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**International
Finance Corporation**
WORLD BANK GROUP

Creating Markets, Creating Opportunities

The Impact of COVID-19 on Disruptive Technology Adoption in Emerging Markets





Disruptive technologies—defined as emerging technologies that result in a step change in the cost or access to products or services or that dramatically change how we gather information, make products, or interact—increasingly have been altering the development paths of emerging markets and of businesses that operate in emerging markets. Examples of disruptive technologies include artificial intelligence (AI), blockchain, robotics, 3D printing, genomics, and distributed power systems. Disruptive technologies are far broader than digital services.

This note presents examples of how disruptive technologies have been employed in emerging markets during the COVID-19 crisis; discusses market trends that may heighten the role of disruptive technologies in emerging markets post crisis; and reviews risks to and opportunities of faster adoption of disruptive technologies in emerging markets. Throughout this note, post-COVID-19 typically refers to the period beyond 2021, when the economy starts to rebound, according to growth projections from the International Monetary Fund. However, this time horizon will be affected by potential new waves of the virus and by changes in individual preferences with respect to reopening.

Key Findings



- 01** The COVID-19 pandemic is exposing a large divide between high-income/upper-middle-income countries and poorer countries in digital usage and the availability of technology solutions to support the pandemic response.
- 02** Despite the divide, disruptive technologies are enabling numerous responses to the COVID-19 pandemic in emerging markets. Technologies adopted include online health care; blockchain-based epidemic monitoring platforms; robots that deliver food and medications and that screen people's temperatures; online education platforms and home-based working solutions; and robotics and 3D-printing technologies to manage social distancing in manufacturing plants. Governments have employed digital platforms, big data analytics, and AI to provide social welfare programs, which are often paid out using mobile money.
- 03** Technology companies in emerging markets are attracting investor interest even at times of capital outflows from emerging markets. For example, 54Gene, a two-year old company specializing in the collection of genetic samples in Nigeria, raised \$15 million in series A equity in mid-April; Bigbasket, an Indian online grocery platform, raised \$60 million in funding while the country was in lockdown.
- 04** The contribution of technology companies to COVID responses varies across sectors and is dependent on the presence of relatively developed digital ecosystems. In addition, their contribution is linked to their ability to quickly pivot toward new services and models, and their ability to expand into adjacent markets and to reach the underserved in a more cost-effective manner than traditional businesses.
- 05** Despite uncertainties surrounding the economic outlook post-COVID-19, emerging markets are expected to experience an acceleration in the adoption of disruptive technologies and a proliferation of online business models and platforms. The pace of the acceleration will likely be faster in upper-middle-income countries than in low-income countries. However, such acceleration will mean not only increased adoption of technologies developed in high-income markets but also innovation relevant to local needs.
- 06** Verticals where surges in demand are expected include online health care, education, commerce, e-logistics, fintech, and software-as-a-service. Verticals at risk of reduced demand in the short term because of COVID-related disruptions may include urban mobility, hospitality, and tourism.

Key Findings *(continued)*

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With venture capital funding in emerging markets outside of India and China representing only a small fraction of global venture capital funds pre-COVID-19, the availability of funding for disruptive technologies in emerging markets, especially in the smaller markets, will continue to remain a key issue. Development finance institutions like the IFC can help demonstrate the viability of disruptive technologies in emerging markets post COVID, thereby attracting more investors.

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Digital connectivity and digital skills—disruptive technologies in their own right—will become even more critical as foundations to enable the adoption of broader disruptive technologies. In low-income countries, governments can accelerate targeted interventions in this space: these interventions can include infrastructure sharing through independent private sector operators, limited taxation of mobile devices and digital services, and digital connectivity at education institutions.

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In middle-income countries, governments can enable fast scale up of technology companies by supporting local venture capital funds, promoting public-private partnerships, strategically adjusting the taxation of online services with the goal of enabling affordability, and aligning competition policy between online and offline services. These interventions can be complemented by setting up digital ID systems, promoting advanced digital skills at scale, and placing increased effort on cybersecurity and protecting personal data.

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Private companies could accelerate their digitalization by outsourcing their back-office operations to software-as-a-service companies and by gradually relying on technology companies to manage their relationship with suppliers, customers, and workers.

