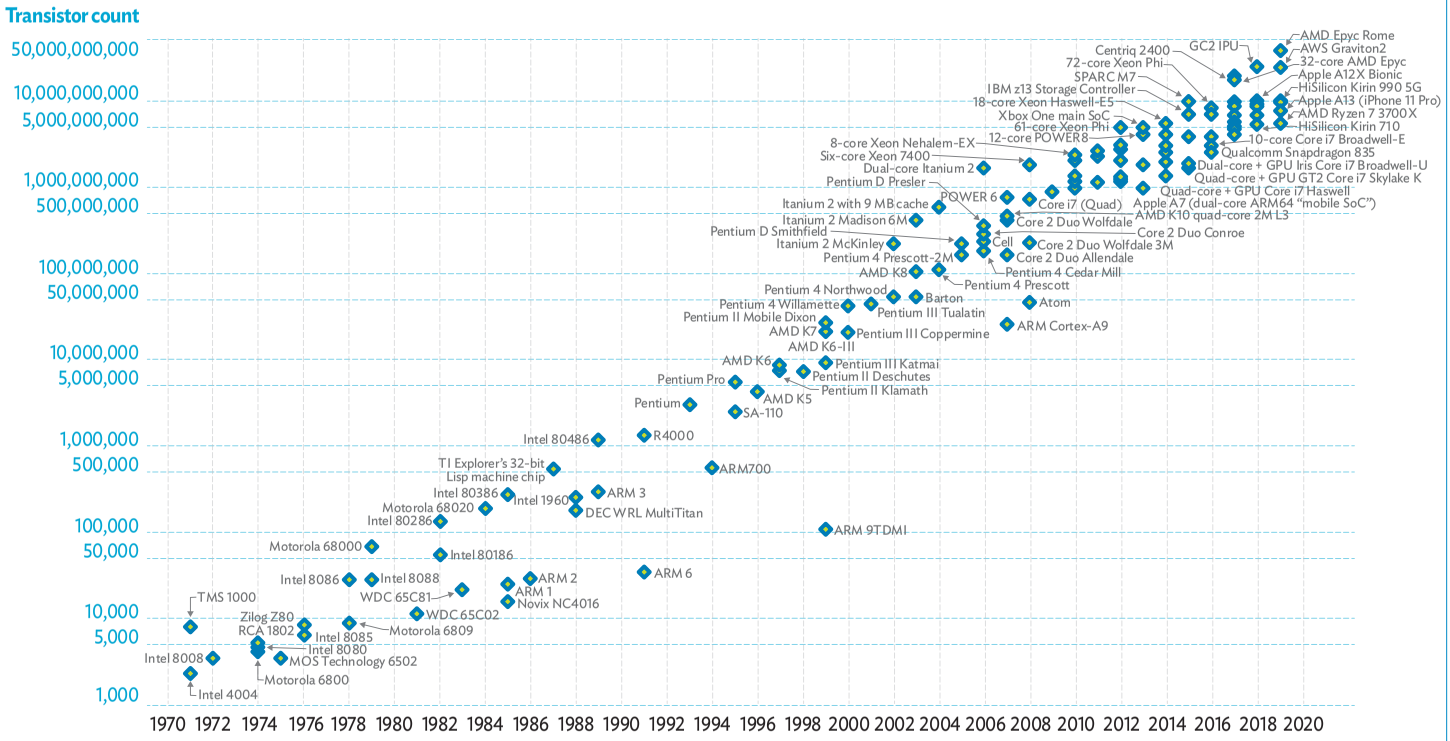
Infrastructure technologies, as the name would suggest, provide the basic building blocks for the platform economy (ADB 2021). These are:

- ***Connectivity:*** Digital connectivity enables people and services to communicate over wired, optical, and wireless networks. In 2019, internet connectivity reached 54% of the global population, driven mainly by expanding low-cost wireless networks. Reaching the remaining population is a key requirement for continued growth of the digital economy.

- ***Devices:*** People interact with the digital economy using a variety of devices, such as personal computers, smartphones, and wearables. Currently, the smartphone is the dominant device globally; and wearables, such as smart eyewear, earpieces, and watches, are poised to be the next trend.

- ***Imaging:*** Imaging technologies enable rapid progress in the use of photography and video.

Figure 3.2: Improvement in Semiconductor Technology



Sources: Roser and Ritchie (2013, 2020).

- ***Cloud computing:*** Cloud technology is on-demand scalable and cost-effective computing hardware that is cheaper and expandable compared to traditional computing equipment. This enables new services and technology start-ups.

The third group, transactional technologies, are the important enablers of digital commerce:

- ***Digital payments:*** Efficient, safe, and affordable digital payment tools for companies and individuals are crucial for allowing digital commerce to develop and thrive. Digital payments through online banking, mobile money accounts, or smartphone-based apps offer a relatively efficient and more secure payment model. This also allows users to create a digital footprint that builds up a credit history and keeps track of their economic activity.

- ***Digital identity:*** Secure, low-cost identity services are critical for the digital economy to enable citizens to access services, such as health, education, and bank accounts. In some instances, this has expanded to citizenship rights, such as the ability to receive social benefits or vote. In addition, emerging biometrics like facial recognition, fingerprinting, and iris scanning, are helping to leapfrog the paper-based approaches to build dependable and low-cost digital identification systems that can scale to national levels.

- ***Cybersecurity and privacy:*** Cybersecurity is crucial for keeping various types of data safe, enabling secure transactions, and managing devices. Cybersecurity tools are used to protect against unauthorized access to data centers and other similar systems. This is especially relevant for institutions related to banking, health, social protection, education, utilities, manufacturing, and communication.

Integrating technologies, meanwhile, enable digital platforms to combine multiple fundamental technologies to create new types of digital products and services (ADB 2021). These include:

- ***Artificial intelligence:*** Artifical intelligene (AI) defines a set of algorithms that tries to imitate a person's cognitive functions to identify and respond to increasingly complex real-world situations or challenges. AI also entails machine-learning languages that are capable of learning from training datasets, improving their

problem–solving capability by applying their experience or intuition during the training stage, which is often supervised. The immense increase in computational power as well as the availability of big data have also supported recent AI advances. This is evident through AI applications in language translation, recognition of patterns and images, as well as medical diagnosis.

