



United States
International Trade Commission

Global Digital Trade 1: Market Opportunities and Key Foreign Trade Restrictions

August 2017
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United States International Trade Commission

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Abbreviations and Acronyms

Acronym	Definition
3D	three-dimensional
3G	third generation (of mobile telecommunications technology)
3PL	third-party logistics
4G	fourth generation (of mobile telecommunications technology)
ACE	Automated Cells and Equipment (systems integration firm)
AI	artificial intelligence
AML	anti-money laundering
AOL	formerly America Online, Inc. (division of Verizon)
APAC	Asia-Pacific region
APEC	Asia-Pacific Economic Cooperation (organization)
ATM	automated teller machine
AVMS	Directive on Audiovisual Media Services (European Union)
AWS	Amazon Web Services
B2B	business-to-business
B2C	business-to-consumer
BKPM	Investment Coordinating Board (Indonesia)
BPaaS	business process as a service
BRICIE	Brazil, Russia, India, China, Indonesia, and the European Union
BRTI	information technology regulatory agency (Indonesia)
BSA	The Software Alliance (trade association)
C2C	consumer-to-consumer
CAGR	compound annual growth rate
CD	compact disc
CDN	content delivery network
CIDS	social economic interference contribution (Brazilian technology transfer tax)
CNN	Cable News Network (division of Time Warner)
COD	cash-on-delivery
CPQ	configure-price-quote software
CRM	customer relationship management
CRO	Compulsory Registration Order (India)
CSP	cloud computing service provider
DaaS	data as a service
DDoS	distributed denial of service
DEITY	Department of Electronics and Information Technology (India)
DIM	days in milk
DJI	Da-Jiang Innovations (drone manufacturer)
DLC	downloadable content
DNS	domain name system or domain name servers
DPI	deep packet inspection
DVD	digital video disc
EC	European Commission
ECB	European Central Bank
EDI	electronic data interchange
ERP	enterprise resource planning
EU	European Union
FAA	Federal Aviation Administration
FDI	foreign direct investment

Acronyms and Abbreviations

Acronym	Definition
FM	fleet management
FSB	Federal Security Service (Russian Federation)
FSTEC	Federal Service for Technical and Export Control (Russian Federation)
G20	Group of Twenty (forum for international economic collaboration)
GaaS	games as a service
GB/s	gigabytes per second
Gbps	gigabits per second
GIS	global information systems
GM	General Motors
GMAC	General Motors Assurance Company
GPA	Government Procurement Agreement (World Trade Organization)
GPDR	General Protection Data Regulation (European Union)
GPS	global positioning system
HIPAA	Health Insurance Portability and Accountability Act of 1996
HVAC	heating, ventilation, and air-conditioning
IaaS	infrastructure as a service
IBM	International Business Machines
ICT	information and communication technology
IEEE	Institute of Electrical and Electronics Engineers
IFPI	International Federation of the Phonographic Industry
IoT	Internet of Things
iOS	proprietary operating system for Apple smartphones
IP	Internet protocol or intellectual property
IPO	initial public offering
IPR	intellectual property rights
ISP	Internet service provider
IT	information technology
ITA	Information Technology Agreement (Indonesia)
ITE	Information and Electronic Transactions Law (Indonesia)
KB/s	kilobytes per second
Kbps	kilobits per second
LAN	local area network
LED	light-emitting diode
LONIS	Law of Network Information Security (Vietnam)
LTE	Long-Term Evolution
M2M	machine-to-machine
MB/s	megabytes per second
Mbps	megabits per second
MCI	Ministry of Communications and Information (Indonesia)
MCIT	Ministry of Communication and Informatics (Indonesia)
MGI	McKinsey Global Institute
MHI	Material Handling Institute (nonprofit organization)
ML	machine learning
MoT	Ministry of Trade (Indonesia)
MPAA	Motion Picture Association of America
NEC	NEC Corporation (Japan)
NIST	National Institute of Standards and Technology
NPR	National Public Radio (nonprofit news broadcaster)
NTE	National Trade Estimate Report (USTR)
NYU	New York University
OECD	Organisation for Economic Co-operation and Development
OTT	over-the-top communication services

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Acronym	Definition
P2P	peer-to-peer
PaaS	platform as a service
PAYG	pay-as-you-go
PC	personal computer
PLA	People's Liberation Army (China)
PRC	People's Republic of China
PwC	PricewaterhouseCoopers (consulting firm)
QR	quick response barcodes
R&D	research and development
RFID	radio frequency identification
RMB	Chinese renminbi (yuan)
ROI	return on investment
SaaS	software as a service
SAS	formerly "Statistical Analysis System" (analytics software firm)
SCAA	State Civil Aviation Authority (Russian Federation)
SEC	United States Securities and Exchange Commission
SDN	software-defined networking
SD-WAN	software-defined wide area network
SMEs	small and medium-sized enterprises
SMS	short message service
SOE	state-owned enterprise
SSA	sub-Saharan Africa
TB/s	terabytes per second
Tbps	terabits per second
TIA	Telecommunications Industry Association
TRIPS	The Agreement on Trade-Related Aspects of Intellectual Property Rights
UAS	unmanned aerial systems
UAV	unmanned aerial vehicle
UBI	usage-based insurance
UC	unified communications
UCaaS	unified communications as a service
UNCTAD	United Nations Conference on Trade and Development
UK	United Kingdom
URL	uniform resource locator (Internet address)
USB	universal serial bus
USDA	United States Department of Agriculture
USTR	[Office of the] United States Trade Representative
VoD	video on demand
VoIP	Voice over Internet Protocol
VPN	virtual private networks
WAN	wide area network
WLAN	wireless local area network
Wi-Fi	IEEE 802.11x wireless networking standard and associated wireless-capable devices
WTO	World Trade Organization

Executive Summary

This report is the first of three on global digital trade to be prepared by the U.S. International Trade Commission (Commission) during 2017–19, at the request of the U.S. Trade Representative (USTR). The reports will describe developments in several areas—global business-to-business (B2B) and business-to-consumer (B2C) digital trade; the adoption of digital technology by different industries; and market conditions for U.S. companies in foreign markets, including regulations and policy measures related to digital trade that may impede those companies’ ability to compete.

Highlights

Global digital trade is growing quickly as Internet usage is increasingly cloud-based. Four U.S. companies (Amazon, Microsoft, Google, and IBM) are the top global providers of cloud computing services. The United States (\$44 billion), EU (\$15 billion), and China (\$1.3 billion) spent the most on public cloud computing services in 2015.

Global e-commerce grew from \$19.3 trillion in 2012 to \$27.7 trillion in 2016. B2B e-commerce makes up more than 86 percent of that total. Top B2C e-commerce markets in 2015 were China (\$767 billion) and the United States (\$595 billion).

U.S. industry representatives report that many types of measures—data protection and privacy, cybersecurity, censorship, and restrictions on market access and investment—may impede digital trade. Overall, the most cited policy measure impeding digital trade was data localization, while **content industry representatives reported that ineffective enforcement of intellectual property protection affected them the most.**

As requested by USTR, this report provides, to the extent available:

- A description of the broad landscape and recent developments of important B2B digital products and services used primarily by firms, such as cloud-based data processing, storage, and software applications, as well as communications services and digital services related to manufacturing and the Internet of Things (IoT)¹;
- An overview of developments in the provision of B2C digital products and services used primarily by consumers and individuals;
- Information on the market for digital products and services, both in the United States and in key foreign markets, such as the European Union (EU), China, Russia, Brazil, India, and Indonesia, with a particular focus on products and services that can scale globally, for the purpose of assessing U.S. firms' global competitiveness;
- Up-to-date information on the rate of adoption of digital technologies, domestically and abroad, and on the importance of data flows (domestic and cross-border) to a wide range of sectors across the economy; and
- A description of regulatory and policy measures currently in force in important markets abroad that may significantly impede digital trade. Such measures affecting digital trade might include restrictions on foreign direct investment and other means of market access; limitations on cross-border data flows (data localization requirements, Internet blocking, censorship, cultural regulations of digital content, and data privacy protections); cybersecurity regulations and limitations on the choice of encryption technologies; regulations on Internet service providers (ISPs), including limitations on ISPs intended to protect intellectual property rights; rules determining liability for third-party content; and intellectual property rights enforcement.

This report describes recent developments in digital trade, defined as the delivery of products and services over either fixed-line or wireless digital networks. It also describes the use of digital products and services by a wide range of industries, including online sales of goods and services over e-commerce platforms. The report is organized by type of digital product or service, with details of recent market trends, rates of adoption, and the importance of data flows provided for each broad category of B2B and B2C digital product or service. Relevant policy measures are discussed together in the final chapter as these apply across the range of digital products and services. The Commission used industry and economic research, including a public hearing, open-source research, and fieldwork (domestic and foreign) to prepare this report in response to the USTR's request.

¹ The Internet of Things refers to digital technologies that include Internet-connected physical devices and sensors.

Report Overview

Digital technologies are transforming business and international trade. The expansion of network infrastructure has contributed to the creation of a large pool of devices, cloud services, and data analytics resources that are used by many companies. The network expansion has greatly increased Internet speed and access while reducing costs. As a result, the sophisticated technology found in many new (and increasingly affordable) devices has been able to exploit the higher bandwidth available to collect and transmit more data. The expanded capacity and functionality of Internet-based infrastructure and technologies has also enabled the growth of cloud-based services.

Advances in analytics and machine learning (ML), which take advantage of cloud infrastructure and cloud services' relatively cheap and plentiful processing capabilities, have led to cost savings and innovations in many industries. Access to affordable analytics has enabled firms to achieve more precision in product development and marketing in particular. For example, chemical firms use analytics to simulate the properties of chemical compounds before they actually experiment with them. To improve efficiency in customer service, firms' "chatbots" use artificial intelligence (AI) to respond to a wide range of questions from customers, allowing customer service representatives to focus on more complex queries.² In the media sector, content providers use cloud-based analytics to customize the video content they offer viewers and to make digital video gaming accessible anywhere and anytime to game players. Similarly, e-commerce shopping platforms such as Amazon and eBay, which are integrated across devices, effectively target and optimize retail services.

The range of Internet communications services and devices that can connect to the Internet has expanded rapidly, opening new avenues for communication and data gathering. Services facilitating voice, video, and other methods of interaction between people (for business or personal use) exemplify this trend, as does the use of smartphones, tablets, wearables, and remote healthcare devices. In addition, with networks of connected devices in "smart homes" and "smart cities," consumers and public utilities are able to remotely monitor or even adjust settings within a home or a city.

Although cloud-based data processing and analytics capacity has expanded in many markets, some countries have imposed regulatory and policy measures that slow or halt the adoption of digital technologies and digital trade domestically. According to industry analysts, data

² A bot is a software application designed to automate defined tasks and/or provide standardized replies, typically in response to verbal or typed queries. De Laminne, "What Is a Bot or Chatbot?" April 11, 2017; LaFrance, "The Internet Is Mostly Bots," January 31, 2017.

localization rules that require data storage, management, and/or processing to occur in a single country are a major impediment for firms engaged in digital trade, because they prevent firms from taking advantage of the cost, speed, and security advantages offered by the distributed nature of cloud-based technologies. These types of policies affect different firms in different ways: some are able to store their data locally, albeit at additional cost, while others have found that they cannot operate profitably in smaller countries with data localization policies.

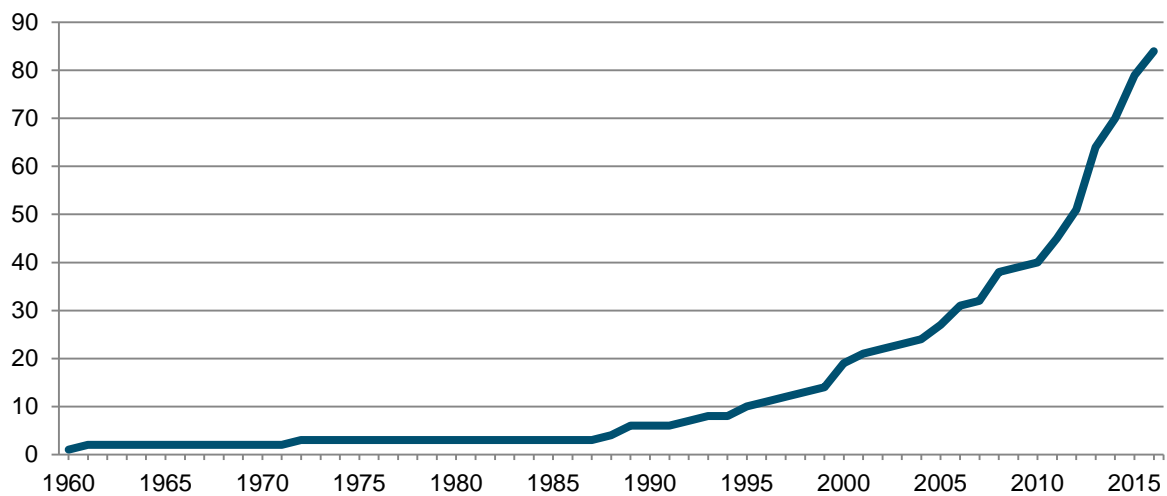
Regulatory and Policy Measures

Regulatory and policy measures that impede digital trade in major markets abroad generally fall into six categories:

- Data protection and privacy (including data localization)
- Cybersecurity
- Intellectual property rights
- Censorship
- Market access
- Investment

As discussed above, according to U.S. industry representatives, data localization measures pose a significant problem for U.S. firms doing business across borders, due to the importance of free-flowing data for digital trade. Data localization measures are typically enacted for privacy or cybersecurity reasons. U.S. industry representatives report that each of the key foreign markets covered in this report (Brazil, China, the EU, India, Indonesia, and Russia) has some type of data localization policy in place. Many U.S. companies and trade associations have voiced special concern about the EU's General Data Protection Regulation (GDPR), which comes into effect in 2018, due to many U.S. firms' extensive trade with the EU. While the GDPR allows data to be transferred to countries with approved privacy frameworks, it places significant restrictions on the data and is expected to raise the cost of data storage and processing. Further, countries outside the EU often use EU regulations as a model for their own, magnifying the potential effect of the EU's rules. Although businesses increasingly rely on data flows, with fully half of all global trade in services now depending on access to cross-border data flows, the number of data localization measures has grown considerably in recent years (figure ES.1), and doubled in the last six years.³

³ The United Nations defines trans-border data flows as "movement across national boundaries of machine readable data for processing, storage or retrieval." United National Center on Transnational Corporations (UNCTC), *Transnational Corporations and Transborder Data Flows: A Technical Paper*, 1982, 8.

Figure ES.1: Number of data localization measures globally (1960–2015)

Source: ECIPE Digital Trade Estimates database.

Note: The database includes data localization measures of 65 countries, worldwide. Corresponds to [appendix table G.1](#).

U.S. industry representatives have also expressed concern about cybersecurity restrictions in many countries. They claim that two types in particular—source code disclosure requirements and restrictions on cryptography—can seriously impede digital trade. Many firms consider their source code to be highly valuable proprietary information, and have expressed concern that foreign governmental authorities will not keep source code confidential. Citing security reasons, Brazil, China, and Indonesia have implemented or introduced such requirements. Some countries have also begun requiring the use of specific (often local) cryptography standards or methodologies. These requirements can keep firms from using their preferred cryptography methods, which are often more advanced, and force them to create unique products for that market, thus increasing cost. China, India, and the United Kingdom all have restrictions on cryptography.

Some governments have adopted censorship measures which block Internet content for various reasons related to the public interest. Censorship policies have affected a wide range of content providers, including news, video, and social media services. China is considered by many to have the most extensive censorship network, with more limited instances of censorship in India, Indonesia, and Russia. In China, many websites are entirely blocked, and specific topics are filtered.

Poor protection of intellectual property rights in a country's legal framework, or the weak enforcement of such rights, can lead to widespread digital piracy, which makes it difficult for providers to profit from the legal sale of their content. For this reason, many industry

representatives support a well-administered intellectual property rights protection regime with effective enforcement. Many content providers also support laws expanding Internet intermediaries' liability for hosting copyright-infringing content on their websites. However, some Internet intermediaries argue that increased liability raises their costs, reduces their ability to host content, and restricts the ways they can combat piracy.

Other anti-infringement measures that U.S. firms view as controversial are the “ancillary” copyright laws imposed by Spain and Germany. These laws require payments to news publishers from search engines and online platforms that provide short fragments of news text (including headlines and quotations) to the public. Ancillary copyright laws potentially drive up costs, including administrative costs, for news aggregation providers.

Industry representatives also note concerns about policies that impact market access for digital trade. Important issues include measures affecting customs de minimis rules, electronic payment systems, technical standards, and government procurement. Low de minimis thresholds (which impose duties and taxes on relatively low-value imports) and restrictions on electronic payments can make it particularly difficult for small businesses to engage in digital trade. Regulations that impose country-specific technical standards on hardware and software products can impede U.S. exports, as can government procurement rules that give preference to domestic firms. U.S. industry representatives have raised particular concerns about China's technical standards policies, while concerns related to government procurement are expressed by observers in many countries.