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In a post-COVID-19 era, development finance institutions (DFIs) can further support the scaling up of technology companies in emerging markets by intervening more upstream through the development of the enabling environment for increased investment in digital infrastructure, technology companies, and digital skills, especially in low-income countries.

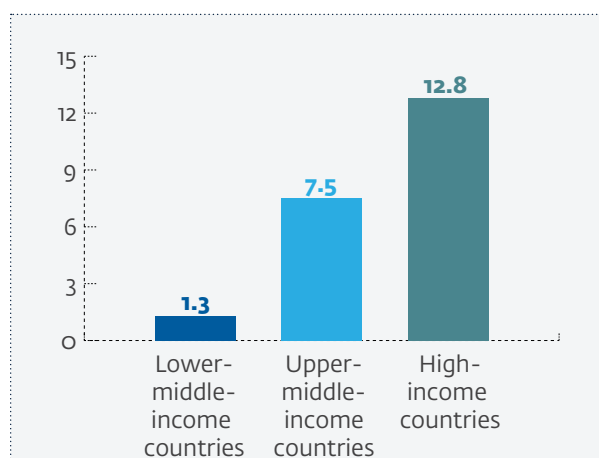
Disruptive Technologies Are Enabling Numerous Responses to COVID-19, Though at Different Scale across Emerging Markets

Prior to the COVID-19 pandemic, individuals, businesses, and governments increasingly relied on disruptive technologies, especially digital platforms, for a variety of activities including financial transactions, commerce, logistics, education, and health care. In 2019, mobile internet traffic per user, a proxy for the usage of digital platforms, was growing at a quarterly rate of 12 percent in high-income countries and 10 percent in middle-income countries.¹

The first few months of 2020, however, have witnessed an increased usage of technologies. Compared with usage in the first quarter of 2019, the usage of mobile internet grew faster in the first quarter of 2020 as citizens, governments, and businesses experienced dramatic changes in how they interact as a result of the COVID-19 pandemic and of lockdowns. Businesses have had to quickly set up new ways to keep workers delivering from home, maintain relationships with suppliers, and continue serving clients, if possible, with minimal physical contact (*Economist* 2020a). Governments have introduced new approaches to continue interacting with citizens for both public services and representation (*Economist* 2020b). Individuals are devising innovative methods for social interactions and consumption with limited physical contact.

The scale of technology usage, however, markedly hinges on countries' level of income (figure 1.1). Countries with lower incomes show lower usage of technology as part of their response to COVID-19. For instance, mobile internet usage, a measure of the use of digital technologies, grew faster across most countries during the first quarter of 2020 compared with usage in the first quarter of 2019. However, such acceleration largely depends on a country's level of income. According to early evidence from a selected number of countries, the quarterly growth in internet usage was 1.3 percentage points higher in lower-middle-income countries in first quarter 2020, compared with first quarter 2019. This excess growth is 10 times below that experienced by high-income countries and six times below that observed in upper-middle-income countries, reflecting a cross-country gap in digital connectivity.²

FIGURE 1.1. Excess Quarterly Growth in Internet Usage, Q1-2020 (percentage point)



Source: IFC research, using data from GSMA Intelligence (2020). Mobile data traffic per connection of 24 operators from 20 countries: seven lower-middle-income countries, nine upper-middle-income countries, and four high-income countries. Of those countries, two are in Africa, one is in Latin America, 10 are in Asia, and seven are in Europe. No data was available for low-income countries.

Note: The excess is the difference in quarterly growth rates between the first quarter of 2020 and the first quarter of 2019. For instance, in lower-middle-income countries, growth in internet usage was 1.3 percentage points higher in the first quarter of 2020, compared with the first quarter of 2019. Note that differences across income groups may also reflect differences in telecommunications technologies—for instance high-income countries use both fixed and mobile broadband—and differences in the timing of the outbreak.

¹ Authors' calculations based on data from GSMA Intelligence (2020), quarterly growth rates during 2019.

² According to GSMA Intelligence (2020), average penetration of mobile internet stood at 77 percent in high-income countries, compared to 58 percent in upper-middle-income countries and 36 percent in lower-middle-income countries.