- ***Robotics/drones:*** The combination of AI, sensors, communications, and processing technologies underpin autonomous operation of vehicles, robots, and drones, delivering new products and services. Robotic technology has been extensively applied in the manufacturing sector for a few decades, and recent breakthroughs in computing have permitted wider and low-cost applications of robotics. Autonomous vehicles comprise one branch of robotics. Self-driving cars use a range of technologies, including machine vision systems with digital cameras, radar, light detection and ranging sensors, and advanced navigation platforms. Another branch of robotics is drones offering low-cost geo observation functions such as monitoring and mapping of physical infrastructure. They can also work with autonomous navigation systems to carry out more sophisticated instructions and tasks, such as search and rescue missions during disasters or package delivery.

- ***Internet of Things:*** Internet of Things (IoT) generally involves connecting sensors or devices directly to the internet through wireless networks or Bluetooth connections, and does not require a computer or mobile phone. IoT devices, which communicate and interact over the internet, can be remotely controlled. IoT devices in households are typically used for "smart home" solutions in order to control utilities and digital equipment, such as lighting, cameras, thermostats, and related systems (ADB 2021). IoT devices in commercial establishments commonly involve controlling sensors for temperature and humidity or to track movement using built-in cameras or sensors.

- ***Earth observation:*** Satellite technology, combined with sensors and communication capabilities, allow low-cost geo observation that can cover the entire world. This enables new products and services applicable for land management, agricultural production, and environment observation.

- ***Geospatial information services:*** Given their ability to accurately measure and measure physical locations, these systems can also assist key transactions and vital intermediary functions of digital marketplaces. In comparison to traditional paper-based maps, *geospatial information services* give users greater accuracy and capability in tracking and analyzing land, resources, infrastructure, and human activities. This will open new opportunities for designing and managing transportation systems.

The fifth group, future technologies, are under development and expected to emerge in the next few years as new drivers for digital platforms and the digital economy (ADB 2021). These technologies could disrupt current leading technologies and so should be closely monitored.

- ***Genetics:*** Genetic technologies, such as gene editing and gene sequencing, are one of the most noteworthy future technologies. Gene editing, using recently discovered clustered regularly interspaced short palindromic repeats (widely known as CRISPR), is rapidly developing into new solutions for treating diseases and improving agricultural performance. Meanwhile, gene sequencing has allowed examination and understanding of the early origins of our genetic composition that can be associated with many human diseases. It can also be used to analyze our evolution (ADB 2021).

- ***Quantum computing:*** Building on theoretical discoveries in quantum physics, quantum technologies are capable of outpacing digital computing and to further strengthen encryption systems. The current technologies may be mainly limited to research laboratories, but quantum is positioned to become a breakthrough disruptive technology.

- ***Artificial general intelligence:*** As AI becomes more powerful, on the back of big data, larger computing resources, and new modeling approaches, potential exists for the emergence of general intelligence that has the capability to perform human activities like writing, research, and art. This technology is highly controversial, with leading technology companies, academia, and governments prioritizing research in this area.

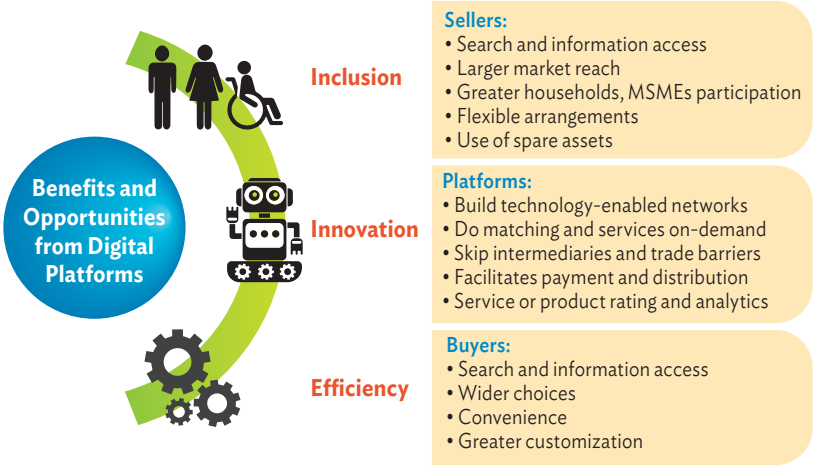
- ***Human–computer Interfaces:*** Current digital technologies are limited by the ability of people to speak or type into their devices. Communicating by typing or speech recognition are many times slower than digital communications, so new interface technologies are intended to enable humans to work more directly with digital solutions. Direct neural interfaces, for instance, are being designed to help people with speech or motor disabilities (ADB 2021).

Digital platforms and the digital economy are growing rapidly, driven by these key technologies. The companies and countries leading this growth are prioritizing their technology investments to maintain their leads.

3.3. Development Impacts of Digital Platforms

The internet and other digital technologies have contributed to the emergence of powerful online networks or digital marketplaces that can substantially reduce the cost of information, lowering information barriers, and cutting production and transaction costs. By reducing information and transaction costs, the internet helps promote commercial and social activities that can boost economic development in three major and interrelated ways (World Bank 2016, Figure 3.3):

Figure 3.3: Ways Digital Platforms Spread Benefits



MSMEs = micro, small, and medium-sized enterprises.
Source: Authors, based on ADB (2021).

- ***Inclusion*** (search and information)—By enhancing the speed and reach of search algorithms, the internet can help meet data gaps and address information asymmetries more effectively. E-commerce platforms, for example, have enabled small producers or distributors to find and connect with consumers in real time, and to sell in both domestic and international markets. This has contributed to providing goods and services on demand, raising the quality of goods and services, as well as reducing prices.