Policies affecting foreign investment by digital trade firms include limitations on foreign ownership, discriminatory licensing and taxation policies, and local content requirements. Industry representatives have especially noted Chinese and Indonesian limitations on foreign ownership that require firms to set up joint ventures with local firms to access those markets. Indonesia and Russia have made investment in their markets more difficult for global Internet companies, including several headquartered in the United States. Brazil, China, the EU, India, Indonesia, and Russia all maintain local content requirements—for example, rules mandating that a minimum share of audiovisual content streamed within a country be locally produced—and industry representatives note that instances of such measures have increased in recent years.

Internet Infrastructure and Network Communications Services

The Internet has grown remarkably, with sizable increases in bandwidth driven by more long-haul fiber-optic terrestrial and submarine cable networks, 4G mobile networks, and high-bandwidth local networks. Mobile broadband has expanded particularly quickly, as it is useful in less developed areas where fixed broadband connections may be both costly and difficult to install. Not only have improvements in infrastructure enabled more data to travel over the Internet, but global speeds (both mobile and fixed broadband) have also increased sharply. These higher speeds enable the devices and services discussed in the rest of this report to function.

The complex traffic demands of cloud computing and data centers are driving rapid growth in high-bandwidth business Ethernet services and a shift to more flexible methods of routing traffic and other B2B network functions. Heavier use of Internet-based communication services has likely been a factor in the substantial decline of traditional international voice traffic.

Cloud Services

Cloud computing services can be divided into three major categories: software as a service (SaaS),⁴ infrastructure as a service (IaaS),⁵ and platform as a service (PaaS).⁶ Each category has grown steadily in recent years. While SaaS continues to absorb the largest share of global spending on cloud services, IaaS has been the fastest growing, with spending on IaaS almost quadrupling since 2012. IaaS has benefited from the fact that more businesses now rely on cloud infrastructure services in addition to or in place of their own storage and processing capacity (table ES.1). IaaS and PaaS are primarily used for B2B activities, while SaaS is used for both B2B and B2C applications.

⁴ A software or application that is hosted on cloud infrastructure and accessed over the Internet.

⁵ Large networks of servers providing data storage and processing capacity.

⁶ Dedicated platforms that companies use to develop software and applications supported by cloud infrastructure. PaaS is designed as a bridge between IaaS and consumer-facing cloud software services. Rackspace, *Understanding the Cloud Computing Stack*, 2017.

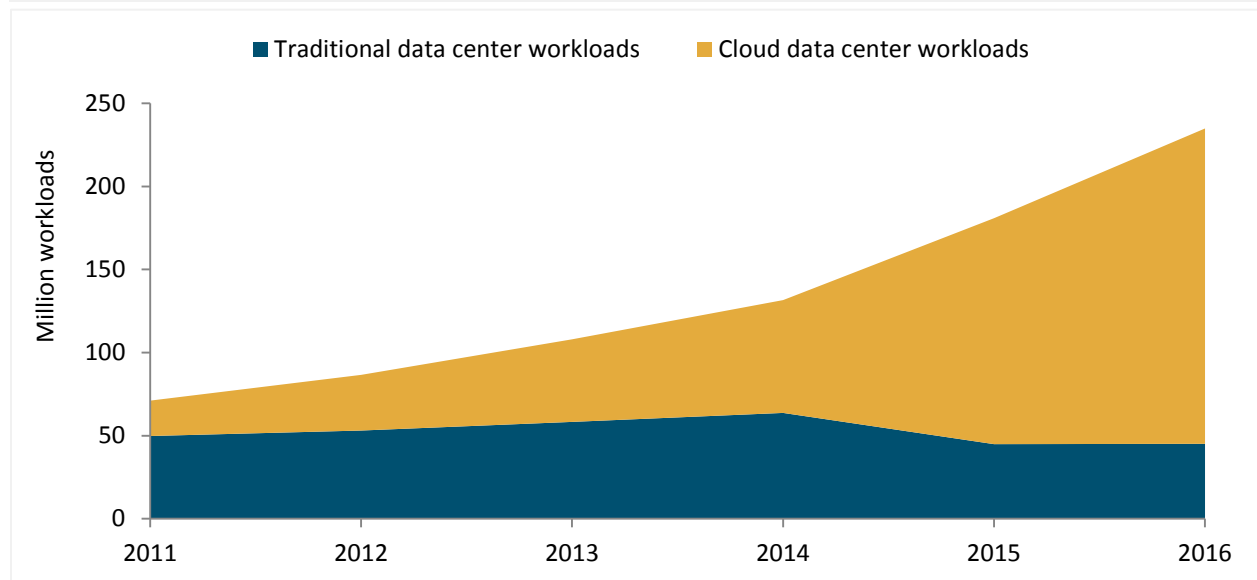
Table ES.1: Global spending on public cloud services, 2012–16 (billion \$)

Cloud service	2012	2013	2014	2015	2016	Annual growth (percent)
SaaS	28.6	35.1	43.8	56.1	60.4	20.5
IaaS	4.6	5.1	7.5	12.4	17.1	38.9
PaaS	3.0	3.8	5.4	8.8	10.9	38.1

Sources: IDC, “IDC Pivot Table, Q1 2015 Final,” July 2015; IDC, “IDC Version 4-Cloud Services,” March 2017.

Internet usage is increasingly moving to the cloud. Using industry data, the Commission estimates that 70 percent of all 2015 global Internet traffic went through cloud data centers—a striking increase from 2011, when only 30 percent went through those centers.⁷ At the same time, cloud data centers also sharply increased their share of total data center workloads (figure ES.2).

Figure ES.2: Global data center traffic, 2011–16 (million workloads^a)



Source: Cisco, *Cisco Global Cloud Index*, 2016; Cisco, *Cisco Global Cloud Index*, 2012.

Note: Corresponds to [appendix table G.1](#).

^a “A server workload is defined as a virtual or physical set of computer resources, including storage, that are assigned to run a specific application or provide computing services for one to many users. For the purposes of quantification, we consider each workload as being equal to a virtual machine or a container.” Cisco, *Cisco Global Cloud Index*, 2016, 8.

The United States is the largest market for cloud services and home to some of the largest cloud service providers (table ES.2). U.S. firms such as Amazon Web Services, Google Cloud Platform, Microsoft Azure, and IBM Rackspace are the largest providers of cloud services for the global market, which had total estimated revenues of \$89.9 billion in 2016. Furthermore, total

⁷ USITC estimates using data from Cisco, *Cisco Global Cloud Index*, 2016; Cisco, *Cisco Global Cloud Index*, 2012; Cisco, *Cisco Visual Networking Index*, 2016; and Cisco, *Cisco Visual Networking Index*, 2012.

U.S. spending on public cloud services comprised 71 percent of total spending among all the key markets reviewed in this report, followed by the EU (24 percent) and China (2 percent).⁸

Table ES.2: Public cloud services spending by country, 2016 (million \$)

Cloud service	United States	EU	Brazil	Russia	China	India	Indonesia
SaaS	46,428	12,702	440	275	804	402	37
IaaS	8,076	4,007	262	83	1,427	229	63
PaaS	8,193	2,325	143	32	75	61	7
Total spending	62,698	19,034	845	390	2,307	692	107

Source: IDC, "IDC Version 4-Cloud Services," March 2017.

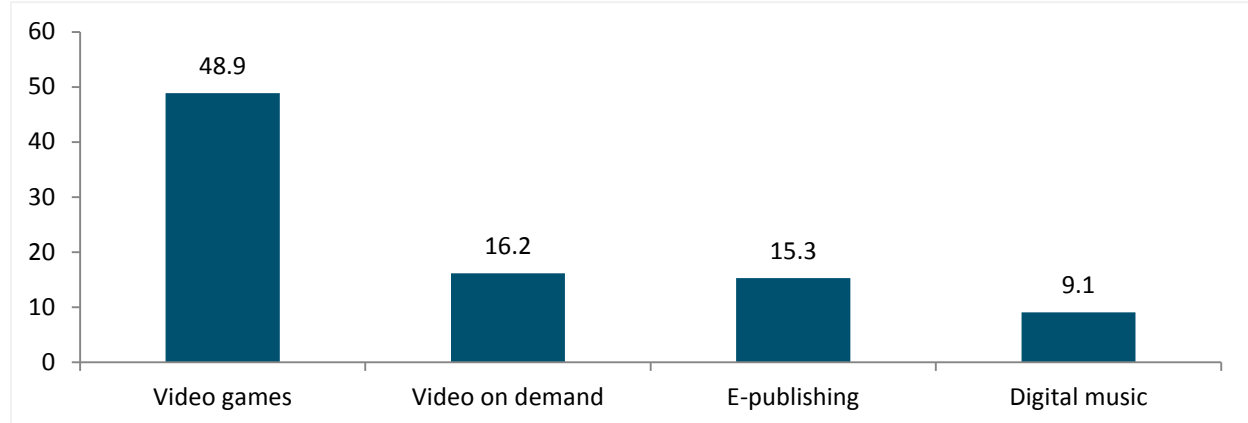
Note: EU spending excludes Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta.

Digital Content

The global digital content market, which includes video games, video on demand (VoD),⁹ digital music, and e-publishing, reached \$89.5 billion in total revenue in 2016. This industry is primarily B2C. The largest sector was video games, with \$48.9 billion in revenue that year (figure ES.3). The United States had the largest market for digital content by relatively large margins in most digital content sectors. However, in the video games sector, China followed the United States closely, buoyed by its strong mobile games subsector.

⁸ A **public cloud** gives users access to the provider's computing infrastructure. The infrastructure is used by multiple firms and individuals at the same time, based on their needs. A **private cloud** has dedicated server space that is available only for a specific firm and cannot be used by others.

⁹ Video on demand (VoD) refers to the viewing of live or recorded online programming either in real time (streaming), or via purchasing to own (download), or by accessing within a defined time period (pay-per-view). A VoD system can consist of a standard TV receiver along with a digitally enabled set-top box. The video content can also be delivered over the Internet to personal computers, smartphones, tablets, video game consoles, and other digital media players. The video content is delivered via the Internet without requiring users to subscribe to a traditional cable or satellite pay-TV service (e.g., Comcast or Time Warner Cable).

Figure ES.3: Digital content industry global market size, 2016 (billion \$)

Sources: Statista, “Digital Media,” 2016; IFPI, *Global Music Report*, 2016, 8–13.

Note: Corresponds to [appendix table G.2](#).

Supported by increasingly robust cloud infrastructure and faster broadband speeds, games played on mobile devices via social media platforms opened the industry to a wider demographic of consumers. Casual players and women over 45 have become an increasingly important part of the market, leading mobile gaming to generate \$25.6 billion in total revenue in 2016. Particularly important drivers of this trend are “freemium” games, which are free to download, but offer in-app purchases for a better player experience.

Streaming—accessing content such as movies, TV programming, and videos directly over the Internet without downloading them—generated the majority of VoD revenue in 2016, reaching \$9.7 billion out of the \$16.2 billion in total VoD revenue. The growing global popularity and market strength of U.S.-based streaming VoD providers, such as Netflix, Amazon Prime, and YouTube, have put increasing pressure on traditional/local broadcast and pay-TV companies. Consequently, many traditional cable providers have started offering “skinny” bundle options that provide customers more flexible digital channel packages at lower prices, among other digital options.

The global music industry has also been driven by digital streaming in recent years as companies such as Spotify (Sweden) and Apple Music (U.S.) continue to expand their share of the global market. As of 2016, these two companies accounted for about 65 percent of the over 100 million digital music subscribers worldwide.

By contrast, the global e-book industry has largely experienced moderate to slow growth due to rising e-book prices, as well as growing “digital fatigue” (a preference by some readers to revert to print books as a relief from an increasingly digital world). Although Amazon leads the global market in e-book sales, a rapidly burgeoning market for self-published or independent e-book

publishers is expected to drive future growth. This is particularly true in developing markets where Amazon’s Kindle does not yet have a dominant presence (e.g., India and Indonesia).

Search engines and social media provide two ways for consumers to access content. Search engines connect Internet users to information and connect businesses to customers, generating revenues via sales of advertising. There are two types of search engines: horizontal ones, which allow users to search on any topic, and vertical ones, which specialize in a specific topic. In the horizontal search engine field, U.S. firms (with some exceptions), primarily dominate. The top U.S. services in this field are Google, Yahoo, and Bing. Google is also the worldwide leader, except in China (where Baidu leads), Russia (Yandex), and South Korea (Naver). The vertical search engine field, on the other hand, is the province of more specialized search engines, such as WebMD (medical search), Kayak (travel search), Zillow (real estate search), and myriad others. User review sites such as Yelp are also a type of vertical search. In the local search engine field, U.S. firms face more competition from local firms in foreign markets. Many social media platforms provide vertical search engines that offer consumers more specialized or curated news, in tandem with the social interactions that are their primary focus.

E-Commerce

B2B and B2C e-commerce sales have grown rapidly in recent years, with global B2B e-commerce reaching \$23.9 trillion in 2016 and B2C e-commerce totaling \$3.8 trillion in the same year.¹⁰ This expansion has been spurred by the proliferation of online platforms that use innovative digital technologies, including cost-saving cloud computing systems that integrate back- and front-end processes. Mobile technologies are a key driver of e-commerce growth, as consumers and businesses increasingly use mobile devices—smartphones and tablets—to facilitate research, payment, and delivery. E-commerce marketplace platforms such as eBay, Etsy, and Symphony facilitate cross-border trade, enabling exporting firms, particularly SMEs, to reach customers more easily. However, cross-border trade relies on open digital channels, and differences in policy measures across markets pose challenges in areas such as payments, finance, customs processes, contracts, and logistics.

The global B2B e-commerce industry is undergoing rapid transformation as businesses replace their legacy supply chain and distribution systems with modern cloud-based platforms. These platforms optimize procurement, inventory, order management, and logistics systems that connect producers, suppliers, distributors and dealers, and services providers. B2B sales volumes in the United States and most other global markets are led by large corporations in major industries, such as petroleum, automotive products, computer technology, and foods.

¹⁰ These estimates include Electronic Data Interchange (EDI); IDC, “Worldwide and US Ecommerce,” July 31, 2017.

B2B platforms facilitating sales by SMEs are dominated by a handful of well-known global firms, including Alibaba (headquartered in China), Amazon Business, and IndiaMart.

B2C e-commerce is transforming the global retail sector. Online competition is leading traditional retailers to set up their own platforms to meet rising consumer demand for convenience in ordering, delivery, and comparison shopping. The spread of mobile technology and of enhanced payment options/flexibility is driving global demand for retail e-commerce, boosting the share of e-commerce in total retail sales. The United States and China are the global leaders in online B2C sales and home to the world's largest and most innovative e-commerce providers, including Amazon and Alibaba. Amazon and Alibaba are transforming their domestic retail industries and are key suppliers and competitors in the rapidly expanding global B2C market.

Three new technologies—digital payments, blockchain, and digital signatures—are helping to make e-commerce safer and more practical. Consumers increasingly use digital payments for routine transactions, and while consumers in developed countries use them more often, emerging markets are adopting them rapidly. Blockchains are ledger-keeping technologies that use decentralized networks to maintain records securely. Digital signatures allow individuals to affirm their identity, making digital contracts valid and enforceable.

Industry Adoption of Digital Technologies

The ability to move data over digital networks has fundamentally changed how industry works. Firms in industries across the economy have adopted digital technologies to improve their efficiency and productivity, to offer new or enhanced products and services, and to interact better with customers.¹¹ During the early years of digital innovation, firms usually aimed to improve communications, both internal and with customers, and to reach new markets.¹² In recent years, businesses have been seeking to facilitate the full range of business functions, using three broad types of digital technologies: connected devices and data management technologies related to the IoT; digital technologies for robotics and other automation; and cloud computing services for data processing and advanced analytics. The digital products and services relying on these technologies are primarily B2B.

IoT refers to the ever-growing network of connected objects that are able to collect and exchange data via sensors and other devices. Industries are rapidly adopting digital technology related to the IoT. In 2015, 43 percent of firms indicated that they used such digital

¹¹ Daugherty et al., *Driving Unconventional Growth*, 2015, 4; Manyika et al., *Digital America*, December 2015, 3.

¹² USITC, *Digital Trade in the U.S. and Global Economies, Part 2*, 2014, 50–51.

technologies or planned to use them in 2016.¹³ Industry usage of connected devices has fueled much of the global increase in adoption of digital products and services, as business strategies and solutions for R&D, production, and other core functions change in response to technological advances.

Unmanned aerial vehicles, 3-D printing, AI, and ML are only a few of the digital innovations that industries are adopting. Global robot sales in 2015 totaled over 250,000 units, mostly in the manufacturing sector.¹⁴ “Collaborative” robots use cloud connectivity and improved AI to interact more closely with workers.

Automation, robotics, cloud computing, and advanced data analytics, like the digital technologies enabling the IoT, are becoming standard tools for firms in all functional areas of their business. These resources are used in research and product development; production; management and internal coordination; marketing, sales, and customer relationship management; and distribution and post-sales services. As firms of all kinds increasingly collect data from an ever-wider range of sources and devices, they use big data analysis and other types of advanced data analytics to enhance efficiency and generate profits.¹⁵ To reap efficiency gains, many firms outsource the storage and processing of their data to cloud services providers, reducing their up-front costs and gaining access to almost unlimited data storage and processing power. Data analysis is also moving increasingly to the cloud because it often requires large amounts of data that would otherwise be difficult to store or process. Some firms outsource the analysis of their data to data analytics services providers (usually operating in a cloud environment). Others use ML and other AI techniques internally to glean insights from their datasets.¹⁶

¹³ Examples of IoT are robots, sensors, and 3-D printers, as well as things like thermostats, cars, lights, refrigerators, and more. Gartner, “Gartner Survey Shows That 43 Percent,” 2016.