Despite these challenges, disruptive technologies have been used by governments, businesses, and individuals in their responses to the crisis across the world. A review of how disruptive technologies have been employed in emerging markets during the crisis reveals a broad set of responses:

- **As part of the response to the health crisis**, many hospitals in high-income or upper-middle-income countries were able to quickly provide **online health care**, regulators waived restrictions on telemedicine, and users embraced the technology, many for the first time (Webster 2020).

Middle-income countries like China and India have leveraged technologies in response to the crisis. In China, virtual-care technologies were embraced by physicians as the country's national health insurance agency agreed to pay for virtual-care consultations and the government contracted large internet platforms to implement such technologies (Webster 2020). Lianfei Technology launched the nation's first **blockchain** epidemic monitoring platform, which can track the progress of COVID-19 in all provinces in real time and register the relevant epidemic data on the chain so that the data can be traced and cannot be tampered with (Xiaoxia 2020). **Robots** were used to disinfect hospitals (Chandran 2020). India has successfully deployed Aarogya Setu, a **contact-tracing app** that was downloaded by more than 100 million users in less than two months (Singh 2020a).

Low-income countries have also experimented with new technologies, especially with digital financial services, in response to the health crisis. For example, Rwanda temporarily eliminated charges on transfers and payment and tripled the maximum authorized amount of **mobile money** transfers, resulting in significant growth in peer-to-peer transfers, both in value and volume (Carboni and Bester 2020). The government has also deployed five **robots** that can deliver food and medications and can screen the temperatures of 50–150 people per minute, helping to limit health care workers' exposure (Brown 2020).

At the global scale, pharmaceutical companies are increasingly relying on **genomics** to accelerate the time from viral genetic sequence selection to the first human study, potentially shortening the time to the discovery of an effective vaccine (Bio 2020).

- **As part of their effort to build resilience**, education institutions across emerging markets have shifted to online instruction, using various media such as the internet, television, radio, and text messages (World Bank 2020a). Businesses have arranged **home-based work**, established social distancing in the office, or both

(*Jeune Afrique* 2020a). Manufacturing companies have relied on advanced technologies like **robotics and 3D printing** to manage social distancing (Fannin 2020). In addition, technologies have been used to soften the economic shocks. Governments, often in partnership with the private sector, have introduced disruptive technologies such as **digital platforms, big data analytics, and AI** to provide social welfare programs to the poorest (Rutkowski and others 2020).

In China, more than 24,000 online courses have been made available to university students. Several companies rushed to deploy robots during the crisis (Fannin 2020). In India, Sayam, a government-run education platform, hosted 1,900 complete courses for grades 9 through 12 and for higher education. The government leveraged the national digital ID system (Aadhaar) to provide targeted social benefits to 200 million women to ease the income shocks induced by COVID-19 (Bagchi 2020).

In Africa, OCP, a large agribusiness company, leveraged **telecommuting** applications like Zoom, Skype, and Microsoft Teams to enable 95 percent of its staff at headquarters to work from home (*Jeune Afrique* 2020b). Companies in the outsourcing sector in Morocco rely on telecommuting applications to enable 60 to 80 percent of workers to work from home, with the expectation that such an arrangement could be partly maintained post crisis (*Jeune Afrique* 2020c). Offline retailers, including Decathlon in Tunisia, built a website to support online shopping for the first time (*Jeune Afrique* 2020d). In Kenya, Kenblest Group, a bread and milling company, relies on an **online supply chain** application developed by the technology company Kobo360 to get wheat from the Mombasa port to its manufacturing facility outside of Nairobi (Maylie 2020). In Nigeria, the Oyo State School-On-Air program reaches 60 to 70 percent of students. The government of Nigeria used digital payment platforms to provide cash transfers to 3.6 million poor households (Human Rights Watch 2020). In the absence of up-to-date information about individuals' income, readily available data on the amount and frequency of mobile phone recharging have been referenced in Nigeria and the Gambia to target social welfare programs (IMF 2020).

These responses are being supported by technology companies (that is, software-as-a-service [SaaS] firms or online platforms) that are connecting individuals, businesses, and governments. The responses vary across sectors, depend on the presence of relatively developed digital ecosystems, and are linked to those businesses' ability to quickly pivot toward new services and models, to expand into adjacent markets, or to reach the underserved in a more cost-effective manner than traditional businesses. A

review of selected examples from emerging markets of how technology businesses have adapted their business models to rapidly respond to the crisis provides the following indications:

- In the **health care sector**, online pharmaceutical and diagnostics platforms and telemedicine companies have experienced a surge in demand as patients' preferences for health care services have shifted online (PR Newswire 2020). As a sign of the positive prospect in this sector, 54Gene, a recently established biobank in Nigeria, raised \$15 million in series A equity in mid-April as the number of new confirmed COVID-19 infections continued to rise in Africa (Crunchbase 2020).