- ***Efficiency*** (automation and coordination)—The internet, likewise, augments the production factors. It lowers the cost of performing certain functions such as inventory management and significantly improves efficiency by allowing companies to better allocate and use labor and capital, including spare assets. Enterprises, industries, households, as well as the public sector, can thus experience higher efficiency.

- ***Innovation*** (scale economies and platforms)—The internet enhances innovation by creating technology-enabled marketplaces that can bundle the ordering of goods and services, with their payment, as well as transportation and delivery. They have also allowed companies to take advantage of economies of scale through digital platforms and other online services that compete with traditional business models, such as Airbnb (lodging), Amazon and Alibaba (retail), Facebook (media), and Uber and Grab (transport). Through technology mediation, buyers and sellers also provide and receive feedback which helps the market expand and improve services.

UNCTAD (2019) notes that data and digital marketplaces are two key drivers of value in the digital era. Koskinen, Bonina, and Eaton (2019) argue that digital platforms hold promise in solving numerous developmental and societal challenges. The emerging digital platforms are particularly effective in addressing market frictions that exist in many developing economies due to absent or weak institutions, insufficient or huge information gaps, and hurdles arising from poor infrastructure. Nonetheless, the effectiveness of policy responses aimed at managing the impacts of digital platforms hinges on clear understanding of the interplay of these two factors and their implications for value creation and distribution of the gains.

Digital marketplace can also help attain the Sustainable Development Goals. Several notable examples have emerged during the pandemic, when the use of digital technology to access health and education services became a game

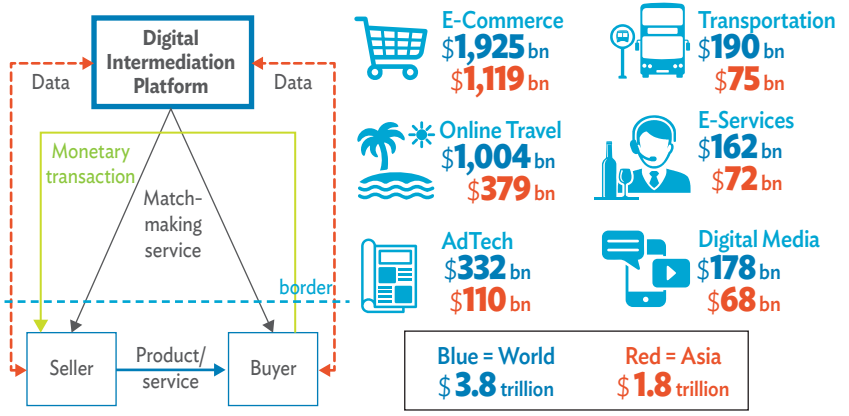
changer. More so, apps contributed to new forms of employment generation through food delivery and ride hailing online, flexible work arrangements, and jobs for different skill levels; and generated additional income for individuals and households. Digital payment apps have also expanded access to financial services—which helped the unbanked receive payments, and crowdfund microenterprises, social projects, medical needs, and so forth.

3.4. Importance of Digital Platforms

According to the United Nations Conference on Trade and Development (UNCTAD 2019), the combined value of platform companies with a market capitalization of over $100 million in 2017 has exceeded $7 trillion, or roughly 20% of global gross domestic product (GDP). Digital platform use drives the growth of these companies. In 2019, seven of the eight largest companies in the world were platform companies—Alphabet, Alibaba, Amazon, Apple, Facebook, Microsoft, and Tencent.

Following Statista's data on six key sectors, including (i) e-commerce, (ii) transportation, (iii) online travel, (iv) e-services, (v) advertising technology (AdTech), and (vi) digital media, business-to-consumer digital platform revenues reached $3.8 trillion in 2019, roughly equivalent to 4.4% of global output (Figure 3.4). E-commerce accounted for more than half of global

Figure 3.4: Digital Platform Revenues, World and Asia, 2019



bn = billion.
Note: Refer to ADB (2021) for the data source, country grouping, and framework.
Source: ADB (2021).

revenues, yielding over $1.9 trillion (ADB 2021). Online travel follows with over $1 trillion in revenues, AdTech with $332 billion, and transport with $190 billion. In Asia, e-commerce generated the largest revenue, which amounted to $1.1 trillion, followed by online travel with $379 billion, AdTech with $110 billion, and transport with $75 billion.

Asia captured about 48% of total sales revenue in 2019, equivalent to $1.8 trillion or 6.1% of its regional GDP. Within Asia, 68% of total sales revenue or over $1.2 trillion was generated in the PRC, which represents about 8.8% of that country's GDP (ADB 2021). Globally, the US ranked third, generating $837 billion or 3.9% of its GDP. The euro area followed, with about $445 billion sales revenue equivalent to 3.3% of its GDP (Table 3.1).

Table 3.1: Digital Revenue by Region, 2019
($ billion)

Sector	World	Asia	Dev Asia (ex PRC)	PRC	ANZ + Japan	Euro area	US	RoW
Digital media	177.5	67.6	13.8	35.0	18.9	17.3	57.6	35.0
E-commerce	1,924.9	1,119.2	143.3	862.6	113.3	196.0	343.1	266.5
E-services	161.8	71.7	16.3	47.0	8.4	15.0	42.8	32.3
Online travel	1,003.8	379.5	127.8	179.8	71.9	173.5	199.1	251.8
AdTech	331.7	110.4	15.4	71.4	23.6	29.2	129.9	62.2
Transportation	190.3	75.4	19.8	48.8	6.8	14.2	64.2	36.5
Total	**3,790.0**	**1,823.7**	**336.3**	**1,244.6**	**242.8**	**445.3**	**836.7**	**684.3**
% of GDP	**4.4**	**6.1**	**3.7**	**8.8**	**3.6**	**3.3**	**3.9**	**3.3**
Per capita spend	**513.9**	**432.3**	**121.1**	**863.6**	**1,547.6**	**1,308.2**	**2,542.5**	**275.1**

ANZ+Japan = Australia, New Zealand, and Japan; GDP = gross domestic product; PRC = People's Republic of China; RoW = rest of the world; US = United States.
Notes: Refer to Table 8.3 of ADB (2021) for the list of economies. The raw data are taken from Statista.
Source: ADB (2021).