¹⁴ IFR, via Statista, “Worldwide Sales of Industrial Robots from 2004 to 2015” (accessed May 1, 2017); IFR, “World Robotics 2016,” September 29, 2016.

¹⁵ “Big data” is the industry term for very large, high-volume datasets composed of structured and unstructured data from a wide variety of sources, often collected at high velocity in “real time.” Examples include click streams from search engines, transaction data from electronic markets, or environmental or location data from machine sensors. USITC, *Digital Trade in the U.S. and Global Economies, Part 2*, August 2014, 151.

¹⁶ Weldon, “The 14 Leading Products for Predictive Analytics,” March 23, 2017, 1. Major cloud-services providers that have strength in analytics, such as IBM, Google, Microsoft, and SAP, are active in this market, as are specialist analytics software firms, such as Alpine Data, RapidMiner, SAS, and Statistica.

Consumer Communications Services and Connected Devices

Communications services have changed significantly in the past decade, as an increasing number of consumers and businesses use cloud-based apps to communicate via voice, text, or video. Similarly, devices other than computers are increasingly interacting with the Internet. In 2007, most people accessed the Internet through computers, but in 2017 smartphones are commonly used to access it, and the use of smaller wearable devices to connect to the Internet (or to a smartphone that is connected to the Internet) is now a large market in itself (table ES.3). Most wearable devices are in the early stages of market adoption, and some are struggling to achieve mainstream acceptance.

Table ES.3: Selected communications services and devices market sizes, worldwide, 2016 (million \$)

Technology	Global
Smartphones	428,900
Wearables	16,239
Smart homes	24,000
Remote healthcare monitoring	8,000

Sources: IDC, "Worldwide Wearables Computing Forecast Update," July 2017; Perez, "U.S. Wearables Market Is Doing Much Worse," December 21, 2016; Statista, "Smart Home" (accessed May 9, 2017); Berg Insight, *MHealth and Home Monitoring* (executive summary), February 2017, 1.

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Chapter 1

Introduction

Overview

The global economy is being transformed by the continued expansion of access to and capability of the Internet. As of January 2017, roughly half the world's population (about 3.8 billion people) were Internet users (up 10 percent from a year earlier), and the volume of data flowing over the Web is exploding.¹⁷ At the same time, there has been a proliferation of connected devices. Mobile devices have become a viable Internet tool for both consumers and firms due to widespread installation of 3G networks in countries around the world in the early 2000s, followed by 4G mobile networks in many regions, since 2009.¹⁸

U.S. firms are among the most globally competitive suppliers of digital technologies, products, and services, and digital trade plays an increasingly crucial role in the U.S. economy in terms of innovation and job growth. More and more, all types of U.S. companies are using the Internet to deliver innovative products and services at home and abroad, both business-to-business (B2B) and business-to-consumer (B2C). In 2017, it is expected that global spending on Internet advertising will outpace spending on television advertising for the first time, with Google and Facebook responsible for a large share of this growth in the U.S. market and in many foreign markets as well.¹⁹ Parcel shipment volumes are growing by nearly 10 percent a year in the United States and similarly in major markets around the world as e-commerce becomes a way of life for many consumers.²⁰ Global revenue for digital music streaming reached \$2.9 billion in 2015, nearly five times the level in 2010, with two market leaders, Spotify (Sweden) and Apple Music (U.S.) holding market shares of 44 percent and 21 percent, respectively.²¹

Despite the robust growth of digital commerce, many U.S. companies have voiced concerns over the regulatory and policy measures in certain countries that have slowed or halted data flows, thereby impacting U.S. suppliers and users of cloud data and software services, data analytics, new Internet communication services, and digital services that support various

¹⁷ We Are Social and Hootsuite, *Digital in 2017 Global Overview*, January 2017, slides 5–6.

¹⁸ Mobile networks connect smartphones and other devices to cell towers; from that access point, data are transmitted through terrestrial or submarine cables. Mauldin, "Frequently Asked Questions: Submarine Cables 101," February 14, 2017.

¹⁹ KPCB, "Internet Trends 2017," May 31, 2017, 14–15.

²⁰ *Ibid.*, 65.

²¹ Mulligan, "Music Subscriptions Passed 100 Million in December," January 6, 2017.

production processes. The Commission provided two reports on digital trade to the Senate Committee on Finance, the first in 2013 (*Digital Trade in the U.S. and Global Economies, Part 1*) and the second in 2014 (*Digital Trade in the U.S. and Global Economies, Part 2*).²² Given the rapidly changing economic and policy environment, such information must be continually updated to ensure that policy makers have the most current understanding of the digital trade landscape.

The Request

In a letter dated January 13, 2017, the U.S. Trade Representative (USTR) asked the Commission to conduct three investigations and prepare three reports under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332 (g)). The reports are to examine the value of new digital technologies for U.S. firms and how restrictions faced by U.S. firms affect their competitiveness in international markets.²³ This report is the first of the three requested reports. It is based on a review of the literature and other information, and, to the extent practicable, it:

- Describes the broad landscape and recent developments of important business-to-business (B2B) digital technologies used primarily by firms. These include cloud data, software, and communications services, advanced data analytics services, and digital services related to manufacturing and the Internet of Things (IoT);
- Provides an overview of developments in the provision of business-to-consumer (B2C) digital services used primarily by consumers and individuals;
- Provides information on the market for digital services, both in the United States and in key foreign markets, such as the European Union (EU), China, Russia, Brazil, India, and Indonesia, with a particular focus on services that can scale globally in order to assess U.S. firms' global competitiveness;
- Provides up-to-date information on the rate of adoption of digital technologies, domestically and abroad, and documents the importance of data flows (domestic and cross-border) to a wide range of sectors across the economy; and
- Describes regulatory and policy measures currently in force in important markets abroad that may significantly impede digital trade. Measures affecting digital trade might include restrictions on foreign direct investment (FDI) and other means of market access;

²² USITC, *Digital Trade in the U.S. and Global Economies, Part 1*, July 2013; USITC, *Digital Trade in the U.S. and Global Economies, Part 2*, August 2014.

²³ The request letter for all three investigations is in appendix A. The second and third reports in the series, which will be confidential, will draw from the analysis in this report to assess the impact of measures that affect the ability of U.S. firms to develop and/or supply digital products and services in key foreign markets. The second report will be completed on October 29, 2018, and the third report will be completed on March 29, 2019.

limitations on cross-border data flows (data localization requirements, Internet blocking, censorship, cultural regulation of digital content, and data privacy protections); cybersecurity regulations and limitations on the choice of encryption technologies; regulation of Internet services providers (ISPs), including limitations on ISPs intended to protect intellectual property rights (IPRs) and rules determining liability for third-party content; and IPR protections and enforcement.

The USTR requested that this report be delivered on August 29, 2017.

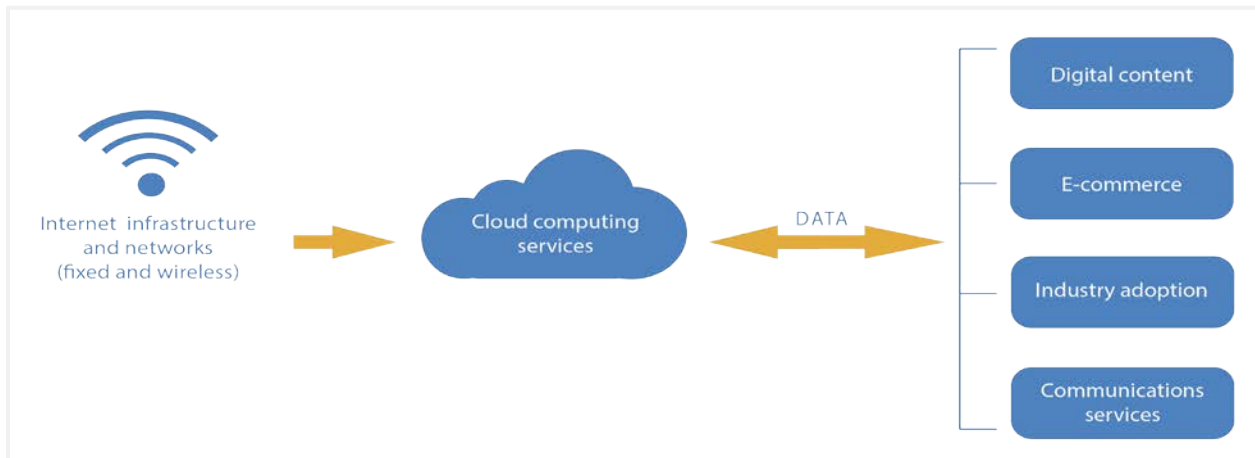
Scope of the Investigation

For the purposes of this report the Commission defined the term “digital trade” as follows:

The delivery of products and services over the Internet by firms in any industry sector, and of associated products such as smartphones and Internet-connected sensors. While it includes provision of e-commerce platforms and related services, it excludes the value of sales of physical goods ordered online, as well as physical goods that have a digital counterpart (such as books, movies, music, and software sold on CDs or DVDs).

This definition is similar to the definition used by the Commission in its first report on digital trade, prepared in 2013 at the request of the Senate Committee on Finance.²⁴ Based on this definition, this report divides the many components of the digital trade landscape into six broad functional types of digital products and services. Figure 1.1 shows the way these broad functional types tend to connect.

Figure 1.1: The flow of data across the Internet



Source: USITC.

²⁴ USITC, *Digital Trade in the U.S. and Global Economies, Part 1*, 2013, xii, 1–2.

Not all Internet infrastructure is cloud-based, nor do all of these functional types of digital products and services always connect to each other through cloud computing services. But the source or destination of Internet connections is increasingly cloud-based. Fixed and mobile broadband infrastructure has increased the role of cloud infrastructure and services. In turn, new cloud infrastructure has enabled cloud computing firms, with their centralized repositories, to offer cheaper and more dynamic services such as data analytics. Using these data storage and analytics resources, companies are able to offer an ever-expanding range of digital products and services to meet demand from businesses and consumers for better and faster digital content, e-commerce, and communication services. For example, content providers can now store and stream video directly from the cloud to computers, televisions, and tablets (instead of requiring downloads), and companies can track their production, sales, and marketing processes from start to finish on a variety of devices.











































For each specific type of digital product or service, the report describes broad trends in demand and rates of adoption; the size of the global, U.S., and key foreign markets; major suppliers, and the presence of U.S. and foreign competitors in those markets. Several large firms participate in multiple areas of digital trade, and are mentioned throughout the report (box 1.1).

Box 1.1: Horizontal Integration across Digital Sectors






It is important to note that many providers of digital products and services perceive synergies between the various digital sectors—communication and social media, cloud computing, e-commerce, content and search, and digital industry processes. Decreases in the cost and speed of data due to advances in cloud computing have enabled U.S. and foreign firms to benefit from the competitive advantages of their core operations by expanding horizontally into other business areas. For example, the tremendous amount of data available to many large digital companies can be leveraged for data analytics and other computer-based services.^a

Google expanded from its search engine service, which began in 1998, to provide digital video content on YouTube, communications through Gmail, and e-commerce through Google Shopping (table 1.1).^b Each of these new services fit with Google's goal of organizing the world's information, and often took advantage of skills Google had already developed (e.g., using its search engine in Gmail to allow users to find old emails more easily than they could in the past).^c Amazon began in 1994 as an e-commerce company but now rents access to its large data centers for cloud infrastructure services and provides streaming music and video content through its Amazon Prime membership services.^d Similarly, by the fourth quarter of 2016, China's Tencent derived two-fifths of its revenue from online video games, one quarter from social networking (which benefited from investments in digital music), and the rest from advertising and mobile news.^e Russia's Yandex not only accounted for 55.4 percent of Russia's domestic search market in the fourth quarter of 2016, but also offers classified advertising, music and video content, taxi, and e-commerce services.^f

Table 1.1: Horizontal expansion of large Internet firms in key markets

Firm (country)	Initial business	Year founded	Current major groups within each firm				
Alibaba (China)	E-commerce	1999					
Amazon (U.S.)	E-commerce	1994					
Apple (U.S.)	Personal computer maker	1976					
Baidu (China)	Content (search)	2000					
Facebook (U.S.)	Communications (social network)	2004					
Google-Alphabet (U.S.)	Content (search)	1998					
Microsoft (U.S.)	Software	1975					
Tencent (China)	Communications	1998					
Yandex (Russia)	Content (search)	1997					

Key:

-  Cloud computing services
-  E-commerce
-  Content production/distribution and search
-  Industrial digital processes (e.g., robotics, IoT, smart technologies)
-  Communications and social media

Source: Kleiner Perkins Caufield Byers, “KP Internet Trends,” 2017.

^a This trend was observed for U.S. firms in the 2014 report, and it extends to major foreign digital services firms.

^b Google, “Annual Report,” 2016.

^c McCracken, “How Gmail Happened: The Inside Story,” March 31, 2014. Further, horizontal expansion by Google, from search into e-commerce, was at the heart of the EU’s recent fine of €2.4 billion. Boffey, “Google Fined Record €2.4 Bn by EU,” June 27, 2017.

^d Narendula, “Amazon Web Services: A Case Study,” July 2, 2012, 4.

^e Tencent, “Tencent Announces Fourth Quarter and Annual Reports 2016,” March 22, 2017.

^f Yandex, “Yandex Announces Fourth Quarter,” February 16, 2017.

Information Sources

This first report is based on relevant literature, a public hearing at the Commission and accompanying written submissions, fieldwork, and publicly available data. The Commission held a public hearing on April 4, 2017, and participants included representatives of academic institutions, nongovernment organizations, industry, and trade associations. The Commission also received written submissions for that hearing from a similar cross-section of interested parties. Commission staff also conducted dozens of interviews with industry, academic, and government representatives in the United States, Europe, and the Asia-Pacific region. Data used in this report include official government data, where available, as well as data from trade associations and market research firms.

Organization of the Report

The report contains information that responds to requests for information in the USTR’s letter. Table 1.2 lists the principal information provided in each chapter of the report, and table 1.3 shows the chapter in the report where information responding to the requests in each of the bullets can be found. Chapters 2 through 7 are organized by technology group to streamline information for the requestor and reduce repetition.

Table 1.2: Global digital trade in this report: Digital product and services and relevant policy measures

Chapter	Category of digital product or service	B2B or B2C
2	Internet infrastructure and network communication services	B2B
3	Cloud computing services: data processing, storage, analytics, and software applications	Primarily B2B
4	Digital content, search, and news	Primarily B2C
5	E-commerce, digital payments, and records	B2B and B2C
6	Industry adoption of digital technologies	B2B
7	Consumer communications services and connected devices	Primarily B2C
8	Regulatory measures and policies affecting digital trade	B2B and B2C

Source: USITC.

Table 1.3: Roadmap of request letter bullet points, by chapter

Bullet from request letter	Relevant Chapters
Business-to-business (B2B) digital technologies used primarily by firms	2, 3, 5, 6
Business-to-consumer (B2C) digital products and services used primarily by consumers and individuals	4, 5, 7
Market for digital products and services, both in the United States and in	2, 3, 4, 5, 6, 7

Bullet from request letter	Relevant Chapters
the EU, China, Russia, Brazil, India, and Indonesia, with a particular focus on products and services that can scale globally	
Rate of adoption of digital technologies, domestically and abroad, and documentation of the importance of data flows (domestic and cross-border)	2, 3, 4, 5, 6, 7
Regulatory and policy measures currently in force in important markets abroad	8

Source: USITC.

Internet Infrastructure and Network Communication Services

Fixed and mobile broadband have grown significantly in recent years. As of 2016, nearly half of the global population had access to mobile broadband, and these connections have given people reliable high speed connections to the Internet, even in places without widely available (or affordable) fixed broadband connections.²⁵ Between 2007 and 2015, global Internet traffic rose from 2,000 to 26,600 gigabytes per second,²⁶ or roughly 33 percent per year on average.²⁷

By early 2017, two-thirds of the global population (or almost 5 billion people) had mobile phones (both “smart” and basic), and 50 percent of web traffic was mobile. People use their phones to connect to the Internet to access content, shop, and communicate; for example, in January 2017, 2.5 billion people used their smartphones to access social media (up 30 percent from a year earlier).²⁸

With more than 90 percent of organizations reporting that they use or are experimenting with cloud computing in some part of their business, firms in nearly every sector are able to benefit from the increased capacity and functionality of Internet-based infrastructure and technologies.²⁹ Aspects of Internet infrastructure and network communications examined in the report are primarily B2B, and include Internet infrastructure, access to and speed of the

²⁵ ITU, “ICT Facts and Figures 2016,” 2016.