Ping An Good Doctor, a Chinese healthtech company, had 10 times more newly registered users from early January to mid-February 2020, with average daily consultations reaching nine times more than normal (PR Newswire 2020). JD Health, the online health care subsidiary of Chinese e-commerce firm JD.com, has experienced a tenfold increase in monthly consultations on its platform since the outbreak (Economist 2020c). In India, 1mg, the largest integrated online health care platform, experienced a 440 percent jump in demand for flu and fever e-consultations following the national lockdown (Wilkinson 2020). Zipline in Rwanda is using drones to deliver essential goods (blood, medical supplies, and potentially vaccines) (de León 2020).
- In the **education sector**, companies that provide online tutoring, upskilling, and reskilling have provided free access to their services, or repurposed their platforms to train workers in the most in-demand skills.

Global online education platforms like Coursera and EdX have made thousands of courses available to students for free (Coursera 2020). In India, Byju's, a learning app for grades K–12, has experienced a 60 percent increase in the number of new users—it had 2.8 million paid users in 2019 (Dash 2020). In China, Zhangmen, an online one-on-one tutoring after-school service provider for K–12 students, experienced a near three-digit growth in January–February 2020, compared with the same period in 2019.³ Etudesk, an online education platform in Africa, is providing free access to students across Côte d'Ivoire and Senegal (Cio Mag 2020). Upskilling and talent-as-a-service companies like Andela and Gebeya in Africa or Revelo in Latin America are repurposing their business models to train workers in the most in-demand skills (Young and Alderson 2020).

- In the **retail sector**, e-commerce platforms that specialize in serving businesses have quickly switched to serving customers directly or through supermarkets, or they have broadened their product line to essential goods and services like agricultural, foods, and hygiene (Citizen Digital 2020). As a sign of continued investor appetite, Bigbasket, an Indian online grocery platform, raised \$60 million in funding while the country was in lockdown (Singh 2020b).

Twiga Foods, a business-to-business (B2B) e-commerce platform that specializes in delivering agricultural products to vendors in urban areas, has partnered with Jumia in Kenya to reach end-customers (Citizen Digital 2020). In April and May 2020, Bizongo, a B2B e-commerce platform, supplied 200,000 high-quality, certified PPE kits, helping protect 120,000 medical staff and 250,000 field workers across India. TradeDepot in Nigeria and MaxAB in Egypt are handling the distribution of goods to informal retailers that are seeking to manage operating expenditures and to limit the risk of infection at crowded wholesale offline markets.⁴

- **Long-haul e-logistics platforms** have increased activity to support growth in online shopping as a result of continued social distancing. In addition, some of these platforms, for instance in India, have expanded into adjacent markets like e-tolling and fueling. **Last-mile e-logistics platforms** (that is, companies using technologies to facilitate the delivery of goods in urban areas), have also witnessed an increase in traffic to support the growth in online shopping of foods and groceries.

For example, Full Truck Alliance, a market leader in B2B logistics in China, quickly recovered to half of its normal capacity by the first week of March 2020 with overseas expansion; the company acquired Brazilian TruckPad by the end of March during the COVID-19 outbreak. Kobo360 in Nigeria and Blackbuck in India are rebalancing traffic from low-demand to high-demand goods. And governments are relying on e-logistics companies like CargoX in Brazil and Liftit in Colombia to help with the distribution of essential goods.

PickMe, an online ride-hailing platform in Sri Lanka, pivoted from connecting cab drivers and passengers to an emergency delivery fleet during the crisis (Parajuli and Jayasooriya 2020). In Brazil, Mandae, a technology platform providing intracity delivery for small and medium enterprises (SMEs), experienced an increase in demand and also pivoted to serving larger companies.

³ IFC research, based on internal data and interviews with companies and investors.

⁴ IFC research, based on internal data and interviews with companies and investors.