Per capita, however, the US leads other regions and countries in spending, recording $2,542 per capita spending on digital platforms. Australia, New Zealand, and Japan (as a group) follow, with $1,548 and the euro area with $1,308. The spending in Asia was way below, at only $432 per capita—lower than the average per capita spending worldwide.

Asia is also the growing in digital platform revenues based on most recent data available, recording double-digit growth in revenue in 2019 from 2018 (Table 3.2). The growth of digital platform revenue in Asia reached 16.1%, higher than the global growth rate, at 12.7%. The growth of digital platform

Table 3.2: Growth of Digital Revenue by Sector, 2019
(%)

Sector	World	Asia	Dev Asia (ex PRC)	PRC	ANZ + Japan	Euro area	US	RoW
Digital media	6.3	7.1	11.0	8.8	1.6	5.6	5.3	6.8
E-commerce	16.4	19.6	28.3	19.7	9.7	10.4	11.0	14.8
E-services	16.0	18.8	22.8	18.7	12.3	15.5	10.0	18.3
Online travel	7.2	9.1	10.2	10.7	3.3	5.6	6.0	6.6
AdTech	14.4	14.3	15.4	16.2	8.5	11.9	15.6	13.3
Transportation	8.0	12.4	12.4	13.6	4.7	6.9	4.3	6.6
Total	**12.7**	**16.1**	**18.3**	**17.5**	**6.9**	**8.4**	**9.5**	**10.8**

ANZ+Japan = Australia, New Zealand, and Japan; PRC = People's Republic of China; GDP = gross domestic product; RoW = rest of the world; US = United States.
Notes: Refer to Table 8.3 of ADB (2021) for the list of economies. The raw data are taken from Statista.
Source: ADB (2021).

revenues in developing Asia, excluding the PRC, is even faster, at 18.3%; while in the PRC the growth stands at 17.6%. In contrast, the growth of digital platform revenue in the US and euro area are only 9.5% and 8.4%, respectively. This suggests that Asia will be the center of global competition among the big digital platform companies in the world.

Looking at the composition of digital revenue by sector (Table 3.3), one sees Asia's dominant role in all sectors, except in AdTech, where the US dominates largely because of the role of Google and Facebook. In e-commerce, Asia captures over 58% of total sales revenue. In e-services, the region accounts for 44.3%, while its share is over 38% in both transportation and digital media, which is larger than the US (ADB 2021). The PRC remains the most active country in the region. For instance, it accounts for about 44.8% of the sales in e-commerce, 29.1% of the sales in e-services, and over 25% of sales in transportation (ADB 2021). While Australia, New Zealand, and Japan are advanced economies, their share in digital platform revenues are in single digits, except for digital media—which stands at 10.6%—where Japan plays an important role. The market in developing Asia (excluding the PRC) also plays a modest role, as it captures only from 10% to 13% of the revenues in online travel, transportation, and e-services; and only from 4% to 8% of the revenues in AdTech, e-commerce, and digital media.

Table 3.3: Digital Revenue, 2019
(% share of region in segment)

Sector	Asia	Dev Asia (ex PRC)	PRC	ANZ + Japan	Euro area	US	RoW
Digital media	38.1	7.8	19.7	10.6	9.7	32.4	19.7
E-commerce	58.1	7.4	44.8	5.9	10.2	17.8	13.8
E-services	44.3	10.1	29.1	5.2	9.3	26.5	20.0
Online travel	37.8	12.7	17.9	7.2	17.3	19.8	25.1
AdTech	33.3	4.6	21.5	7.1	8.8	39.2	18.7
Transportation	39.6	10.4	25.6	3.6	7.5	33.8	19.2
Total	**48.1**	**8.9**	**32.8**	**6.4**	**11.7**	**22.1**	**18.1**

ANZ+Japan = Australia, New Zealand and Japan; PRC = People's Republic of China; RoW = rest of the world; US = United States.
Notes: Refer to Table 8.5 of ADB (2021) for the list of economies. The raw data are taken from Statista.
Source: ADB (2021).

Another indicator of the importance of digital platforms is the growing number of users (Table 3.4). Among the digital platform sectors, AdTech—which includes social media apps such as Facebook and Google—ranks first in users, with over 4.1 billion, equivalent to more than half of the world population. E-commerce subscribers' accounts total close to 3.2 billion, about 60% of which are in Asia. Meanwhile, accounts in digital media that include e-services, Netflix, Spotify, and online travel and transport number over 1.4 billion, with 775 million in the region (ADB 2021).

Table 3.4: Total Users in 2019 and Growth Rate in 2018–2019

Segment	World		Asia	
	Number (million)	Growth Rate (%)	Number (million)	Growth Rate (%)
Digital media	1,438.3	6.1	774.8	6.5
E-commerce	3,170.8	15.4	1,876.4	17.9
E-services	815.4	12.1	463.6	13.6
Online travel	987.6	2.5	540.4	2.8
Transportation	632.6	2.8	403.9	3.2
AdTech-exposed internet users	4,119.5	9.2	2,338.0	11.9

Notes: Refer to Table 8.6 of ADB (2021) for the list of economies. The raw data are taken from Statista.
Source: ADB (2021).

3.5. Macroeconomic Impact of Digitalization

Historically, the rapid improvement in information and communications technology (ICT), which saw a significant drop in the price of broadband and smartphones and increased computing power, has unleashed the power of the internet economy. In the 3 years to 2018, the cost of international internet bandwidth for internet protocol transit dropped an average of 27% annually. This allowed businesses and people to increase data usage and expanded the availability and use of smartphones globally. The enhanced ability to process data created also a shift toward a data-centric business model and a new data value chain, where businesses now build comparative advantage based on their ability to collect, store, analyze, and monetize data. Similarly, the evolution of the various technologies will drive the growth of digital platforms.