²⁶ Data transfer rates are commonly displayed using variations of bits or bytes, which are basic units of digital information. One byte contains eight bits, and both units generally appear with a prefix that multiplies the unit; such prefixes include kilo- (K, one thousand), mega- (M, one million), giga- (G, one billion), and tera- (T, one trillion). Internet service providers will frequently advertise their data transfer rates in bits, such as offering a broadband connection with a bandwidth of 100 Mbps, or 100 million bits per second. A transfer rate of 100 MB/s (100 million bytes per second) is significantly faster than a 100 Mbps connection, whereas a 12.5 MB/s transfer rate is equivalent to 100 Mbps. All information presented in bits in this report will be abbreviated as Mbps, Gbps, or Tbps, while all information in bytes will be abbreviated as MB/s, GB/s, or TB/s. All figures presented in bits may be divided by 8 to obtain the byte equivalent.

²⁷ Cisco, “The Zettabyte Era,” June 2, 2016.

²⁸ We Are Social and Hootsuite, *Digital in 2017 Global Overview*, January 2017, 76 and 5–6.

²⁹ Ezell and Swanson, “How Cloud Computing Enables Modern Manufacturing,” June 2017, 7.

Internet, communications network services, wide area networking, and software-defined networking.

Cloud Computing Services

Several recent B2B technology innovations in cloud computing infrastructure and services have significantly reduced the cost and increased the availability of massive amounts of data storage and processing power. Cloud computing encompasses a variety of services, including data storage, convenient network access, tailored software services, and pooled processing of information on remote, shared, and externally managed computer resources. Driven by advances in the underlying technology, the convenience and low cost of cloud computing options has resulted in its rapid adoption by many kinds of firms. Rapid adoption boosted global cloud computing revenues by over 34 percent per year, from \$27.6 billion in 2012 to \$89.3 billion in 2016.³⁰

Cloud computing services topics examined in the report include basic information on cloud computing (how it works, types of cloud services, adoption of cloud computing services, drivers and inhibitors); the size of the global cloud computing market and the volume of data traffic in the cloud; firm spending on cloud computing services and industry revenues from providing cloud services; market competition; regional and country markets for cloud services; and providers of cloud services in global markets.

Digital Content, Search, and News

Digital B2C services provide creative content, news, and information, especially in six product categories: video games, video, music, e-books, horizontal and vertical search, and news (aggregation and social media). In this sector, delivery has progressed from nondigital formats to file download formats to on-demand streaming. Consumers' increasing preference for delivery of content on smartphones and other portable devices has been an important development in this industry. This progress has been particularly beneficial for the video game sector, which now makes up more than 50 percent of the global digital content market. Digital content, search, and news topics examined in the report include the six categories above.

E-commerce, Digital Payments, and Records

Developments that have expanded e-commerce services include e-commerce platforms, digital payment and transaction services, and logistics and package delivery services. The section of

³⁰ MarketLine, "Global Cloud Computing," 2016, 8.

this report that covers e-commerce examines B2B and B2C e-commerce and the firms that compete in each segment. Although B2B e-commerce is much larger than B2C, new technologies have not advanced as far into this sector: many firms continue to use older technologies such as electronic data interchanges instead of web or cloud-based platforms, which are used in B2C e-commerce. There have also been advances in digital payments services, the application of blockchain technologies, and the introduction of digital signatures. Services provided by logistics and express delivery firms are crucial for successful e-commerce, and firms in this sector are themselves adopting digital technologies. E-commerce, digital payments, and records topics examined in the report include B2B and B2C e-commerce, digital payments, other transactional digital technologies (blockchains, digital signatures), and logistics and express delivery.

Industry Adoption of Digital Technologies

For firms in all sectors, adoption of digital technologies has improved the productivity and efficiency of their operations. Pertinent topics examined in this report include the Internet of Things (the use of connected devices and sensors in manufacturing and chemicals, precision agriculture, fleet management systems, usage-based insurance), robotics and other automated processes (robotics in manufacturing, robotics in agriculture, unmanned aerial systems, 3D printers), and data management and processing (cloud computing and data analytics for enterprise resource and customer relationship management). Important technologies used by firms include the “Internet of Things” or “IoT.” Firms from a range of industries including agriculture, manufacturing, and construction are also capitalizing on advances in robotics and automation. For example, drones are being used to survey construction sites and crop development, while manufacturers have begun using robots that can safely interact with workers. Firms are gleaning, managing, and processing large amounts of data—from the research lab, the factory floor, customer interactions, and public data sources—in more sophisticated ways to improve internal processes and operations. Examples include the introduction of digital technologies for research and development, production, procurement and supply, corporate administration, marketing, and managing customer relationships.

Consumer Communications Services and Connected Devices

Consumers and firms now use a broad range of devices to connect to the Internet, enabling them to use many different services to communicate. With the exception of China (which blocks many of these channels), people around the world tend to use the same five or six communications services: WhatsApp, Facebook Messenger, WeChat (Weixin), Viber, Line, and Kakao Talk. Another development of interest is the use of networks of connected devices in

homes (smart homes) and cities (smart cities), enabling people to access previously unavailable data about their home or city. Examples include the ability to manipulate thermostats and find parking spaces from a smartphone. This section of the report focuses on communications services (Internet communications services and unified communications) and Internet-connected devices (smart phones, wearables, remote healthcare monitoring, smart homes, and smart cities).





























Regulatory and Policy Measures Related to Digital Trade

Although data processing and analytics capacity have expanded alongside growth in cloud-based data centers, some countries have implemented regulatory and policy measures that have had the effect of slowing or halting these data flows, thereby driving up the costs and limiting the performance of those products and services. For example, governments enact data protection and privacy laws to protect consumers' data, yet the implementation of these measures raises costs for firms and may potentially impact the viability of cloud computing services. Cybersecurity policies that require firms to disclose source code limit e-commerce and digital content provision in some countries, while de minimis rules that require payment of duties and taxes on even low-value imports limit e-commerce for small and medium-sized firms. Further, U.S. firms are increasingly concerned about doing business in markets with data localization rules—rules that require data storage, management, and/or processing to occur within national boundaries—saying that such rules raise issues of cost and intellectual property security for firms engaged in digital trade. The impact of such barriers is likely higher costs for U.S. firms and lower-level performance of those products and services.³¹






In all, this report identifies eight groups of regulatory and policy measures potentially impeding digital trade, including measures involving data protection and privacy, data localization, cybersecurity, censorship, intellectual property, market access, e-commerce transactions, and investment (table 1.4). In most cases, these measures are described on a country-by-country basis, with a focus on the six key foreign markets of interest (Brazil, China, the EU, India, Indonesia, and Russia).

³¹ CSI, "Cross-Border Data Flows," n.d. (accessed June 29, 2017).

Table 1.4: Digital trade regulatory and policy measures relevant for digital products and services

Type of regulatory or policy measure	Types of digital trade affected				
Data protection and privacy					
Data localization requirements					
Private and public cybersecurity					
Censorship					
Intellectual property rights					
Market access					
Import duties, taxes, and customs procedures					
Investment restrictions					

Key:

-  Cloud computing services
-  E-commerce
-  Content production/distribution and search
-  Industrial digital processes (e.g., robotics, IoT, smart technologies)
-  Communications and social media

Source: Compiled by USITC.

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Chapter 2

Internet Infrastructure and Network Communication Services

Introduction

The provision of communications services and devices is more than just an important component of international digital trade. It also plays a crucial role in enabling all other types of international digital trade by providing the backbone for the Internet and points for accessing it. Telecommunications networks, both wireline and wireless, as well as related network management services, provide the infrastructure over which virtually all digital products and services flow.

This chapter spotlights emerging trends in the digital communications industry, with a focus on products and services that facilitate digital trade—particularly the emerging role of wide area networking technologies and services. The chapter is divided into two sections. The first section examines changes in Internet infrastructure, and what they have meant for the availability and speed of the Internet. The second section describes two important networking technologies—wide area networks and software-defined networks—used by enterprises and how they are growing. This chapter primarily focuses on business-to-business (B2B) technologies, though Internet infrastructure also has an effect on the availability and speed of the Internet for consumers. Policies that restrict cross-border data flows, such as data localization requirements, and any restrictions on investment in Internet infrastructure could impede the ability of U.S. firms to compete in these industries in some foreign markets. For further discussion of related policies and regulatory measures, see chapter 8.

Internet Infrastructure

Global bandwidth grew from roughly 70 terabits per second (Tbps)—i.e., 70,000 gigabits per second (Gbps)—in 2011 to nearly 300 Tbps by the end of 2015.³² This expansion supported a sharp rise in global Internet traffic, from 2,000 gigabytes per second (GB/s) in 2007 to 26,600

³² TeleGeography, Global Bandwidth Research Service, 2016, 2.

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GB/s in 2016—an increase of 33 percent annually.³³ Internet infrastructure includes long-haul fiber optic terrestrial and submarine cable networks, 4G mobile networks,³⁴ and high-bandwidth local networks.

To keep up with sharply rising demand from firms and consumers, the global submarine cable industry has upgraded older cables systems and built new ones. By February 2017, there were 428 active submarine cable systems connecting more than a dozen countries on six continents.³⁵ Many existing submarine cable systems have installed new transmission equipment capable of delivering 100 Gbps wavelengths, leading to increased overall traffic-carrying capacity (bandwidth).³⁶

In November of 2016, the average global 4G download speed was 17.4 megabits per second (Mbps), although speeds ranged from roughly 6 Mbps in Costa Rica to more than 45 Mbps in Singapore and South Korea.³⁷ As of 2016, an estimated 49 percent of the global population had a mobile broadband subscription. Those subscriptions have grown at a much higher rate than fixed broadband subscriptions since 2010, as consumers in many countries use their phone as their sole means of Internet communication (figure 2.1).³⁸ The availability of mobile broadband is especially important in less developed areas, as it enables users to access the Internet without having to invest in more costly fixed connections.³⁹

³³ As noted in the previous chapter, data transfer rates are commonly displayed using variations of bits or bytes, which are basic units of digital information. One byte contains eight bits, and both units generally appear with a prefix that multiplies the unit, e.g., kilo- (K, one thousand), mega- (M, one million), giga- (G, one billion), and tera- (T, one trillion). Internet service providers will frequently advertise their data transfer rates in bits, such as offering a broadband connection with a bandwidth of 100 Mbps, or 100 million bits per second. A transfer rate of 100 MB/s (100 million bytes per second) is eight times faster than a 100 Mbps connection, whereas a 12.5 MB/s transfer rate is equivalent to 100 Mbps. All information presented in bits in this report will be abbreviated as Mbps, Gbps, or Tbps, while all information in bytes will be abbreviated as MB/s, GB/s, or TB/s. All figures presented in bits may be divided by 8 to obtain the byte equivalent. Cisco, “The Zettabyte Era,” June 2, 2016.

³⁴ 4G mobile networks are the fourth generation of mobile networks, with peak speed requirements ranging from 100 Mbps to 1 Gbps.

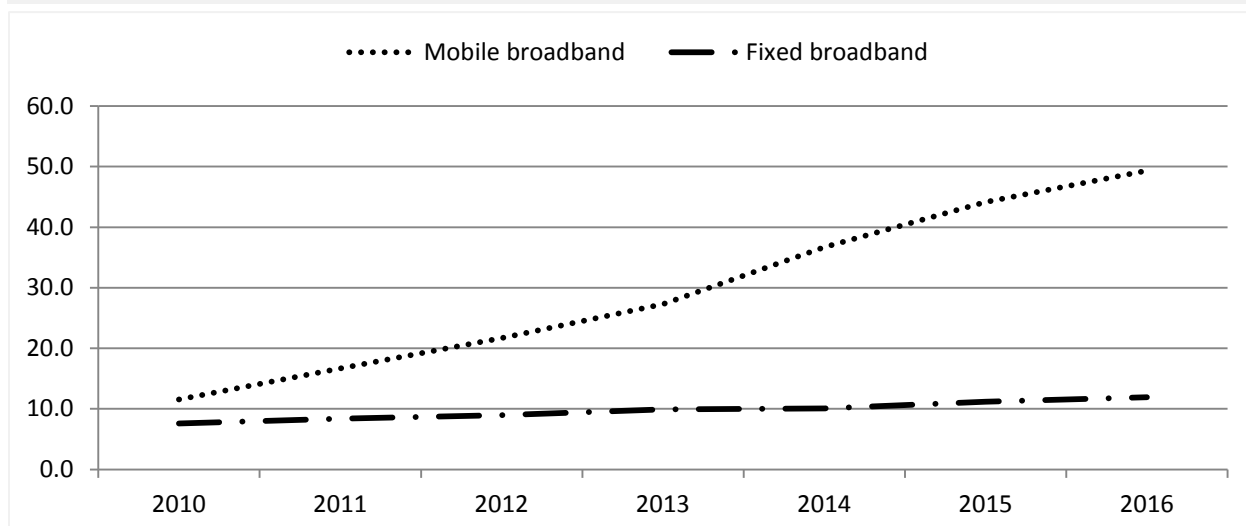
³⁵ Mauldin, “Frequently Asked Questions: Submarine Cables 101,” February 14, 2017; TeleGeography, “Submarine Cable Map,” 2017.

³⁶ TeleGeography, “Global Bandwidth Research Service,” 2016, 5.

³⁷ OpenSignal, “The State of LTE,” November 2016.

³⁸ The World Bank World Development Indicators defines fixed broadband to include “fixed subscriptions to high-speed access to the public Internet . . . cable modem, DSL, fiber-to-the-home/building, other fixed (wired)-broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband.”

³⁹ ITU, “ICT Facts and Figures 2016,” 2016, 1–5. See chapter 1 for additional discussion of Internet availability and speeds and chapter 4 for a discussion for how these affect digital content.

Figure 2.1: Fixed and mobile broadband subscriptions per 100 people, 2010–16

Source: ITU, “ICT Facts and Figures 2016,” 2016.

Note: Corresponds to [appendix table G.3](#).

Access and Speed of Internet

Worldwide, about one half of all people had at least a mobile Internet subscription in 2016, but adoption rates vary across countries (table 2.1). In 2015, India and Indonesia had the lowest rates of Internet use among key markets studied in this report, but they also showed the largest increases in penetration rate. In contrast, the European Union (EU) and the United States had the highest Internet penetration rates in both 2012 and 2015; since they started from a higher base, however, they had the slowest rates of growth over the period.

Table 2.1: Individuals using the Internet (share of population)

Country ^a	2012	2015	Annual growth (%)
Brazil	48.6	58.3	6
China	42.3	50.3	6
Europe	70.0	75.3	2
India	12.6	26.0	27
Indonesia	14.5	22.0	15
Russia	63.8	73.4	5
United States	74.7	74.6	0

Source: ITU, Statistics web page (accessed August 16, 2017).

^a This table, and others that follow it, highlight key markets for the report (Brazil, China, EU, India, Indonesia, and Russia).

Globally, fixed broadband subscriptions grew by 8 percent per year from 2012 to 2015, with Chinese and Indonesian subscriptions increasing at the fastest annual rate (table 2.2). The United States and the EU had the highest number of fixed broadband subscriptions in 2015.

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U.S. fixed broadband connections, however, grew relatively slowly. Many attribute this slow growth to the fact that more users are opting to access the Internet solely via their smartphones.⁴⁰

Table 2.2: Fixed broadband subscriptions (per 100 people)

Country ^a	2012	2015	Annual growth (%)
Brazil	9.6	12.3	9
China	12.7	19.8	16
Europe	26.3	29.4	4
India	1.2	1.3	3
Indonesia	1.2	1.6	10
Russia	14.6	18.9	9
United States	29.1	31.4	3
World	9.2	11.5	8

Source: ITU, Statistics web page (accessed August 16, 2017).

^a This table highlights key markets for the report (Brazil, China, EU, India, Indonesia, and Russia).

Between 2012 and 2015, broadband speeds, or the amount of data that is transferred per second over an Internet connection, increased by double-digit percentages in each of the key countries studied in this report. Among the countries listed in table 2.3, the Netherlands and the United States had the fastest average fixed broadband speeds in 2016 at about 17 Mbps, both up significantly from 2012 levels. Indonesia's speeds increased the most during this period, from less than 2 Mbps in 2012 to 6.7 MBPs in 2016 (an average rate of about 48 percent per year).

Table 2.3: Fixed broadband speed (average Mbps) 2012–16^a

Country ^a	Q4, 2012	Q4, 2016	Annual growth (%)
Brazil	2.3	6.4	29
China	1.8	6.3	37
United States	7.4	17.2	23
EU			
France	4.8	10.0	20
Netherlands	8.6	17.6	20
India	1.2	5.6	47
Indonesia	1.4	6.7	48
Russia	5.1	11.6	23

Source: Akamai, *The State of the Internet*, March 2017, 24, 28, 32; Akamai, *The State of the Internet*, April 23, 2013, 45.

^a This table highlights key markets for the report (Brazil, China, EU, India, Indonesia, and Russia). As the EU levels have not been aggregated by the source, this table includes statistics for two member states.

⁴⁰ Bode, "Number of US Broadband Subscribers Sees Decline," October 27, 2016.