- **Fintech** companies like LinkAja in Indonesia are partnering with governments that want to digitize payments of social welfare programs (Rahman 2020).
Safaricom, a mobile operator providing the mobile-money solution M-Pesa in Kenya, has waived fees to reduce the physical exchange of currency (Bright 2020). Ant Duo-Chain, a supply chain finance platform launched by Chinese Ant Financial in early 2019, allows SMEs to get instant credit by selling invoices to banks, which collect the money from the corporate customer, thereby giving higher liquidity to suppliers (*Ledger Insights* 2020). Lulalend, an online lending platform in South Africa, has maintained the provision of working capital to SMEs. TerraPay, a hub for remittance payments, enabled growth of internet money-transfer operators by allowing them to scale rapidly to several corridors by leveraging third-party platforms.
- **SaaS** providers such as cloud computing companies, information sharing platforms, or applications for business operations (for example, accounting and human resource) have made their databases and services available to governments to aid recovery support. Africa's Talking, a pure digital SaaS platform offering short text messages and application programming interface software to start-ups mainly in Kenya, is proposing a COVID-19 response platform using its technology for COVID-19 information dissemination to less affluent communities.⁵

Despite these challenges, disruptive technologies have been used by governments, businesses, and individuals in their responses to the crisis across the world.

⁵ IFC research, based on internal data and interviews with companies and investors.

Opportunities of Disruptive Technology Adoption in Emerging Markets Post COVID-19



Discussions with technology investors and market experts have indicated the expectation that **COVID-19 could accelerate innovation and technology adoption.** Established companies that survive could integrate innovations into their business models; new companies may emerge that alter competition and markets; and consumers could adapt their tastes rapidly. Businesses may leverage digital technologies to adapt and innovate, trying out novel business models, developing new business processes and practices, and redefining models for collaboration and teamwork. These trends are likely to occur in upper-middle-income economies, and potentially in lower-income countries as they gradually develop foundational elements such as digital connectivity and skills. China is already offering evidence of how COVID-19 will drive digitalization in upper-middle-income countries (Narayandas, Hebbar, and Li 2020).

An acceleration in the adoption of disruptive technologies in emerging markets will primarily be driven by responses to economic shocks (table 2.1). On the basis of discussions with market participants, a review of the IFC technology portfolio, and an analysis of evidence from recent technology trends across emerging economies, IFC has undertaken an assessment of how businesses, individuals, governments, and society can adopt innovative

technology solutions to respond to the short-term (by the end of 2020), medium-term (between 2021 and 2025) and the long-term (beyond 2025) shocks induced by the COVID-19 crisis (see table 2.1 for a detailed description). Such time horizons may be affected by a change in consumers' preferences, the duration of the crisis, and potential new waves of the pandemic.

TABLE 2.1. Summary of COVID-19 Shocks and Potential Technology Adoption in Emerging Markets

	SHOCKS	TECHNOLOGY ADOPTION	TECHNOLOGIES
Businesses	Increased cost of operations stemming from the implementation of social distancing in informal settings; reduced access to international capital as a result of outflows from EMs; resulting in loss of international competitiveness , with respect to advanced markets competitors	Digitalization of business operations , with increased use of digital financial services, automation, additive manufacturing and remote-control systems in tradable goods and services (including agriculture and aquaculture; mining, oil and gas; ports and logistics; retail and manufacture); but also in nontradable goods and services and the informal sector	Big data analytics and Cloud, AI, Internet of Things, blockchain, robotics, drones, 3D printing, genomics, and distributed power systems, supported by 5G