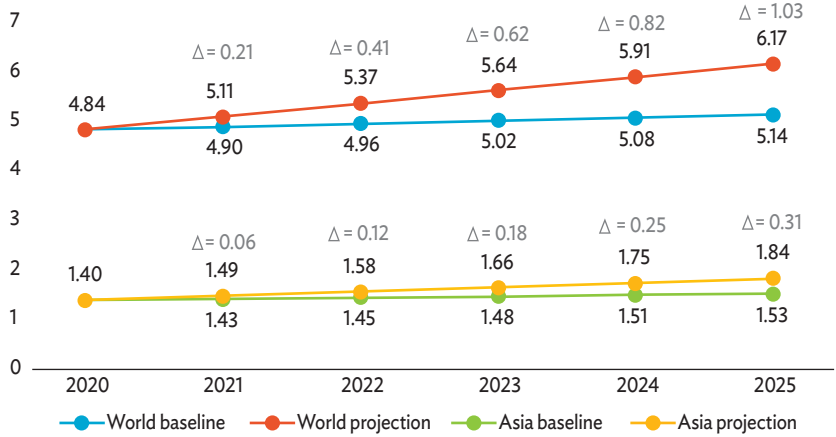
In what follows, this chapter examines the macroeconomic benefits of increased usage of digital technology. This could be partly attributed to the transformation in work arrangement, education, acquiring goods and services, health provision, and entertainment that has occurred during the COVID-19 pandemic.

The size of the digital economy depends on the definition used. Presently, various studies estimate the size of the digital economy to be roughly between 4.5% and 15.5% of global GDP. The digital sector within the digital economy is even smaller. Its size is estimated to be somewhere between 1% and 6% of GDP (Villafuerte 2020). To estimate the macroeconomic benefits from the increased usage of digital technology, a scenario that leads to a 20% increase in the digital sector size from the baseline by 2025 is analyzed (Figure 3.5).

Scenario

The digital transformation scenario considers an increasing investment in the digital sector. This will directly impact the economy as output rises in sectors that use digital inputs more intensively. At the same time, aggregate productivity in the economy also goes up. Consequently, the size of the global digital sector is expected to rise an average of roughly $617 billion per year from baseline levels, or $3.1 trillion in total from 2021 to 2025. Similarly, the digital sector in Asia is expected to increase by about $184 billion per year from the baselines, or about $919 billion in 5 years.

Figure 3.5: Size of the Digital Sector, World and Asia
($ trillion)



Notes: The calculations are based on the Global Trade Analysis Project (GTAP) database. Asia refers to Asia and the Pacific. In this case, economies that are not ADB members are included due to the aggregation of the Pacific subregion in GTAP. The numbers do not necessarily sum up due to rounding.
Source: Authors.

This scenario tries to capture the digital transformation observed in 2020, when the COVID-19 pandemic led to online work from home, remote learning, telehealth, online purchases, and home deliveries for groceries, and the use of digital payments and e-wallets, to reliance on digital media and entertainment. It is expected that this trend will continue as social control measures remain in place because of the pandemic.

The expansion of investment was implemented by endogenizing productivity growth in the digital sector in line with the target 20% expansion in the output of the sector from 2020 to 2025. More importantly, it is also known that the expansion in the digital sector will boost total factor productivity in the economy. Based on a literature review, it is assumed that the total factor productivity across the world increases by 1% for every 10% of digital sector expansion. In other words, global total factor productivity also increases by 2% from 2020 to 2025 in the modeling scenario.

Model

The modeling exercise for this undertaking employs the recursive-dynamic GDyn developed by Ianchovichina and Walmsley (2012). The GDyn Model is the dynamic extension of the standard GTAP model, which is a multi-region

multi-sector Computable General Equilibrium (CGE) model. This dynamic CGE model combines aspects of financial assets and associated income flows, capital accumulation, and investment theory. The model also takes a disequilibrium approach to account for capital mobility. It allows for short- and medium-term variances in the rates of return across regions that imply imperfect capital mobility. In the long run, these different rates can be eliminated to achieve perfect capital mobility across regions. Financial assets are also treated in a stylized way in this model to represent international capital mobility with no links to foreign accounts. In the real world there are many types of financial assets, but in the model there is only one financial asset—which is equity representing an indirect claim on a physical asset— but there is no financial sector. Adaptive expectations are also assumed in the model with the net rates of return, expected and actual, converging over time within and across regions.

Data

The simulation draws from Global Trade Analysis Project (GTAP) 10A database with a reference year of 2014 (Carrico, Corong, and van der Mensbrugghe 2020), which the authors updated to 2019 using World Bank macro data sets and the Asian Development Bank (ADB) Multi-Region Input–Output database. The results from the long containment scenario of a previous ADB study on the global economic impact of the pandemic were incorporated into the 2020 baseline. In addition, a number of the parameters used in this simulation exercise are based on Golub and McDougall (2006).

In order to extend the baseline for macro variables beyond 2020, particularly GDP and population projections by organizations such as the International Monetary Fund, Organisation for Economic Co-operation and Development, the United Nations (UN), and the World Bank were adopted. These are further revised and collated in the Shared Socioeconomic Pathways data set by the International Institute for Applied Systems Analysis (Riahi et al. 2017).[3] GDP projections are sourced from International Monetary Fund, the UN, and the World Bank, while the population and labor force growth projections are taken from the UN and the International Labour Organization. From the different scenarios in the Shared Socioeconomic Pathways data

[3] Refer to Moss et al. (2010); Arnell, van Vuuren, and Isaac (2011); van Vuuren et al. (2012); and Kriegler et al. (2012) for discussion on the methods.

set that represent different levels of interactions between sustainability and growth, a balanced projection was chosen for this exercise, which corresponds to the middle path of the Organisation for Economic Co-operation and Development methodology (ADB 2021).

After the baseline is developed, the policy simulation is implemented by expanding the size of digital sector in all economies covered incrementally by 20% from the baseline, to 2025. It is also assumed that use of greater digital inputs would increase total factor productivity growth by 2% in all sectors from 2020 to 2025, as previously noted. Note, however, that before the simulation exercise is carried out, the communication sector in GTAP is divided into the digital platform sector and other communication sector, using several global and national datasets, and literature as the basis.