Globally, mobile broadband has become more important due to the growing popularity of using mobile devices to access social media, gaming, video streaming, and online shopping services. Among this report’s focus markets, countries where smartphone ownership was relatively low a few years ago saw the largest increases in the percentage of the population owning smartphones between 2013 and 2015; these were Brazil (26 percent), Russia (22 percent), and China (21 percent) (table 2.4). By 2015, almost three-fourths of adults in the United States and 60 percent of adults in Europe owned a smartphone, while only 16 percent of adults in India and 21 percent of adults in Indonesia had one (see chapter 7 for a discussion of smartphones).

Table 2.4: Share of adult population owning a smartphone, percent (2013–15)^a

Country ^b	2013	2015
Brazil	15	41
China	37	58
Europe		60
India	12	16
Indonesia	11	21
United States	56	72

Sources: Poushter, “Smartphone Ownership and Internet Usage,” February 22, 2016; Smith, “Smartphone Ownership 2013,” June 5, 2015.

^a “n/a” data for Europe on an aggregated basis for 2013 is not available.

^b This table highlights key markets for the report (Brazil, China, EU, India, Indonesia, and Russia).

Over the last five years, total mobile data volumes increased 18-fold, with 69 percent of the traffic coming from 4G-capable devices.⁴¹ In 2016, out of 78 countries surveyed, South Korea had both the world’s fastest 4G speed (45.77 Mbps) and its most readily available network: 4G is available to consumers 95.71 percent of the time (table 2.5). China’s 4G speed reached 21.74 Mbps in 2016, with the network available almost 74 percent of the time. India and Indonesia’s ranked near the bottom for average 4G speeds, while Russia and Ireland were in the bottom 10 percent of countries surveyed for 4G availability. The United States has relatively high availability (ranked tenth highest), but relatively low speed (ranked eleventh lowest).

⁴¹ Cisco, “Visual Networking Index,” 2017, 1.

Table 2.5: Comparison of 4G mobile broadband speeds and availability

Country ^a	4G availability (percent)	4G speed (Mbps)
Brazil	53.9	19.7
China	73.8	21.7
EU		
Germany	57.1	20.3
Ireland	43.5	22.5
Sweden	81.4	23.1
India	71.6	6.4
Indonesia	58.8	8.8
Russia	49.2	17.6
South Korea	95.7	45.8
United States	81.3	14.0

Source: Open Signal, “The State of LTE,” November 2016.

^a This table highlights key markets for the report (Brazil, China, EU, India, Indonesia, and Russia). As the EU levels have not been aggregated by the source, this table includes statistics for three member states. The table also includes South Korea, as it has the widest availability and the fastest speeds in the rankings.

Communications Network Services

Networking technologies are used to connect companies in disparate locations and to help them communicate. This section provides an overview of the expansion in firms’ use of wide area networks and software-defined networking. Many enterprises are starting to use cloud-based solutions that, while not necessarily faster, tend to be more flexible and less expensive than traditional offerings.

Wide Area Networking

Wide area networks (WANs) are telecom networks that connect an enterprise’s offices and facilities in different geographic locations to form a single, proprietary network, whether connecting distinct offices within a single city or two or more offices anywhere in the world. Over the last few years, WAN technologies have become increasingly important for connecting enterprises to data centers and cloud computing facilities.

Currently, more than 20 companies offer WAN services in the United States, including companies like AT&T, Verizon, Sprint, CenturyLink, and Level 3. In 2015, the U.S. enterprise services market grew by 8.3 percent to \$36.0 billion, similar to the 8.5 percent compound annual growth rate recorded during the previous five years.⁴²

⁴² TIA, *TIA’s 2015–2018 Market Review and Forecast*, 2015, 4-29.

The principal WAN services are leased lines, Internet protocol virtual private networks (IP VPNs), and business Ethernet.⁴³ Leased lines provide a fixed connection between locations. Since leased lines offer an exclusive, organization-specific communications path and do not travel over the public network, they are typically used by enterprises that require a reliable, high-speed connection and a high degree of network security. Due to their high cost, leased lines are typically used by companies with only two locations or by those that want a direct, high-quality connection to a data center or cloud computing facility. Indeed, several cloud service providers currently offer connections to data centers using leased lines.⁴⁴ However, in 2015, the U.S. leased-line market declined by 1.7 percent to \$12.5 billion, largely due to competition from alternative WAN technologies that are either less expensive (IP VPN) or that offer higher bandwidth (business Ethernet).⁴⁵

IP VPN services allow companies to establish a WAN using the public Internet. Although users' telecommunications traffic travels over public networks, intermingling with all-source Internet traffic, IP VPN services use a variety of techniques—including encryption, tunneling, and authentication—to establish a secure connection between locations and emulate the functionality of a private network. By using the Internet, WANs based on IP VPNs can directly connect a large number of diverse geographic locations without the high costs associated with dedicated leased lines. Companies are also adopting IP VPN services due to their ability to offer cost-effective access to data centers and cloud computing facilities from multiple locations.⁴⁶ In 2015, the U.S. IP VPN services market grew by 10.2 percent to \$17.0 billion, slightly slower than the 12.9 percent compound annual growth rate recorded during the previous five years.

Among the three main WAN technologies, business Ethernet offers, by far, the highest data transfer rates, meaning it is the fastest way for companies to connect multiple locations. With connection speeds of 2.5 Gbps, 5 Gbps, and 10 Gbps now largely standard products, and 40 Gbps and 100 Gbps products becoming more common, business Ethernet services are increasing used by companies that have large data transmission needs and/or require high-bandwidth connections to data centers and cloud computing facilities. Other benefits of business Ethernet WANs include rapid connectivity and the ability to handle large amounts of data, along with competition-induced price decreases.⁴⁷ In 2015, the U.S. business Ethernet market grew by 29.4 percent to \$6.6 billion, even faster than the average annual rate of 26.4 percent recorded during 2010–14. The expansion was driven by ongoing growth in cloud

⁴³ Ibid., 2016, 4-32.

⁴⁴ TIA, *TIA's 2015–2018 ICT Market Review and Forecast*, 2015.

⁴⁵ TIA, *TIA's 2016–2020 ICT Market Review and Forecast*, 2016, 5-13.

⁴⁶ Ibid., 4-6.

⁴⁷ Ibid., 2-8.

computing services, falling product prices, and the general need for high-speed network facilities.⁴⁸

Software-Defined Networking

Until recently, the structure of the network over which voice telephone calls, corporate data, and Internet traffic flowed remained roughly the same, with the software that routed telecommunications traffic embedded in the individual switches and routers transmitting the data. Since network traffic was relatively predictable, the traditional network configuration was more or less adequate.⁴⁹ Growth in cloud computing over the past few years, however, has begun to strain the traditional network model. Applications that ran on a single server, for example, now operate across several servers, and workstations increasingly need to be connected to multiple databases and servers residing on different hosts. As a result, network traffic volumes now fluctuate widely, with such traffic moving in multiple directions over a variety of platforms.⁵⁰

In an attempt to deal with this complexity and volatility, a growing number of telecommunication services providers are implementing “software-defined” networking technologies. Under traditional network architectures, routing functions were performed by individual routers and servers. By contrast, software-defined networks (SDNs) use specialized software to perform traffic routing and other network functions from a centralized location (or locations), sometimes referred to as network operating centers. From these centers, network administrators use SDNs to monitor the entire network, manage traffic flows, and control bandwidth utilization.⁵¹

SDN technologies also allow telecom service providers to manage bandwidth deployment between high-capacity sites (e.g., between a client’s headquarters and one or more data centers) and route traffic dynamically over a number of transport technologies based upon factors like cost and network congestion. In particular, software-defined wide area network (SD-WAN) services also allow companies to route lower-priority data over slower but more cost-effective connections (such as dedicated Internet access or broadband). At the same time, the companies can route traffic that is more sensitive to service quality (such as video or voice traffic) over multiprotocol label switching (MPLS) VPN networks. While MPLS VPN networks are

⁴⁸ Ibid., 2-8.

⁴⁹ TIA, *TIA’s 2016–2020 ICT Market Review and Forecast*, 2016, 2-10.

⁵⁰ Ibid.

⁵¹ Ibid.

more expensive, they are lower latency—that is, they are less vulnerable to delay due to network congestion.⁵²

U.S. and International Markets

Overall, SDN and SD-WAN services are in the early stages of market adoption, although deployment is expanding rapidly. Service providers fall into four categories: established network equipment providers like Cisco; WAN service companies like Citrix; SD-WAN specialists, like VeloCloud and Viptela; and managed WAN service providers like AT&T, Level 3, Telstra, and Verizon.⁵³

Gartner, a research and advisory firm, estimates that less than 5 percent of its clients had used SD-WAN by March 2017, but expects this percentage to grow rapidly in coming years.⁵⁴

According to another industry report, the global SD-WAN market was estimated to be \$739 million in 2016. This report estimated that North America was the largest regional market for SD-WAN (\$347 million), followed by Europe (\$229 million) and the Asia-Pacific region (\$103 million).⁵⁵

⁵² Boudreau, “A Primer for Anyone,” July 26, 2016.

⁵³ Boudreau, “SD-WAN Provider Facts for the Modern Network Specialist,” August 8, 2016.

⁵⁴ Lerner and Rickard, “Market Guide for WAN Edge Infrastructure,” March 23, 2017.

⁵⁵ Markets and Markets, “Software-Defined Wide Area Network (SD-WAN) Market,” December 2016.

Chapter 2: Communication Services and Connected Devices

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Chapter 3

Cloud Computing Services: Data Processing, Storage, Analytics, and Software Applications

Introduction

The National Institute of Standards and Technology (NIST) defines cloud computing as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”⁵⁶ To store and process data efficiently, cloud service providers use large networks of data centers equipped with enormous banks of servers. Providers offer businesses and individuals access to these servers through the Internet. The development of cloud computing services to replace or supplement traditional information and communications technology (ICT) infrastructure both facilitates digital trade in other services and is an important source of digital trade in itself.

This chapter highlights emerging trends in the cloud services industry, with a focus on the adoption of cloud services across digital industries and across countries. It is divided into three sections. The first section defines cloud computing and explains the technology behind cloud services. It also discusses major business-to-business (B2B) and business-to-consumer (B2C) applications of cloud services and highlights the market forces driving the adoption of these services. The second section describes the size of the market for cloud services, in terms of revenue, spending, and Internet traffic. The final section considers recent developments in cloud services by geography and describes the major global providers of cloud services.

Foreign governments’ regulatory and policy measures may undermine the competitiveness of U.S. firms in providing cloud services. For example, limitations on foreign ownership could hinder the ability of cloud service providers to build additional data centers near consumers. Or policies that limit transfer of data across servers in multiple jurisdictions, such as data localization rules, could impede the ability of U.S. firms to provide a full range of cloud

⁵⁶ While there is no one official definition of cloud computing, the NIST definition is generally accepted and has been consistent since 2011. USDOC, NIST, *The NIST Definition of Cloud Computing*, September 2011, 2–3.

computing services at competitive prices in foreign markets. For more information on specific regulatory and policy measures that affect cloud service providers, see chapter 8.

What Is Cloud Computing?

As indicated in the introduction to this chapter, cloud computing is an umbrella term for the Internet-based technologies through which data are processed and stored across multiple servers to be accessed over the Internet on demand. Cloud platforms provide services that supplement, or compete directly with, traditional on-premises platforms.⁵⁷ Since traditional ICT infrastructure processes and stores data on a single machine or group of machines on a firm's premises, the system's capacity and its speed in handling information depends on the size of its machine(s). By contrast, a cloud platform's distributed network of servers in several locations, even several countries allows data to be stored wherever there is excess capacity in the platform's data centers.

Types of Cloud Services

There are three primary types of cloud services: software as a service (SaaS), infrastructure as a service (IaaS), and platform as a service (PaaS). In recent years, other types of services, such as business process and data analytics, have sometimes been listed as separate types of cloud services, but are also often considered segments of the broad SaaS category. Table 3.1 summarizes the key services and segments of each major type of cloud service.

Table 3.1: Cloud computing services summary

Type of service		
Software as a service (SaaS)	Global revenue (2015)	\$32 ^a –\$52 billion
	Description	Provides software managed from a central cloud-based location, accessed via the Internet.
	Key services	Desktop and mobile applications; video streaming; text-, voice- and video-based communication; data processing and analytics; the Internet of Things (IoT)
	Includes	Business process as a service (BPaaS), data as a service (DaaS), unified communication as a service (UCaaS), security as a service (SECaaS)
Infrastructure as a service (IaaS)	Global revenue (2015)	\$20–\$25 billion
	Description	Provides data processing power and storage resources to firms on demand. Secures and maintains underlying data center infrastructure. Provides data storage for both firms and individuals.

⁵⁷ Traditional platforms are based on an operating system, a group of infrastructure services, and a set of packaged and customized applications.

Type of service		
	Key services	Data storage for firms and individuals
	Includes	Content delivery networks (CDNs)
Platform as a service (PaaS)	Global revenue (2015)	\$2–\$4 billion
	Description	Provides dedicated platforms for software and applications development.
	Key services	Application building tools, application testing, and platform hosting

Sources: Synergy Research Group, “2015 Review Shows \$110 Billion Cloud Market,” January 7, 2016; Synergy Research Group, “UCaaS Continues to Disrupt,” January 6, 2017; MarketLine “Global Cloud Computing,” November 2016, 9; Columbus, “Five Key Take-aways,” December 22, 2015.

^a Estimate includes UCaaS data.

Software as a Service (SaaS)

Software as a service (SaaS) is the broadest segment of cloud services: any software or application that is hosted on cloud infrastructure and accessed over the Internet by businesses and consumers is considered SaaS. In contrast to the traditional software model, SaaS manages software from a central location. SaaS software is accessed through the Internet through subscription and is updated by the software managers rather than by the users.⁵⁸

One of the key determinants of effectiveness in providing SaaS is “latency”—the gap between the time when a data request is made over the Internet and the time when the information is provided. The degree of latency chiefly depends upon the distance between the user and the data center.⁵⁹ Latency management needs vary by the type of application used: basic SaaS applications, such as email, tend not to have perceptible differences in latency based on the location of data centers and users. However, more data-intensive applications in both the B2B and B2C markets require low latency, and therefore closer proximity to cloud data centers, to be effective. Examples include high-definition video streaming, machine-to-machine (M2M) services, and the Internet of Things (IoT).⁶⁰

⁵⁸ Rackspace, “Understanding the Cloud Computing Stack,” March 7, 2017.

⁵⁹ Because information that travels along fiber optic cables cannot travel faster than the speed of light, the distance between a data center and the end user has a tangible effect on latency. Cloud infrastructure and the level of network traffic also affect latency, but to a lesser extent.

⁶⁰ Cisco, *Cisco Global Cloud Index*, 2016, 8, 18–20. For more on machine-to-machine (M2M) services and the Internet of Things (IoT), see chapter 6.

Specialized SaaS

The range of services in SaaS has expanded in recent years as analytical capacity has grown. While these new service categories may fit under the broader label of SaaS, they are also frequently listed as separate cloud service segments. Some examples include:

- **Business process as a service (BPaaS).** BPaaS delivers business process activities, such as payroll and customer service, through a cloud service platform. These business processes service firms also tend to pool staff resources across their customer firms instead of relying on dedicated staff for each customer.⁶¹
- **Data as a service (DaaS).** DaaS providers collect and compile data into easily accessible formats, which are stored on cloud servers and are accessed through a subscription.⁶² These data compiling services are often combined with data analytic services, which analyze the large datasets stored on cloud servers to find trends that inform business decisions.⁶³
- **Unified communication as a service (UCaaS).** UCaaS focuses on communication-specific SaaS, such as videoconferencing and messaging services.⁶⁴ See chapter 7 for a more thorough discussion of UCaaS.
- **Services dedicated to the IoT and to cloud integration with AI.** These applications are discussed in detail in boxes 3.1 (AI) and 3.2 (IoT).⁶⁵
- **Security as a Service (SECaaS).** SECaaS providers deploy their network security software to individuals and companies through cloud based subscriptions, as well as remotely manage the security of individual firm computer networks.⁶⁶

Box 3.1: Artificial Intelligence and Data Analytics: The Newest Trend in Cloud Computing

Cloud service providers have begun to invest substantial resources in integrating AI (AI) and data analytics capabilities into packages of cloud computing services. Fundamentally, adding AI and data analytics services to the other software, data, and communications services provided on cloud computing platforms is expected to be mutually reinforcing. Storing larger amounts of data in cloud data centers makes a deeper pool of information available, improving AI outputs and extending the capabilities of cloud computing beyond traditional fields.

However, the integration of AI and data analytics in cloud computing has led to concerns in a number of areas, including security, privacy, and transparency. While cloud providers use AI to improve data analytics, the same technology can also be used to conduct more effective cyberattacks that are harder

⁶¹ Gartner, “Business Process as a Service (BPaaS)” (accessed April 19, 2017).

⁶² Newman, “Data as a Service,” February 7, 2017.

⁶³ Marr, “Big Data-as-a-Service,” April 27, 2015.

⁶⁴ Johnson, “Definition: UCaaS (Unified Communications as a Service)” (accessed April 19, 2017).

⁶⁵ For a detailed discussion of business applications of the IoT, see chapter 6.