	SHOCKS	TECHNOLOGY ADOPTION	TECHNOLOGIES
Individuals	Business failures , resulting in long-term unemployment, in a context of limited government interventions; loss of skills stemming from reduced access to education and reduced learning, in a context of limited access to quality digital connectivity; reduced remittances as a result of widespread unemployment, ^a especially in advanced economies, and in a context of limited social security; resulting in long-term loss of income	Higher demand for goods and services typically enabled by online platforms, from middle-income urban households, as well as smallholder farmers more willing to join online platforms to access markets. Higher demand for social welfare programs , delivered in a cost-efficient manner, using digital connectivity, especially by low-income households.	Big data analytics and Cloud, AI, distributed power systems, supported by digital connectivity (3G and 4G)
Government	Reduced fiscal revenue as a result of business failures, unemployment, and reduced international trade; increased social expenditure stemming from investment in health and education, as well as social welfare and economic stimulus; resulting in widening public deficit	Investment in e-government solutions as governments gradually shift online to interact with citizens, businesses and visitors; and to operate (for example, teleconference), thereby reducing travel and events expenditures for both central and local governments.	Big data analytics and Cloud, AI, and blockchain
Society	Increased perceived risk of new health crises , given an initially low health care capacity; resulting in increased acceptance of tracking and biotechnologies	Digital surveillance for diseases surveillance and monitoring, smart cities, and digital ID by central or local government. Surge in contactless transactions to prevent infectious diseases. Increased usage of precision medicine for diagnostic by government, with higher usage of wearables by individuals.	Genomics, big data analytics and Cloud, AI, Internet of Things

Source: : IFC analysis based on discussions with market experts and technology investors.

a. Remittances, a major source of income in emerging markets, are expected to fall by 20 percent in 2020 (World Bank 2020b).

These trends suggest that in the medium term:

- To remain competitive, businesses will further digitalize operations to cut cost and alleviate loss of international competitiveness, with higher usage of information and communication technologies to enable remote work, supply chain management, and an online relationship with clients.
- Individuals who have been exposed to online services during the pandemic are expected to increase their relative consumption of online goods and services compared to before the crisis (for example, online group buying of agricultural products and foods, online price comparison platforms, ride-hailing and bike sharing), all of which are typically more affordable than offline counterparts. This increase in the consumption of online services may contribute to less greenhouse gas emissions as more services are delivered with less movement of goods and people.
- To alleviate public deficits and expand social services, governments will invest in faster digitalization (for example, digital ID, government payments, levies and workforce management).

A number of underlying societal and economic trends will be accelerated by the pandemic and by the expected economic crisis, and those trends will also help to spearhead the adoption of disruptive technologies, although governments' attitudes toward the pandemic and individuals' ability and willingness to embrace change will determine the ultimate pace of technology adoption. Technology investors and market participants have identified a number of trends that are expected to support

momentum in investing in disruptive technologies in emerging markets including the following:

- The rise of a contactless society, that is, a reduction in offline human interactions, for instance in financial transactions and the use of cash (Cohn 2020), with clear opportunities for digital currencies. Online delivery platforms increasingly offer contactless options.
- Preferences for shorter business cycles (that is, production and consumption within the same geographical area), could accelerate as a result of a rising concern for local resilience and reshoring (Seric and Winkler 2020)—this may require the development of new digitally based logistics support systems locally.
- Diversification of international supply chains (that is, sourcing of products and services from a variety of suppliers), both geographically and technology-wise, as businesses increasingly build resilience (Kirby 2020). This diversification could provide an opportunity for other countries, particularly frontier markets, to compete with China as a manufacturing base. This diversification could be complemented by a surge in last-mile direct-to-consumer distribution lines.

Well-capitalized technology companies with a large network of users and vast amounts of digital data are better positioned to seize the opportunities offered by the crisis.⁶ E-commerce platforms with large numbers of users may quickly expand into e-payments, while large online urban mobility platforms are better positioned to expand into online delivery. Such opportunities could be materialized through early acquisitions of start-ups, potentially limiting competition.⁷

Businesses may leverage digital technologies to adapt and innovate, trying out novel business models, developing new business processes and practices, and redefining models for collaboration and teamwork.

6 A number of global platforms are already in discussion to acquire struggling rivals (Loten 2020).

7 Such consolidations may also benefit customers because combined operations enable strong network externalities and economies of scale and scope.

Risks to Adoption of Disruptive Technologies in Emerging Markets Post COVID-19



One of the biggest risks to the adoption of disruptive technologies stems from the macroeconomic impacts of the crisis, in particular, increased long-term unemployment or underemployment. The income loss from such outcomes could limit any increase in demand for online services, thereby constraining the adoption of disruptive technologies by businesses. In addition, increased inequalities could limit a broader adoption of technologies by individuals, especially women. COVID-19 is expected to exacerbate labor force and income gaps for women (World Bank Group 2020), particularly because women are less likely to have access to digital skills and assets (Guermazi 2020) and more likely to be disproportionately affected by increases in automation (Brussevich and others 2018).