Economic Impact

The simulation results show that broader digitalization will have a substantial impact on global economic growth, exports, and employment. The simulation exercise indicates an increase in global GDP by about $4.3 trillion per year, equivalent to 5.4% of the baseline 2020 GDP, and accumulates to about $21.4 trillion in 5 years. These are the same results shown in ADB (2021). Asia accounts for over 40% of the increase in global output, where output in the region is estimated to increase by about $1.7 trillion yearly, or about 6.1% of the baseline 2020 GDP. The total increase in output in Asia reaches more than $8.6 trillion over the 5-year period (Table 3.5). As mentioned, the output increase stems from larger investment and usage of the digital sector, which also generates improvement in total factor productivity. Roughly about a third of the GDP increase can be explained by the expansion of the digital sector while productivity improvement accounts for the rest.

The US and Europe—the Group of 2 (G2)—will also benefit significantly from this digital transformation capturing over 34% of the global increase in output equivalent to $7.2 trillion increase in GDP from 2021 to 2025.

Similarly, global trade is expected to increase by almost $2.4 trillion a year on average from 2021 to 2025 (Figure 3.6). This is commensurate to 5.5% increase in the 2020 baseline total trade. In total, this translates to over $11.8 trillion in additional trade value in 5 years. Asia will account for about 43% of this trade gain: with the region's cross-border trade value rising by over $1 trillion annually, or about 6.8% of their 2020 regional trade.

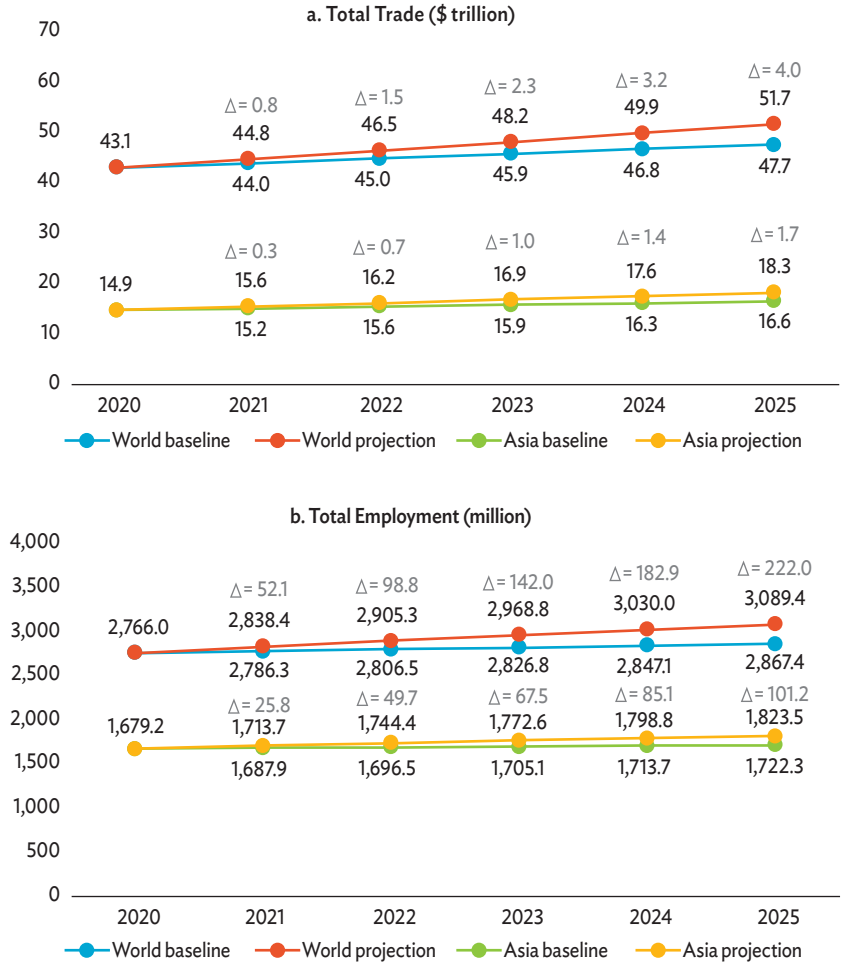
Table 3.5: GDP Impact of Digital Transformation, 2021–2025

Economy	Gains from same year baselines ($ billion)						
	2021	2022	2023	2024	2025	Total	Average
World	**1,532.6**	**2,950.4**	**4,311.0**	**5,646.0**	**6,974.4**	**21,414.4**	**4,282.9**
Asia	**606.5**	**1,180.2**	**1,738.0**	**2,287.6**	**2,832.9**	**8,645.0**	**1,729.0**
Australia and New Zealand	35.1	62.9	86.7	108.1	127.9	420.7	84.1
Central Asia	13.0	27.8	44.3	62.6	82.5	230.3	46.1
East Asia ex-PRC and Japan	50.5	95.4	137.0	176.5	214.7	674.0	134.8
PRC	183.2	338.8	470.6	580.2	667.9	2,240.7	448.1
Japan	137.1	268.8	398.9	529.5	662.1	1,996.4	399.3
Southeast Asia	88.9	181.8	280.2	385.1	496.9	1,432.9	286.6
South Asia	91.4	192.9	304.8	427.1	559.4	1,575.6	315.1
Pacific	7.2	11.8	15.4	18.6	21.5	74.4	14.9
G2	**565.5**	**1,048.3**	**1,479.1**	**1,875.7**	**2,249.4**	**7,217.9**	**1,443.6**
United States	232.1	422.5	586.1	730.8	862.0	2,833.5	566.7
EU-28	333.4	625.8	893.0	1,144.8	1,387.4	4,384.4	876.9
Rest of the World	**360.6**	**721.9**	**1,094.0**	**1,482.7**	**1,892.2**	**5,551.4**	**1,110.3**