⁶⁶ Markets and Markets, “Security as a Service Market Worth 8.52 Billion USD by 2020,” (accessed July 27, 2017).

to attribute to a specific source. Moreover, AI-based systems that are vulnerable to cyberattacks can potentially compromise the safety of data belonging to users of those systems.^a

In addition, advanced data analytics frequently rely on collecting and centralizing large amounts of unencrypted personal data to improve analysis. Because the process typically involves moving large amounts of personal data from devices to cloud computing companies, there is a risk that data privacy will be impaired, especially when data are being moved across borders. Some companies have responded by having the processing of personal data occur on the user's device instead of being transferred to the cloud, though this is not common, due to limited storage space on individual devices.^b Regulating authorities, such as the European Parliament's Policy Department for Citizens' Rights and Constitutional Affairs, also suggest that industries with established data privacy norms, such as healthcare and finance, should use these norms when incorporating AI and other advanced data analytics systems.^c

A third concern with AI and data analytics is the lack of transparency associated with algorithms that continually update based on new information. Algorithms are the step-by-step rules used in various programs to solve problems or make decisions. Without clear documentation as to why changes are made in algorithms, it becomes harder for consumers of data analytic results or regulators to understand how decisions were made. For example, the lack of transparency in integrating advanced data analytics into a credit assessment may give consumers no opportunity to understand why their loan application was rejected.^d

^a Coats, "Statement for the Record: Worldwide Threat," May 11, 2017, 4.

^b Simonite, "Apple Rolls Out Privacy-Sensitive AI," June 13, 2016.

^c Industry representative, interview by USITC staff, March 28, 2017.

^d *Economist*, "Big Data, Financial Services and Privacy," February 9, 2017.

Box 3.2: Cloud Computing and the Internet of Things (IoT)

Cloud computing provides the framework that increasingly enables the IoT to function. In recent years, IoT-enabled technologies have expanded beyond their original focus areas—vehicles and smartphones. They now include major household appliances, wearable devices, and home security technology. The expansion in applications of IoT technologies is only expected to accelerate in coming years, according to many industry sources.^a

Besides providing the capacity to accommodate the volume of IoT devices coming online, the cloud, used as an SaaS platform, provides the backbone needed for IoT technologies to collect and interpret large amounts of data very quickly. For IoT devices to succeed, the technology requires real-time analysis of data (typically from sensors) and often the ability to interact immediately with other relevant devices. Smart meters that adjust home temperatures to be energy efficient, for example, require near-constant reception and analysis of indoor and outdoor temperature changes, a process that requires substantial capacity to both receive and analyze data quickly. This complex process is facilitated by the adaptability and massive capacity provided by cloud computing.

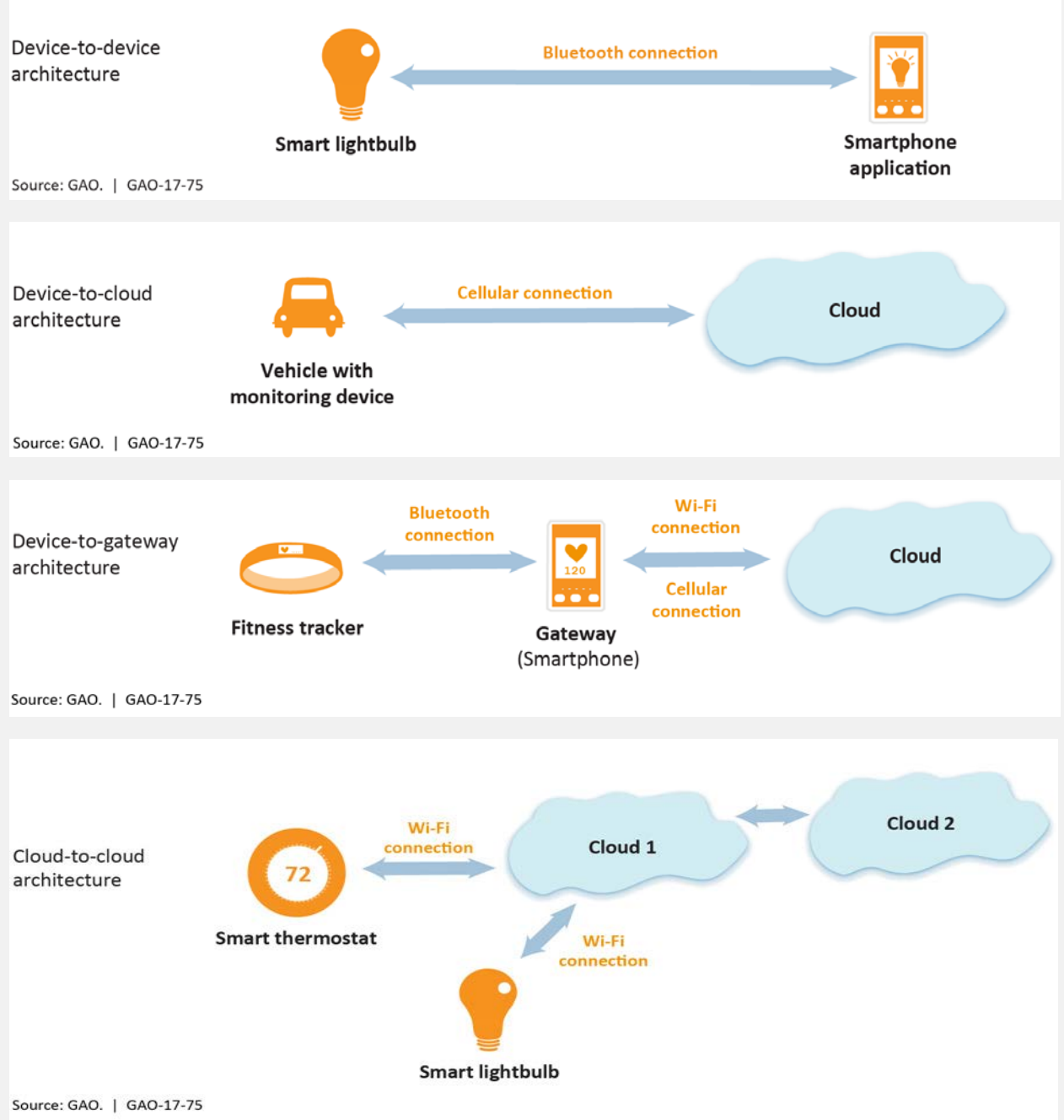
IoT devices can connect to the Internet and transmit data, but many have little to no storage capacity or computing capability. While the devices can operate without being connected to a cloud infrastructure by relying on storage on a single computer, they are limited by the storage capacity of the computer. As

a result, they can also function by transmitting data over Wi-Fi to a cloud-based infrastructure, or by moving through a personal device onto a cloud infrastructure (figure 3.1).^b

^a One recent study estimates that more than 50 billion separate devices will be connected by 2020. Sun, "Internet of Things in 2016: 6 Stats," January 18, 2016.

^b Regardless of cloud architecture, all data-collecting devices transmit data through the Internet, whether through a router or through a Wi-Fi connection.

Figure 3.1: Ways IoT devices can connect to the Internet



Source: U.S. GAO, *Technology Assessment: Internet of Things*, May 2017, 11–12.

Infrastructure as a Service (IaaS)

IaaS supports all other segments of cloud services. IaaS providers maintain the large networks of servers required to benefit from economies of scale in cloud computing, and they provide data storage and processing capacity to other companies. Previously, companies stored and processed data on in-house servers, were responsible for their own data security systems, and purchased new servers to accommodate increases in data flows. IaaS services allow companies to store and process data on an external provider's network of servers, which are maintained and secured by the IaaS provider and can be scaled according to demand for data storage and processing. Companies can choose to access IaaS server networks through the provider's public cloud, an industry-specific cloud, or a private cloud maintained by the provider.

The underlying technology surrounding IaaS is not significantly different across suppliers, which means that cloud infrastructure service providers tend to compete on price. Large cloud service providers have a distinct advantage in providing IaaS, since large data centers are more efficient to operate, and large providers are likely to have a wider geographic network of data centers. Both of these factors allow larger providers to pass their cost advantage on to their customers and thereby increase market share.⁶⁷

The homogeneity of IaaS firms also allows customers to engage multiple cloud service providers simultaneously so they can minimize their "supplier risk" by ensuring that the same or similar services are available from more than one source. Furthermore, the use of multiple suppliers allows companies to build a cloud infrastructure that is specific to their requirements. For example, in its recent initial public offering (IPO), mobile application company Snap disclosed that it had committed \$2 billion over five years for Google Cloud computing, storage, and bandwidth services, as well as \$1 billion over five years to Amazon Web Services (AWS) for similar cloud infrastructure services.⁶⁸ By using services from multiple providers, a company can reduce the risk of a network shutdown that could affect all of its data servers. This strategy also helps mitigate the potential for vendor "lock-in," which prevents companies from changing providers due to the high costs associated with doing so.⁶⁹

Within the IaaS segment, content delivery network (CDN) providers are a specialized service, focusing on decreasing latency and protecting against distributed denial-of-service (DDoS)

⁶⁷ MarketLine, "Global Cloud Computing," November 2016, 15.

⁶⁸ Snap, "Form S-1/A," February 24, 2017.

⁶⁹ Wingfield, "Miscue Calls Attention to Amazon's Dominance," March 12, 2017.

attacks, which block access to websites by overwhelming them with superfluous traffic.⁷⁰ CDN server networks are geographically dispersed and create copies of information accessed through websites. CDN providers route Internet traffic to the closest location that has a copy of the data, rather than accessing data directly from the content provider, thus decreasing latency.⁷¹ This system has the added benefit of protecting web-based content from DDoS attacks. When this type of attack goes through CDN servers, traffic can be dispersed across their network of servers to alternate locations with copies of website data, allowing legitimate users to have continued access to website content.⁷²

Cloud Deployment Models

There are three main models for deploying cloud infrastructure as a service: public, private, and hybrid.⁷³

- A public cloud gives firms, industries, and the general public access to the provider's computing infrastructure over a network that is open for public use. Public cloud service providers, such as AWS and Microsoft Azure, own and operate the infrastructure at their data centers and generally provide access via the Internet.
- Private cloud infrastructure is owned by and/or operated solely for a single firm, with centralized access to ICT resources by different departments or branches of the organization. Private clouds may be hosted and managed by the organization itself or by a third party.
- "Hybrid cloud" describes the use of two or more cloud infrastructures that remain distinct entities, but that are connected and enable data and application portability. Hybrid clouds enable firms to increase the capacity or the capability of their own cloud services by aggregating, integrating, and/or customizing them with another cloud service.⁷⁴ For example, a firm may use in-house databases to process the majority of its data, but may use public cloud infrastructure as backup to handle conditions with higher-than-average data traffic.⁷⁵

⁷⁰ In a distributed denial-of-service (DDoS) attack, multiple compromised computer systems attack a target, such as a server, website, or other network resource, by engulfing it with spurious demands (such as requests for certain services). This causes the flooded resource to deny service to legitimate users.

⁷¹ Cloudflare, *Cloudflare CDN*, 2017, 3.

⁷² Cloudflare, *Cloudflare Advanced DDoS Protection*, 2017, 2.

⁷³ Other deployment models include the community cloud, the distributed cloud, the multicloud, and the industry cloud.

⁷⁴ Bittman, "Mind the Gap: Here Comes Hybrid Cloud," September 24, 2012.

⁷⁵ Cisco, *Cisco Global Cloud Index: Forecast and Methodology 2015–2020*, 2016, 9.

Companies buying cloud infrastructure services choose different cloud deployment models according to their security, cost, compliance, scalability, and management needs.⁷⁶ Companies also consider their existing infrastructure and the predictability of demand when selecting a cloud to host their applications and processes.

Public clouds, which are multi-tenant, provide the best economies of scale and the lowest base costs because they are considerably larger than the other alternatives. Public clouds are preferred for nonsensitive public-facing operations and for unpredictable traffic. Companies typically choose public clouds to host web servers⁷⁷ and applications such as search engines, email, storage, social networking, and video streaming.⁷⁸

Private clouds are attractive in that access can be restricted internally and externally, and firewalls can be erected to protect against threats. However, they are more expensive and offer relatively modest economies of scale. Financial, government, and health organizations that work with sensitive data subject to compliance regulations, such as the Sarbanes-Oxley Act of 2002 and the Health Insurance Portability and Accountability Act of 1996 (HIPAA), usually select a private cloud.⁷⁹ Additional applications that are likely to be hosted by a private cloud include database services, analytical tools and applications, and the IoT, often for security reasons.⁸⁰

Hybrid clouds are typically adopted to supplement traditional data storage infrastructure or private or public cloud infrastructure. Hybrids enable the user to avoid expanding an in-house network.⁸¹

⁷⁶ All models are scalable, but the public cloud is most scalable.

⁷⁷ A web server is a program that uses Hypertext Transfer Protocol (HTTP) or HTTP Secure (HTTPS) to serve the files that form webpages to users in response to their requests, which are forwarded by their computers' HTTP clients. Dedicated computers and appliances may be referred to as web servers as well.

⁷⁸ Kaplan, "Protecting Information in the Cloud," January 2013; Rackspace, "The Difference Between Private and Public Cloud," April 8, 2017.

⁷⁹ Cloud And Compute, "HIPAA Compliant Cloud Storage," accessed May 19, 2017; The Sarbanes-Oxley Act protects shareholders and the general public from accounting errors and fraudulent practices in corporations as well as ensures the accuracy of corporate financial disclosures. The act requires that all business records, including electronic records and electronic messages, be saved for "not less than five years." The Health Insurance Portability and Accountability Act of 1996 established national standards for electronic health care transactions and national identifiers for providers, health insurance plans, and employers.

⁸⁰ Among private cloud users, 75 percent consider private cloud superior to public cloud based on security. However, if implemented correctly, an industry representative contended that a public cloud can be as secure as the most effectively managed private cloud. Industry representative, interview by USITC staff, March 29, 2017.

⁸¹ Industry representatives, interviews by USITC staff, Boston, MA, March 8, 2017.

Platform as a Service (PaaS)

The PaaS is a dedicated platform that companies use to develop software and applications supported by cloud infrastructure. It is designed as a bridge between IaaS and consumer-facing cloud software services.⁸² Unlike IaaS, which provides only the infrastructure, PaaS providers also manage the underlying operating system that developers use to create applications.⁸³ Software developers choose IaaS or PaaS setups according to a company's needs. A pure IaaS setup requires a high level of coding knowledge, but provides more customization control to businesses. PaaS requires less coding knowledge, but is less customizable, as it relies on the PaaS provider for the underlying operating system.⁸⁴ Within PaaS, offerings also vary based on user knowledge of application coding. For example, Salesforce offers two subsegments of PaaS: Force.com and Heroku. Force.com has an app builder that lets a company create an application based on Salesforce's own components, while Heroku manages the deployment of applications written entirely by developers in open-source programming languages such as Ruby, Java, or Python.⁸⁵

Adoption of Cloud Computing Services: Drivers and Inhibitors

As the supply of cloud computing services has evolved, so has the demand for cloud computing. This evolution is being driven by several factors, including (1) the increasing use of ICT tools and services in business operations, (2) the significant cost savings afforded by outsourcing to the cloud relative to investing directly in ICT infrastructure, and (3) the higher-quality services now available, given recent innovations in communications, data storage, and data analysis. In particular, the IoT, with the proliferating data that it collects from cars, appliances, factories, and other connected devices, has increased the demand for cloud computing services such as data storage and data processing. Similarly, the expanding use of AI and other advanced analytic methods has driven up demand for data processing and software services. At the same time, technical innovations that reduce latency and improve server efficiency have also enabled providers to offer cloud computing services at lower cost.⁸⁶

⁸² Rackspace, "Understanding the Cloud Computing Stack," 2017.

⁸³ Royle, "Blurring the Difference Between IaaS and PaaS," August 23, 2016.

⁸⁴ Staten, "Is the IaaS/PaaS Line Beginning to Blur?" January 24, 2011.

⁸⁵ Salesforce, "Salesforce App Cloud" (accessed April 17, 2017).

⁸⁶ For example, software defined networks (SDN) can improve latency and reduce network congestion by separating high frequency flows with minimal latency requirements, such as e-mail, from low traffic flows with strict requirements, like high definition video streaming. Cisco, "Cisco Global Cloud Index: Forecast and Methodology 2015–2020," 2016, 8.

For users, the benefits associated with cloud computing are considerable. The technology enables firms to access and scale state-of-the-art software, platform, and infrastructure resources on demand, with a pay-as-you-go pricing model. Firms no longer need to make significant capital expenditures in ICT when entering a new market or business line, thus substantially reducing barriers to entry in most sectors.⁸⁷ In addition to being a tool to cut costs, cloud computing increases firms' flexibility to change and or upgrade specific ICT infrastructure, which likely increases innovation and reduces time to market.⁸⁸ While these strategic benefits are difficult to quantify, they are frequently cited as the true value of cloud computing.⁸⁹

Despite the benefits of cloud computing, issues and challenges remain. One important area of concern is policies and regulatory measures that impede cross-border data flows, which are discussed in chapter 8. Uncertainty about security, privacy, reliability, and interoperability also weigh on both customers and providers of cloud services. Customers also report that vendor lock-in, gaps in skills and expertise, and the high initial investment required for moving to cloud computing can act as barriers to entry.⁹⁰ Further, in emerging economies such as India, the lack of dependable basic utilities such as electricity and other infrastructure needed for data centers has been an additional challenge. While many of these concerns—especially those pertaining to security—have eased, they have nevertheless slowed the adoption of cloud computing.