Significant barriers to digital connectivity remain that could slow the adoption of disruptive technologies in emerging markets, including the availability of affordable quality internet access and the level of digital skills in the majority of the population of formal and informal workers (GSMA Intelligence). Nearly 3 billion people in emerging markets are still offline (GSMA Intelligence),⁸ and the majority of them are women, who are 20 percent less likely than men to use mobile internet and less likely to use digitalization to mitigate the economic impact of the pandemic (GSMA 2020). This digital divide could widen further with COVID-19, potentially limiting the diffusion of disruptive technologies.

The risks of a persistent digital divide remain severe. The biggest acceleration of technology and digital solutions during the COVID-19 crisis occurred in countries that had a fairly developed digital ecosystem (for example China, India, Kenya, and Nigeria). Any additional funding for technology companies may be primarily directed to those markets with existing infrastructure and ecosystems, which risks leaving others behind. Another divide that may be widened pertains to urban and rural areas. New technology solutions, especially those focusing on last-mile delivery, e-commerce, and e-payment, support the rise of the digital urban consumer, but these solutions may not reduce the urban/rural divide fast enough. Although digital solutions in health care and education have the potential for universal consumption, connectivity barriers in rural areas may make these services harder to use. Realizing the opportunities offered by COVID-19 will require universal access to the internet. A technological gap could also emerge if low-income countries cannot accelerate investment in next generation technologies like 5G or AI.

Cybersecurity risks will likely increase because the rising use of digital services increases exposure to cyberattacks (Deloitte 2020), affecting societal trust in disruptive technologies. For example, in South Africa, up to 300,000 mobile devices suffered

from various network attacks in one week during the lockdown (CISOMAG 2020). In addition, there is a risk that COVID-19 may limit the expansion of technology start-ups by reinforcing **first-mover advantage** positions. Further, privacy concerns remain critical to ensure citizens' data is protected.

COVID-19 also carries a number of broader risks for technology companies in emerging markets, including limited access to venture capital for start-ups, reinforcement of first-mover advantage, and a prolonged pandemic. **Venture capital**, which is essential for providing early stage risk capital to technology companies, may not be available to start-ups as venture capital funds concentrate more on supporting existing portfolio companies and on adjusting their reserve capital accordingly (Gelfer & Zane, 2020). Venture capital deals typically drop off in times of crisis (Startup Genome 2020), which can prevent start-ups with limited cash to continue growing in expectation of a recovery. However, start-ups from the poorest markets, like Africa, may be more resilient because prior to the COVID-19 crisis they were operating in a resource-constrained environment with an emphasis on growth balanced by profitability and positive cash flow. Start-ups will need to focus more on cash-cutting measures and on frugal management of working capital.

In the near-to-medium term, technology companies across verticals with strong offline human interactions such as urban mobility (ride hailing and car, scooter, and bike sharing), hospitality, tourism, airlines, and events may struggle to recover from the crisis because of lockdown and social distancing measures—although mobility companies may mitigate losses through rapid shifts to delivery and freight services. Many of these technology companies are laying off large numbers of workers to align with the expected decline in their revenues including global technology companies with a presence in emerging markets such as Uber and Airbnb (*Financial Times* 2020).

⁸ Sharing of phones, a practice widely present in developing countries, could provide access for some of the unconnected. However, this practice raises confidentiality issues, limiting the use of sensitive digital services like e-payment and online health care.

Recommendations to Support the Adoption of Disruptive Technology in Emerging Markets Post COVID-19

Against a context of technology divide in emerging markets resulting from lower incomes, funding, digital connectivity, and digital skills, there are opportunities for targeted interventions that enable scale up of technology companies and that limit the risk of widening the gap between low-income and middle-income countries. Discussions with market participants and IFC portfolio companies have identified potential interventions, including supporting local venture capital funds, promoting public-private partnerships, and aligning taxation and competition policy between online and offline services. These interventions are government-driven, but they could be complemented by private sector strategies such as research and development expenditures and by corporate governance that is more amenable to technology adoption. They can be further enhanced by various other stakeholders, including multilateral development banks and development finance institutions.