Economy	Gains as proportion of 2020 baseline GDP (%)						
	2021	2022	2023	2024	2025	Total	Average
World	**1.9**	**3.7**	**5.5**	**7.2**	**8.8**	**27.1**	**5.4**
Asia	**2.1**	**4.1**	**6.1**	**8.0**	**9.9**	**30.3**	**6.1**
Australia and New Zealand	2.5	4.4	6.1	7.6	8.9	29.4	5.9
Central Asia	3.2	6.9	11.1	15.7	20.6	57.6	11.5
East Asia ex-PRC and Japan	2.2	4.2	6.0	7.7	9.4	29.4	5.9
PRC	1.5	2.9	4.0	4.9	5.6	18.9	3.8
Japan	2.7	5.3	7.9	10.5	13.1	39.5	7.9
Southeast Asia	2.6	5.4	8.3	11.3	14.6	42.2	8.4
South Asia	2.2	4.7	7.5	10.5	13.8	38.7	7.7
Pacific	13.0	21.2	27.8	33.5	38.7	134.2	26.8
G2	**1.7**	**3.2**	**4.5**	**5.7**	**6.8**	**21.9**	**4.4**
United States	1.4	2.5	3.5	4.3	5.1	16.7	3.3
EU-28	2.1	3.9	5.6	7.1	8.6	27.3	5.5
Rest of the World	**2.1**	**4.2**	**6.3**	**8.5**	**10.9**	**31.9**	**6.4**

EU = European Union, G2 = Group of 2, GDP = gross domestic product, PRC = People's Republic of China.
Notes: The calculations are based on the Global Trade Analysis Project (GTAP) database. Asia refers to Asia and the Pacific. In this case, economies that are not Asian Development Bank members are included due to the aggregation of the Pacific subregion in GTAP. The numbers do not necessarily sum up due to rounding.
Source: Authors.

Figure 3.6: Trade and Employment Impact from Digital Transformation, 2021–2025



Notes: The calculations are based on the Global Trade Analysis Project (GTAP) database. Asia refers to Asia and the Pacific. In this case, economies that are not Asian Development Bank members are included due to the aggregation of the Pacific subregion in GTAP. The numbers do not necessarily sum up due to rounding.
Source: Authors.

In total, Asia will realize a $5 trillion gain in trade until 2025. The US and Europe are expected to capture 33% of the global increase in total trade equivalent to over $3.8 trillion in 2021–2025.

Global employment is estimated to increase by about 140 million jobs every year or equivalent to 5.0% of the 2020 baseline global employment. With this rate of expansion, total jobs generated will be about 698 million by the end of 2025. Similarly, employment in Asia is expected to expand more than 65 million a year from its baseline levels or equivalent to 3.9% of the 2020 baseline. In total, the region will create over 327 million jobs during the 5-year period. In contrast, the US and Europe will create an additional 57.8 million jobs during the same period.

The estimated impact of the digital sector expansion, however, is not the same across all subregions in Asia (Table 3.5). The Pacific subregion will realize the most notable gains, with GDP expected to increase by an average annual 26.8%, employment by 26.1%, and trade by 15.6%, from 2021 to 2025, compared to respective 2020 baseline levels. Next is Central Asia, where GDP is estimated to increase annually by an average of 11.5%, employment by 7.1%, and trade by 7.7% relative to the 2020 baseline levels, during the same period. It is followed by Southeast Asia with estimated average annual gains of 8.4% in GDP, 6.2% in employment, and 8.0% in trade, relative to the 2020 baseline, also for the same period.

The larger expansion in output, employment, and trade in these subregions demonstrate the critical role of digital connectivity in overcoming geographic challenges. It also indicates the important productivity contribution of higher level of investments in the digital sector, especially for economies with very little or emerging digital presence. Similarly, greater adoption and usage of digital technologies can bring about a stronger digitally enabled trade in services, which can boost growth in the internal and external flow of goods and services.

3.6. How These Benefits Are Realized

Where do these large macroeconomic benefits from digital transformation come from? Generally, the large output, trade, and employment responses in the models come from two channels. The first channel is the direct expansion of the digital sector, which also raises the outputs of sectors supplying inputs to the digital sector. For example, as the work-from-home arrangement becomes the norm, a significant increase is seen in the demand for electrical and electronics equipment, which has also supported jobs, manufacturing activities, and exports in Asia and the world. The demand for software

development critical for many of these apps also supported the expansion of digital services. In digital payments, the need to avoid physical contact has seen greater use of online payment platforms and digital currency.

The second channel is the productivity spillover that higher usage of digital inputs brings to all sectors in the economy. For example, during the pandemic, the usage of digital technology has increased digital marketplaces, including telehealth, online education, e-commerce, and other digital platforms for the exchange of goods and services. These digital marketplaces generated high-quality goods and services and created new jobs and huge network externalities. In activities which require physical contact, many of the processes were also redesigned to automate and to shift to online some of the physical interactions. And they make the process faster and more efficient.

Digital technology can similarly enhance the delivery of essential public services. One example is public access to better and safer health services and education. Digital platforms can now deliver health services to remote communities using drones to deliver medical supplies. Artificial intelligence (AI) is used to recognize patterns in images or scans, increasing ability to customize and speed up responses to health emergencies. The pandemic also changed how and where we learn, and to learn new or more relevant skills. Presently, students of all ages are increasingly using smart devices to expand their knowledge.

Digital technology can also facilitate better design, targeting, and delivery of social assistance programs. In the Philippines, for example, *Bayan Bayanihan*, an emergency food program, used poverty maps made by innovative data analysis to identify vulnerable populations. More than a billion people can tap digital platforms across Asia and the Pacific, which give these technologies the power to help end poverty and promote social inclusion and equity.

On a wider scale, digital technology can help open and connect markets safely. However, this can only happen if underlying issues such as access to technology and digital connectivity have been addressed. These issues relate mainly to the phenomenon of the digital divide.

Improved logistics and delivery based on paperless and digital systems can ease trade flows, ensuring that critical supplies get where they are needed. Blockchain technology can help exploit the benefits of strong supply chains by streamlining border administration. And critically, developing systems

and regulations that upgrade financial services and broaden digital payment options can deliver safe and secure payment and financial transactions that support market liquidity and reduce financial risk.