Estimating the Size of the Global Cloud Computing Market

Two types of metrics are used to assess the importance of cloud computing in the digital economy. The first is the amount of data, in terms of bits and bytes, which travels through cloud data centers. The second is the size of the market, in monetary terms, for cloud computing services. In both cases, inconsistent definitions of “cloud computing” and “cloud data centers,” as well as changes in methodology and the introduction of new segments of

⁸⁷ Users of all types, from individuals to multinational corporations and governments, enjoy these benefits.

⁸⁸ Cloud computing usually, but not always, saves money. Mahon, “Cost or Agility: What Is Cloud’s True Purpose?” June 28, 2016.

⁸⁹ Smith, “Cloud Computing Primer,” January 13, 2017.

⁹⁰ RightScale, *2017 State of the Cloud Report*, 2017, 16.

cloud services, make it difficult to accurately assess the size of the global cloud computing market.⁹¹

The Volume of Data Traffic in the Cloud

Cloud infrastructure has become an increasingly important source of data processing, in terms of both capacity and volume of data traffic, as well as the share of data that is processed on cloud infrastructure.

When considering total data traffic that flows through the Internet, definitions typically focus on traffic from device to device (such as mobile phone to mobile phone) and traffic from devices to data centers. Since 2008, the majority of Internet traffic (measured as IP traffic) has either originated or ended in a data center.⁹² At the same time, as the traffic devoted to data center processing has increased, the share of all Internet traffic going through cloud data centers has also expanded, from roughly 30 percent of all IP traffic in 2011 to 70 percent in 2015.⁹³

In addition to the growth in the share of data that passes through cloud data centers, the capacity of cloud data centers has surpassed that of traditional data centers in recent years. Figure 3.2 shows the growth in traditional and cloud data center workloads, a measure of data center capacity, since 2011.⁹⁴ Overall, the total data center workloads have more than tripled

⁹¹ There is no standard definition of cloud computing, which means that firms measure different components with varying weights to estimate the size of the market. While some data sources such as Cisco's Global Cloud Index use the NIST definition (see Chapter 3 introduction), others use their own definitions of cloud computing. For example, Forrester defines cloud computing as "a standardized IT capability (services, software, or infrastructure) delivered in a pay-per-use, self-service way," and Gartner defines it as "a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies." Cisco, *Cisco Global Cloud Index*, 2016; Gartner, "IT Glossary" (accessed April 18, 2017); Forrester, "Cloud Computing" (accessed April 18, 2017). The definition of cloud data centers also varies, particularly in the classification of private clouds. While NIST explicitly includes private cloud in its definition of cloud computing, some reports focus solely on public cloud infrastructure.

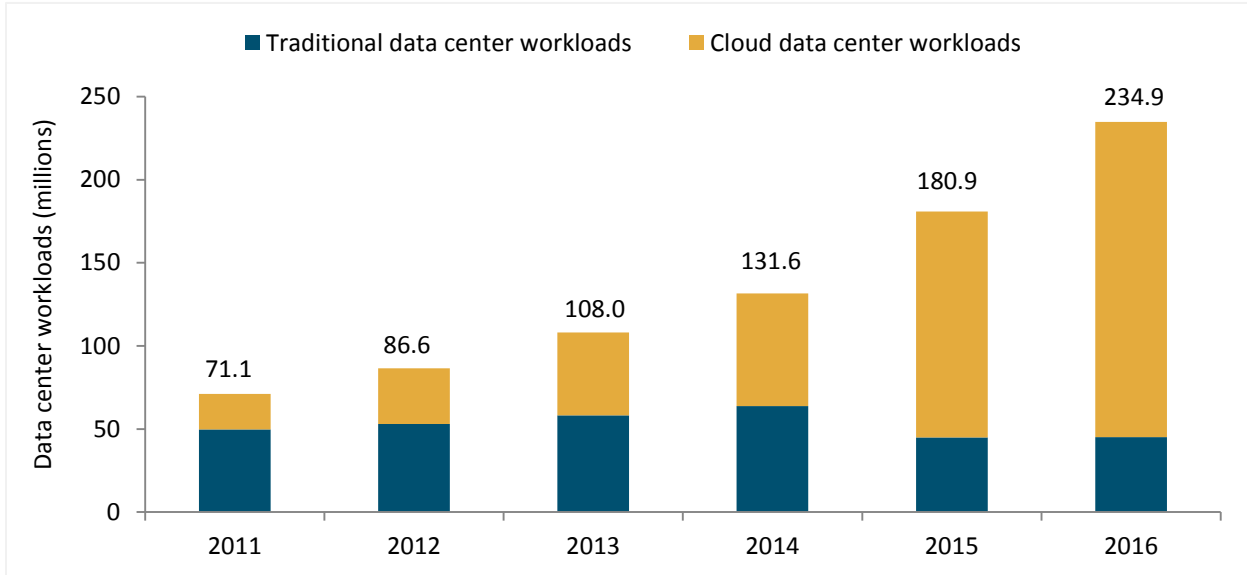
⁹² Cisco, *Cisco Global Cloud Index*, 2016, 5.

⁹³ USITC estimates are based on data from Cisco, *Cisco Global Cloud Index*, 2016; Cisco, *Cisco Global Cloud Index*, 2012; Cisco, *Cisco Visual Networking Index*, 2016; and Cisco, *Cisco Visual Networking Index*, 2012. In Cisco's presentation, data center traffic includes three subsets: data center to data center, within a data center, and data center to data user. Since definitions of Internet traffic typically stop once data reaches a data center, this estimate assumed that "data center to data user" is the subset of data center traffic that is included in total IP traffic in the Visual Networking Index. If the share of data center traffic captured by cloud data centers was constant across all three types of data traffic, then USITC staff can estimate that 15 percent of cloud data center traffic was "data center to user," then calculated that traffic's share of all Internet IP traffic.

⁹⁴ "A server workload is defined as a virtual or physical set of computer resources, including storage, that is assigned to run a specific application or provide computing services for one to many users. For the purposes of quantification, we consider each workload as being equal to a virtual machine or a container." Cisco, *Cisco Global Cloud Index*, 2016, 8.

between 2011 and 2016, with cloud data center workloads growing at an average rate of over 50 percent annually during the period.

Figure 3.2: Global data center workloads (millions), 2011–16

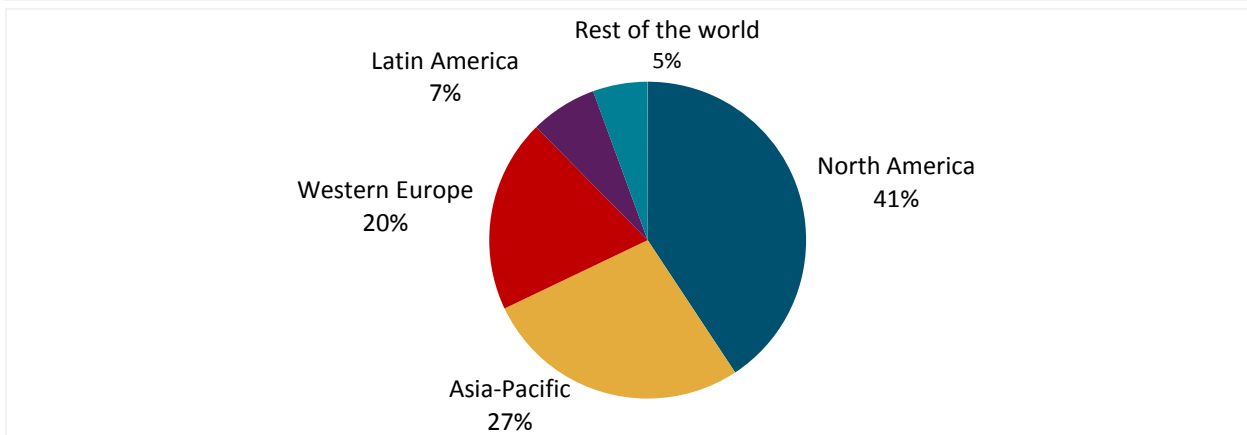


Source: Cisco, Cisco Global Cloud Index, 2016; Cisco, Cisco Global Cloud Index, 2012.

Note: Workloads measure the number of physical and virtual computer resources available to store and run specific applications or computer services. Corresponds to [appendix table G.1](#).

About 40 percent of cloud data center workloads were in North America in 2015, compared to almost 30 percent in the Asia-Pacific region and 20 percent in Western Europe (figure 3.3).⁹⁵

Figure 3.3: Cloud data center workloads, 2015



Source: Cisco, Cisco Global Cloud Index, 2016.

Note: workloads measure the number of physical and virtual computer resources available to store and run specific applications or computer services. Corresponds to [appendix table G.4](#).

⁹⁵ Cisco, Cisco Global Cloud Index, 2016, 26.

Spending by Firms on Cloud Computing Services and Industry Revenues from Providing Cloud Services

Cloud computing is increasingly being used by firms all around the world in a wide range of industry sectors. As a result, firms' spending on cloud services—and, correspondingly, revenues earned from providing cloud computing services to firms—have risen sharply in the past five years. MarketLine estimates that global cloud computing sector revenues increased at an average annual rate of 34.3 percent from 2012 to 2016, rising from \$27.6 billion to \$89.3 billion.⁹⁶ This trend is expected to continue: 96 percent of Fortune Global 50 companies have publicly announced cloud adoption plans.⁹⁷

Monetary estimates of the global cloud services market for 2015 (the latest year for which comparative estimates are available, broken out by type of cloud service) range from about \$52 billion to \$97 billion. Estimates, however, vary significantly depending on the information source and estimation methodology used.⁹⁸

Table 3.2 shows three market research firm estimates of global cloud services spending in 2015, and table 3.3 shows three market research firm estimates of global cloud services revenue in that same year. The reported spending numbers tend to be larger than estimates of providers' revenue, possibly because of differences in categorization of cloud services, or in the treatment of distribution margins and overhead costs. While most estimates include the three main segments of cloud computing services, other cloud services such as business processes, cloud management, and unified communications are also included as separate categories in some estimates. SaaS tends to be the largest source of spending and revenue across estimates, while PaaS tends to be the smallest segment.

⁹⁶ MarketLine, *Global Cloud Computing*, 2016, 8.

⁹⁷ Brinda, "The Changing Faces of the Cloud," January 2, 2017, 1.

⁹⁸ The scope of what constitutes a cloud service may also vary. For example, Gartner includes advertising as a segment of cloud spending, although this segment supports cloud services rather than supplying them directly. Changes in methodology and the introduction of new cloud service segments further complicate efforts to compare cloud spending over time. For example, in 2012, Gartner reported cloud advertising as part of business process as a service, but in 2013 updated the methodology so that cloud advertising was a separate segment. Gartner, "Gartner Says Worldwide Public Cloud Services Market to Total \$131 Billion," February 28, 2013; Gartner, "Gartner Says Worldwide Cloud Services Market to Surpass \$109 Billion," September 18, 2012.

Table 3.2: Estimates of global cloud services spending, 2015 (billion \$)

Cloud service	IDC	Forrester	Gartner
Software as a service (SaaS)	56.1	63.2	31.4
Infrastructure as a service (IaaS)	12.4	5.8	16.2
Platform as a service (PaaS)	8.8	7.4	3.8
Other cloud services			
Cloud business process services		2.0	39.2
Cloud management and security services			5.0
Total	77.3	78.4	95.6

Sources: Columbus, “Roundup of Cloud Computing Forecasts,” January 24, 2015; Gartner, “Gartner Says Worldwide Public Cloud Services Market Is Forecast to Reach \$204 Billion,” January 25, 2016; IDC, “IDC Version 4-Cloud Services,” March 2017. Note: Gartner also includes data for cloud advertising, which is not shown in this table.

Table 3.3: Estimates of global cloud services revenue, 2015 (billion \$)

Cloud service	Synergy	MarketLine	North Bridge/Wikibon
Software as a service (SaaS)	27.0	37.0	52.5
Infrastructure as a service (IaaS)	20.0 ^a	23.1	24.9
Platform as a service (PaaS)		3.6	2.3
Other cloud services			
Unified communications as a service	5.0		
Total	52.0	63.7	79.7

Sources: Synergy Research Group, “2015 Review Shows \$110 Billion Cloud Market,” January 7, 2016; Synergy Research Group, “UCaaS Continues to Disrupt,” January 6, 2017; MarketLine “Global Cloud Computing,” December 2016, 9; Columbus, “Five Key Take-aways,” December 22, 2015.

^a Synergy Research Group reports IaaS and PaaS as a single category.

Over the past five years, all three major segments of cloud services have been growing steadily. Table 3.4 shows two market research company estimates of global spending in the three major segments of cloud services during 2012–16. While SaaS continues to dominate the market for cloud services in terms of size, the fastest-growing segment over the period was IaaS, whose spending more than quintupled.

Table 3.4: Global spending on public cloud services, 2012–16 (billion \$)

Cloud service	Data source	2012	2013	2014	2015	2016
SaaS	Wikibon	19.6	27.6	39.7	49.9	67.5
	IDC	28.6	35.1	43.8	56.1	68.0
IaaS	Wikibon	6.1	9.9	15	23.3	34.9
	IDC	4.6	5.1	7.5	12.4	18.7
PaaS	Wikibon	0.7	1.1	1.6	2.1	2.8
	IDC	3.0	3.8	5.4	8.8	12.5

Sources: IDC, “IDC Pivot Table, Q1 2015 Final,” July 2015; IDC, “IDC Version 4-Cloud Services,” March 2017; Wikibon, “Public Cloud Revenue Worldwide from 2012–2016, by Segment,” July 2016.

A Shift in Deployment Models

Overall, there has been a shift in cloud models, from public-only or private-only to predominantly hybrid. Information technology professionals report that use of public-only architectures declined from 29 percent in 2014 to 22 percent in 2016, and that use of private-only architectures fell from 7 percent to 5 percent over the same period.⁹⁹ Cloud environments will remain predominantly hybrid in the near future as companies transition workloads from existing infrastructure. Although hybrid will be the most common model, it requires the public cloud to be part of the overall strategy.¹⁰⁰

Converting from traditional in-house data storage and processing to the public cloud decreases costs in the short run, as well as increasing flexibility if the amount of data processed changes over time.¹⁰¹ For small firms, the use of public cloud infrastructure also helps to improve security. Large public cloud providers tend to adopt the highest industry standards for security, which would be difficult for a small firm to achieve with limited IT staff and resources.¹⁰²

Firms continue to prefer hybrid clouds because they enable continued use of their existing infrastructure, thus slowing the transition to the public cloud. However, although both public and private cloud use are growing, private cloud use is growing at a slower pace.¹⁰³ The public cloud is becoming the largest part of the cloud services sector, with patterns that are largely the same across large and small companies. In 2016, companies reported running 41 percent of workloads in public cloud data centers; 38 percent of workloads in private cloud data centers; and 21 percent of workloads in traditional data centers.¹⁰⁴

The shift from private cloud to public cloud suggests greater confidence in cloud operations and a willingness to experiment with cloud capabilities and capacity.¹⁰⁵ A majority of firms process their computer-based tasks in cloud infrastructure, with the average firm using four different cloud services and experimenting with four more. This is typically due to factors such as expertise, cost, and reliability.¹⁰⁶

⁹⁹ RightScale, *2014 State of the Cloud Report*, 2014, 5; RightScale, *2017 State of the Cloud Report*, 2017, 9. In a similar survey of firms, Intel Security noted that in 2016, 19 percent of firms reported using public-only infrastructure, while 24 percent used private only. Intel, *Building Trust in a Cloudy Sky*, 2017, 8.

¹⁰⁰ Industry representatives, interviews by USITC staff, Boston, MA, March 8, 2017.

¹⁰¹ MarketLine “Global Cloud Computing,” December 2016, 13.

¹⁰² USITC, hearing transcript, April 4, 2017, 234 (testimony of Leticia S. Lewis, BSA | The Software Alliance); USITC, hearing transcript, April 4, 2017, 307 (testimony of Harley Geiger, Rapid7).

¹⁰³ RightScale, *2017 State of the Cloud Report*, 36.

¹⁰⁴ *Ibid.*, 12.

¹⁰⁵ Industry representatives, interviews by USITC staff, Boston, MA, March 8, 2017.

¹⁰⁶ RightScale, *2017 State of the Cloud Report*, 29.