Recommendation 1: Governments could support local private venture capital funds, accelerators, and incubators by matching funds from private investors and development finance institutions. For example, governments could repurpose funds or grants previously dedicated to public incubators or accelerators to match private sector angel or seed investor groups. Low-income countries often exhibit unique challenges that may not be addressed by adapting innovations from developed markets. In such context, local venture capital funds are better positioned to drive the emergence of technology companies with products and services that are highly valued by users to support rapid and sustainable scale up and penetrate the “mass market,” especially low-income consumers and informal retailers. Traditional businesses with heavy assets have successfully reached scale in low-income countries, suggesting that asset-light technology companies can scale too, and probably faster. These interventions will need to be refined according to demand factors such as the availability of digital skills and trust in online services.

Recommendation 2: Public-private partnerships (PPPs), whereby private technology companies manage specific public services, can be accelerated, especially in countries with a fairly high level of digital connectivity. Technology companies can be involved in the management of routine government operations such as the collection of certain taxes and fees and in the delivery of public services in sectors such as education, health care, and mobility. Key areas of PPPs include the provision of ancillary public services like upskilling of workers, tracking of drugs, and bike or car sharing in cities. A number of such PPPs are underway in several countries, including cash transfers with LinkAja in Indonesia and urban mobility with Bykea in

Pakistan (Rehman 2020). However, they are yet to be embraced by low-income countries as they expand their digital connectivity.

Recommendation 3: Aligning taxation between online and offline services. In low-income countries, relaxing taxation on digital connectivity can help boost the uptake and usage of digital platforms, thereby supporting the diffusion of disruptive technologies such as mobile financial services, online education, and health care. Such measures can be considered in the aftermath of the crisis to support a digitally enabled recovery. In middle-income countries, more strategic taxation of online versus offline services, with the goal of enabling affordability, can support wider adoption of digital services, especially by the poor, with faster scale up of technology companies. Digital services such as online shopping are often subjected to specific taxes above and beyond taxes on the offline equivalent, potentially limiting their affordability. In India for instance, e-commerce platforms are required to withhold 1 percent on the gross amount of sales (Bhojwani and Bhalla 2020). In the context of a high level of unemployment post COVID-19, maintaining these taxes could limit the uptake of digital services.

Recommendation 4: Competition and innovation policies could become more aligned with the functioning of technology companies because most were initially designed to regulate traditional companies. Merger control could be softened to provide exit opportunities for technology start-ups. More flexible intellectual property laws, especially copyrights on digital contents harmonized across several countries, could enable technology companies to rapidly innovate.

Recommendation 5: Governments could further complement these interventions by investing in a set of enabling digital pillars. These pillars include setting up a digital ID system and connecting schools and universities to the internet, while encouraging partnerships with private sector players to enhance technological education and preparedness through online course work and exams (as opposed to building their own), and supporting private higher education institutions delivering specialized information technology programs. Ensuring cybersecurity and personal data protection also will be key to building public trust in technologies. Removing legislative and regulatory barriers in key sectors such as online health care and education could further boost adoption, including more disruptive technologies in publicly procured projects (for example, public transport), innovation sandboxes, and fostering a market for local technology start-ups.

Recommendation 6: Beyond government intervention, private companies could partner with technology companies instead of developing in-house technologies. Where legislation permits, private companies can accelerate their digitalization by partnering with technology companies. These partnerships can take the form of

commercial contracts or venture capital investment in technology start-ups developing complementary services. For example, a retailer could partner with an e-commerce platform or invest in an e-logistics platform to develop online sales instead of developing its own platform. Outsourcing of technological solutions already is underway especially with software-as-a-service companies like cloud service providers; however, digitalization can be accelerated at a lower cost, especially in the context of a post-COVID-19 recovery, by gradually relying on technology companies.

Recommendation 7: In the post-COVID-19 era, development finance institutions can further support the scaling up of technology companies in emerging markets by intervening more upstream. For example, IFC is developing upstream projects to further develop the enabling environment for increased investment in digital infrastructure, technology companies, and digital skills, especially in low-income countries. Such initiatives should become more widespread to create lasting conditions for the growth and sustainability of technology companies in emerging markets, thereby supporting the expansion of their digital economy and strengthening their resilience to shocks like the COVID-19 pandemic.

Discussions with market participants and IFC portfolio companies have identified potential interventions, including supporting local venture capital funds, promoting public-private partnerships, and aligning taxation and competition policy between online and offline services.

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