Digital technology can be an impetus for developing and strengthening new drivers of inclusive economic growth. As policies allow for the greater adoption and use of digital technology, micro, small, and medium-sized enterprises can boost productive scale and efficiency and expand markets. Supplemented by technical support, toolkits, and free advisory services, they can now join a range of new online business practices.

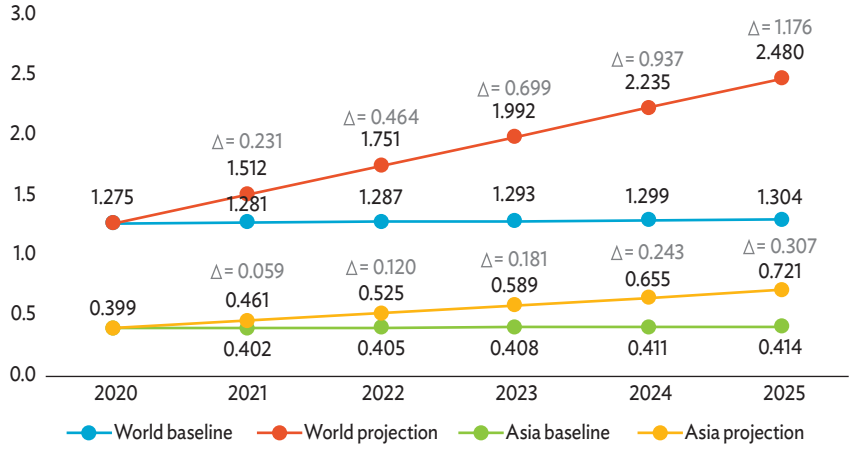
Human capital investment and developing digital skills is a lifelong process. Hence, the quality and relevance of digital education and training need to be boosted. In the workplace, AI can support career coaching, contributing to better job matching. Increasing access to smart devices and online training platforms will help re-educate, re-skill, and prepare workers for the future.

3.7. Policy Challenges of Digitalization

While digital marketplaces continue to develop rapidly, their success is not inevitable. How authorities in the region form policies and regulations to respond to opportunities and new challenges associated with technologies is important in maximizing the potential benefits and managing the risks associated with digital platforms. There are a few important priorities, as noted in ADB (2021).

First, investment in the digital sector needs to increase sharply across the region to support the projected expansion in the output of the digital sector. Globally, investment in the sector from 2020 to 2025 has to rise by an average of $701 billion annually or by $3.5 trillion in total, over the 5-year period (Figure 3.7). For Asia, investment in the digital sector should increase by about $182 billion annually or $910 billion over the 5-year span. These additional investments are needed to expand internet access and coverage and deliver affordable mobile and broadband services.

Figure 3.7: Investment Requirement, 2021–2025
($ trillion)



Notes: The calculations are based on the Global Trade Analysis Project (GTAP) database. Asia refers to Asia and the Pacific. In this case, economies that are not Asian Development Bank members are included due to the aggregation of the Pacific subregion in GTAP. The numbers do not necessarily sum up due to rounding.
Source: Authors.

Improving the trade and logistics processes and infrastructure is another key reform area to alleviate existing barriers to deliver the goods more efficiently. Evidently, the gap in the Logistics Performance Index between the best and worst-connected economies is wide. Increasing the application of digital technology to automate border procedures and customs clearance is vital. In addition, broadening the access to secure and safe digital financial services and payment systems can enable financial inclusion and inclusive growth. Consequently, investing in training to raise the level of digital skills and literacy by providing access to the necessary ICT devices and online teaching platforms is crucial. Moreover, a smart, transparent, effective, and robust regulatory system to protect personal data, prevent illegal activities, and strengthen cybersecurity will be useful.

Digital platforms will change markets, their participants, and the wider economy by reinventing market arrangements and creating new business models to generate and capture value. For instance, the growth of e-commerce in many economies has reduced retailers' profit margins and put enterprises out of business. The online platforms have also affected labor market arrangements through independent contracts, with little employment

protection and social security (Villafuerte 2020). Hence, as Villafuerte (2020) explained, it is important to consider appropriate regulations to manage the unintended adverse effects attributed to the emergence of digital platforms, including:

- ***Competition.*** Digital platforms have a "double-edged" nature. Numerous micro-businesses around the world may gain from unprecedented opportunities provided by these platforms, but they can also give rise to one or very few "winners" due to strong network effects. Authorities ought to design policies that encourage more competition and ease barriers to entry, while maintaining the network effect benefits those large platforms can bring. Governments should also promote interoperability to help market players collaborate and innovate for the benefit of consumers.

- ***Labor security and social protection.*** Governments should consider rolling out emergency health and social services and increase the coverage of social protection systems to cover workers who may fall into poverty, regardless of their working arrangements. This would include workers who lose their jobs due to the closure of physical retail outlets as a result of competition from digital platforms.

- ***Data access, privacy, and security.*** Digital platforms should exercise caution and maintain transparency in using, sharing, and creating value from the intrinsic value of data. Policies and regulations should uphold individual privacy and ensure that access to data and information is secure and not used to discriminate against different groups. Authorities can also help build effective security policies, and regulations will ensure information bring more evenly distributed benefits. In addition, cybercrime must be addressed.

- ***Taxation.*** Among many other concerns, taxing digital platforms is challenging due to difficulties in classifying digital activities, regulatory issues, and lack of cross-border harmonization on tax matters. As digital-enabled transactions become increasingly cross-border, greater international cooperation and stronger dialogue on policy making related to taxation issues are crucial.

While digital platforms continue to emerge rapidly, success is not preordained, as there will be many challenges and disruptions. Although technology could bring adverse changes, it could also usher in positive and inclusive development impacts. For example, the diffusion and application of digital platforms that are already available have strong potential to significantly raise agricultural and rural productivity, increase access to health and education, and greatly improve standards of living. These new emerging technology platforms could also allow developing economies to pursue an innovation pathway different from what advanced economies have tracked. How Asian economies respond and manage this digital transformation will determine their economic fortune.

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