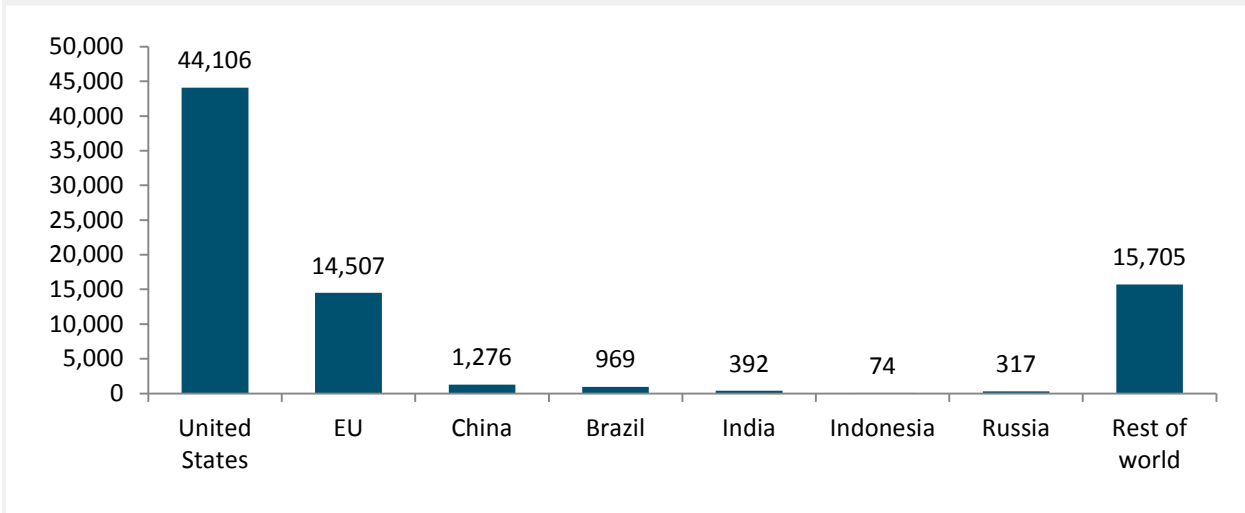
Market Competition and Trends

Geographic Breakdown of the Market for Cloud Services

The U.S. market for cloud computing services is by far the largest, with revenues of \$50.8 billion in 2016; it accounted for 56.9 percent of the \$89.3 billion global cloud computing sector that year.¹⁰⁷ By comparison, Europe accounted for 21.1 percent (\$18.9 billion), while the Asia-Pacific accounted for 15.1 percent (\$13.5 billion).¹⁰⁸

The large U.S. market for cloud computing has been boosted by U.S. providers' large-scale investments in the sector. Chinese and European cloud companies are attempting to elevate their investments in the cloud market, sometimes with support from public sector sources.¹⁰⁹ Overall, the United States and European Union (EU) together made up more than three-fourths of global spending on cloud services in 2016, as shown in figure 3.4. In contrast, the emerging-market countries considered in this report—China, Russia, India, Brazil, and Indonesia— together made up only 4 percent of global spending on cloud services in 2016.¹¹⁰

Figure 3.4: Total cloud spending by country, 2016 (million \$)



Source: IDC, "IDC Version 4-Cloud Services," March 2017.

Note: Corresponds to [appendix table G.5](#).

¹⁰⁷ MarketLine, "Global Cloud Computing," 2016, 10.

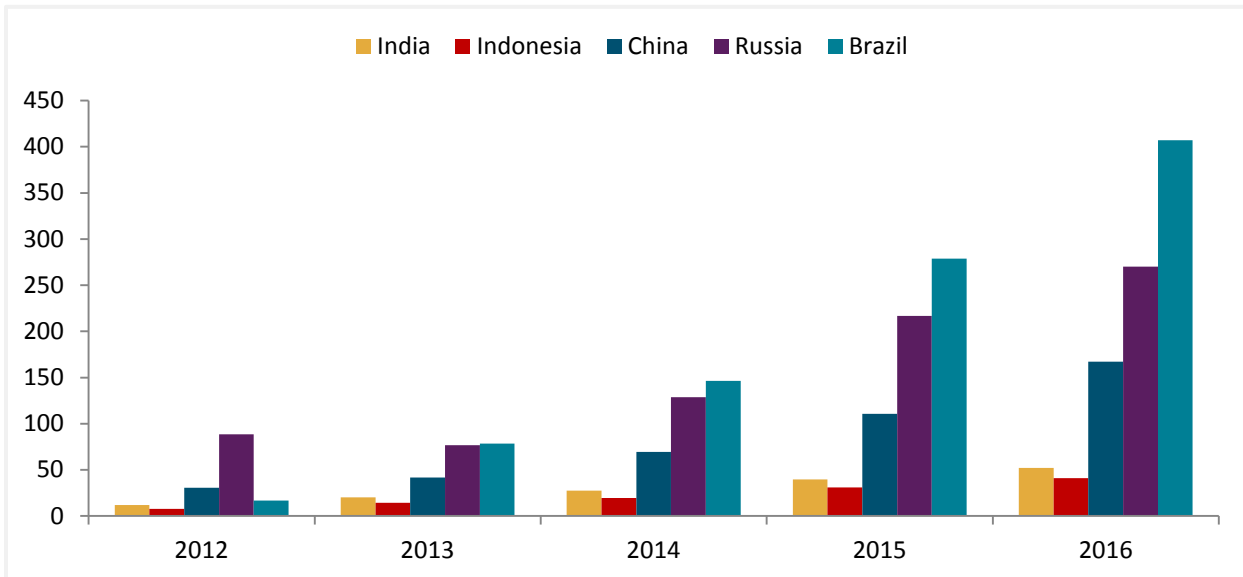
¹⁰⁸ Ibid.

¹⁰⁹ Industry representative, interview by USITC staff, March 8, 2017.

¹¹⁰ China, Russia, India, Brazil, and Indonesia have data localization requirements.

Although the emerging-market countries’ share of total spending is small, the amount they spend on cloud services per person has risen over time. Figure 3.5 shows yearly spending on cloud services per hundred people in Brazil, China, Russia, India, and Indonesia since 2012. Brazil, in particular, has seen strong growth in the amount spent on cloud services per person.

Figure 3.5: Public cloud spending (SaaS, IaaS, and PaaS) per 100 people, 2012–16 (\$)



Source: USITC staff calculations using data from IDC, “IDC Version 4-Cloud Services,” March 2017; and World Bank World Development Indicators (accessed April 4, 2017).

Note: Corresponds to [appendix table G.6](#).

In developed markets and in the global market overall, firms’ spending on SaaS services represents about two-thirds of total cloud spending. In emerging markets, SaaS is not as dominant. Table 3.5 shows spending on cloud services by segment for the United States, the EU, Brazil, Russia, China, India, and Indonesia in 2016. In the United States, almost 75 percent of cloud spending is on SaaS services, as firms move to take advantage of a wide range of software systems to manage all aspects of their businesses and to combine their legacy infrastructure systems with cloud infrastructure. By contrast, in China and Indonesia, the majority of spending (about 60 percent in both cases) is focused on IaaS, as firms need to set up management systems infrastructure before adopting a wider range of cloud services.¹¹¹

¹¹¹ One industry representative noted that Indian technology firms tend to work with U.S. companies to integrate their software offerings with cloud infrastructure services. Industry representative, interview by USITC staff, April 19, 2017.

Table 3.5: Public cloud service spending by country and type, 2016 (million \$)

Cloud service	United States	EU	Brazil	Russia	China	India	Indonesia
SaaS	46,428	12,702	440	275	804	402	37
IaaS	8,076	4,007	262	83	1,427	229	63
PaaS	8,193	2,325	143	32	75	61	7
Total spending	62,698	19,034	845	390	2,307	692	107

Source: IDC, "IDC Version 4-Cloud Services," March 2017.

Note: EU spending excludes Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta.

Providers of Cloud Services in Global Markets

U.S. firms were early innovators in cloud computing and currently dominate the global cloud services industry. In 2016, IBM was the largest global provider of all public cloud services, with \$13.7 billion in revenue, followed by Amazon Web Service (AWS) with \$12.2 billion.¹¹² Since there is no standard for reporting cloud service revenue as a share of total company revenue, it is difficult to assess the market shares of individual companies in cloud service segments. For example, while Amazon's financial statements include discrete data on sales by its cloud services group AWS, Google does not separately report its cloud service business. Industry estimates of market share identify Amazon, IBM, Microsoft, Google, Salesforce, and Oracle as leading providers of cloud services, but estimates of market share are not consistent across reports.¹¹³

These leading U.S. providers of cloud services all have operations in Brazil, the EU, India, Indonesia, and Russia. However, domestic competitors have emerged in these markets as well, taking advantage of local investment in the industry (including government support in some cases), familiarity with the local market and language, and localization policies directed at the industry. Prominent local vendors in specific foreign markets are identified below (table 3.6).

¹¹² Amazon, *Amazon.Com Announces Fourth Quarters*, February 2, 2017; IBM, *IBM 4Q 2016 Earnings*, January 19, 2017.

¹¹³ For example, in 2015, ITCandor reported that AWS captured 15.8 percent of the IaaS market, while Synergy research group estimated AWS captured 31 percent in the IaaS market. ITCandor, "Distribution of Cloud Infrastructure," 2015; Synergy Research Group, "AWS Remains Dominant despite Microsoft and Google Growth Services," February 3, 2016.

Table 3.6: Prominent local cloud providers

Brazil	China	India	Indonesia	EU	Russia
ISLonline	Alibaba	Tata	IndonesianCloud	SAP	Cloudike
BSA Brasil	Huawei	Infosys	TelkomTelstra	OVH	Moe Delo
Com4	Baidu	Wipro	CBNCloud	Interoute	CloudDC

Sources: Gartner, "Gartner Says Worldwide Public Cloud Services," January 25, 2016; Columbus, "Roundup of Cloud Computing Forecasts," January 24, 2015; IDG Enterprises, *What's Next in Cloud Security*, April 2016; USDOC, "2016 Top Markets Report Cloud Computing," April 2016; Scott, "U.S. Tech Giants Are Investing Billions," October 3, 2016; Lucas, "Alibaba Looks to Emulate Amazon," February 28, 2017; Interoute, "Interoute Jumps on Acquisition Trail with New Investors," March 30, 2015; MarketLine "Global Cloud Computing," December 2016, 9; Columbus, "Five Key Take-aways," December 22, 2015.

European Union (EU)

Despite the natural location advantage of EU-headquartered cloud computing companies, four major U.S. firms (Amazon, Microsoft, Google, and IBM) hold more than 40 percent of Europe's cloud computing services market. The combined market share of these firms has grown steadily since 2012, as they have expanded their investments in the region, setting up data centers for local cloud customers. In 2016, Amazon, Microsoft, Google, and IBM invested a total of about \$2 billion to create or expand data centers across the EU.¹¹⁴

EU cloud companies are much smaller than the major U.S. cloud companies operating in the region. Their size limits their ability to build EU-wide client bases, encouraging the further proliferation of cloud services firms that operate on a national, rather than EU-wide level. The telecommunications policies of the individual EU member states, as well as preferences from EU firms to source cloud computing capability domestically, also encourage the creation of companies that specialize in services for individual countries. According to the Dutch Centre for the Promotion of Imports, "European companies prefer to outsource [cloud] services to providers within the same country (onshoring). When outsourcing abroad, they prefer nearshore locations because of proximity, language, cultural similarities, [and] there being little or no time difference."¹¹⁵

China

Chinese firms dominate cloud computing in China. Alibaba's AliCloud service is the largest provider, with \$830 million in global sales in 2016.¹¹⁶ Alibaba's reach is mostly limited to its

¹¹⁴ Schechner, "U.S. Tech Firms Dominate Cloud Services in Western Europe," August 4, 2017.

¹¹⁵ Government of the Netherlands, CBI, Ministry of Foreign Affairs, "Cloud Computing Services," February 10, 2017.

¹¹⁶ USITC staff calculations using data from Alibaba, "Alibaba Group Announces December Quarter 2016 Results," January 24, 2017; Alibaba, "Alibaba Group Announces June Quarter 2016 Results," August 11, 2016; Alibaba, "Alibaba Group Announces September Quarter 2016 Results," November 2, 2016; Alibaba, "Alibaba Group Announces March Quarter 2016 Results," May 5, 2016; Lucas, "Alibaba Looks to Emulate Amazon," February 28, 2017.

domestic market, but the firm has recently begun to expand its cloud infrastructure to eight other locations outside of China through joint ventures with local companies.¹¹⁷ Following Alibaba, the next four largest cloud companies in China are also Chinese and include two state-owned enterprises: China Telecom and China Unicom.¹¹⁸ Despite the dominance of Chinese firms, several large U.S. cloud providers have established operations in China through joint ventures with local companies. For example, Microsoft is partnered with 21Vianet, a Chinese data services firm, and Amazon is partnered with ChinaNetCenter.

¹¹⁷ For example, Alibaba's data center in Germany is a joint venture with Vodafone, while its data center in Japan is a joint venture with Softbank. Kharpal, "Alibaba Cloud Expands Data Centers," November 21, 2016.

¹¹⁸ Lucas, "Alibaba Looks to Emulate Amazon," February 28, 2017.

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Chapter 4

Digital Content, Search, and News

Introduction

New digital technologies are changing how content is being created, distributed, and monetized. Consequently, the curation and consumption of creative content, news, and information is rapidly shifting from traditional sources to more on-demand platforms, as evidenced by the growing number of cloud-based offerings across the media industry and their increasing adoption among global consumers. In general, these publishers are digitizing catalogs and inventories, optimizing workflows, and writing algorithms to help create and discover new content. While some of this content was traditionally provided to consumers through physical formats such as discs and tapes, recent years have witnessed the rapid rise of digital platforms such as video on demand (VoD) and music streaming (box 4.1). Nonetheless, although cloud innovations have allowed more people to access increasingly tailored content, often at low or no cost, content creators continue to face significant challenges. These include the protection of copyrighted materials, the protection of data privacy, and intermediaries' liability for third-party content (see chapter 8).

Box 4.1: Cloud Technology Has Enabled Digital Content to Bridge Several Platforms

In recent years, advances in mobile device technologies as well as in mobile and fixed-broadband Internet have enabled consumers to access almost limitless amounts of online content, information, and data. Central to this move to digital delivery are cloud infrastructure and services that provide content creators with the scale of computing power needed to meet increasingly customized consumer demands for digital content, anywhere and at any time.^a To illustrate, in the digital video game industry, cloud technology has not only allowed firms to better customize users' gaming experiences, but it has also broadened the industry's customer demographics. More people than ever are engaging in mobile gaming, particularly through social network and freemium game applications (apps).^b In both the video on demand (VoD) and digital music industries, advances in cloud infrastructure have allowed streaming technologies to become the chief way many customers watch TV shows and movies or listen to songs. This development is putting increasing pressure on traditional video and music producers to offer more content online and at lower cost. In the e-publishing, news, and search industries, information is gathered, analyzed, and made available through cloud services. Those services have allowed customers to more easily and efficiently find and read the content and news stories that most interest them.

As a result of technology and infrastructure innovations, the boundaries between creative content/publishing industries, social media, and e-commerce have blurred. Besides being able to share personal news and photos with friends and family on sites such as Facebook and Twitter, users can now post their own live video streams for public viewing, read and react to news stories tailored to their interests, and receive product recommendations via targeted ads based on previous online search

queries. And they can watch live sports events, as well as many film and television productions, from any smart device.^c

To stem online content fragmentation, these platforms have created “communities of content.”^d To illustrate, Snapchat, an image-sharing and social messaging app with 100 million daily users, is one-tenth the size of Facebook, which has more than 1 billion daily users. But Snapchat’s users spend a considerable amount of time inside the app watching videos. The average time users spend on Facebook is about 20 minutes compared to 25 to 30 minutes for Snapchat.^e With 21 publishing partners (including BuzzFeed, Vox Media, and the *Daily Mail*), Snapchat is blending its social media platform with professional news and entertainment video providers, as well as advertisers, in order to diversify and streamline its content offerings on a global scale.^f

^a Prinzlau, “The Supreme Role of Cloud Computing in Media,” February 14, 2017; *Economist*, “Smartphones Are Strongly Addictive,” February 9, 2017. By extension, one device in particular, the smartphone, has become an almost indispensable personalized delivery vehicle for a widening array of digital content. Smartphones allow users to play video games with friends in different countries, stream new TV shows or songs the day they are released, read a best-selling book, and use GPS-enabled applications to search for breaking news articles or reviews of nearby restaurants, among other activities.

^b Accenture, “The Pulse of Gaming,” 2014, 16–18. “Freemium” games are initially free to download, but offer optional game enhancements for a fee, such as buying virtual goods or accessing new game levels (these are known as in-app purchases).

^c World Economic Forum, *Digital Transformation of Industries: Digital Enterprise*, January 2016, 5–11.

^d World Economic Forum, *Digital Transformation of Industries: Digital Enterprise*, January 2016, 4. Content is being distributed across many different platforms, devices, and media, making it more difficult for companies to keep audiences engaged. This phenomenon is also called content fragmentation.

^e Wagner, “Facebook v. Snapchat: What Counts as a Video View?” January 15, 2016. As of January 2016, Snapchat reported about 7 billion video views per day compared to Facebook’s 8 billion video views per day. Carson, “Snapchat Users Now Spend 25 to 30 Minutes Every Day on the App,” March 25, 2016; Zephoria, “The Top 20 Valuable Facebook Statistics— Updated May 2017,” May 8, 2017.

^f Strategy+Business, *Global Entertainment and Media Outlook 2016–2020*, 2016, 40; O’Reilly, “Snapchat Is Reportedly Planning a Big Payday,” October 19, 2016.

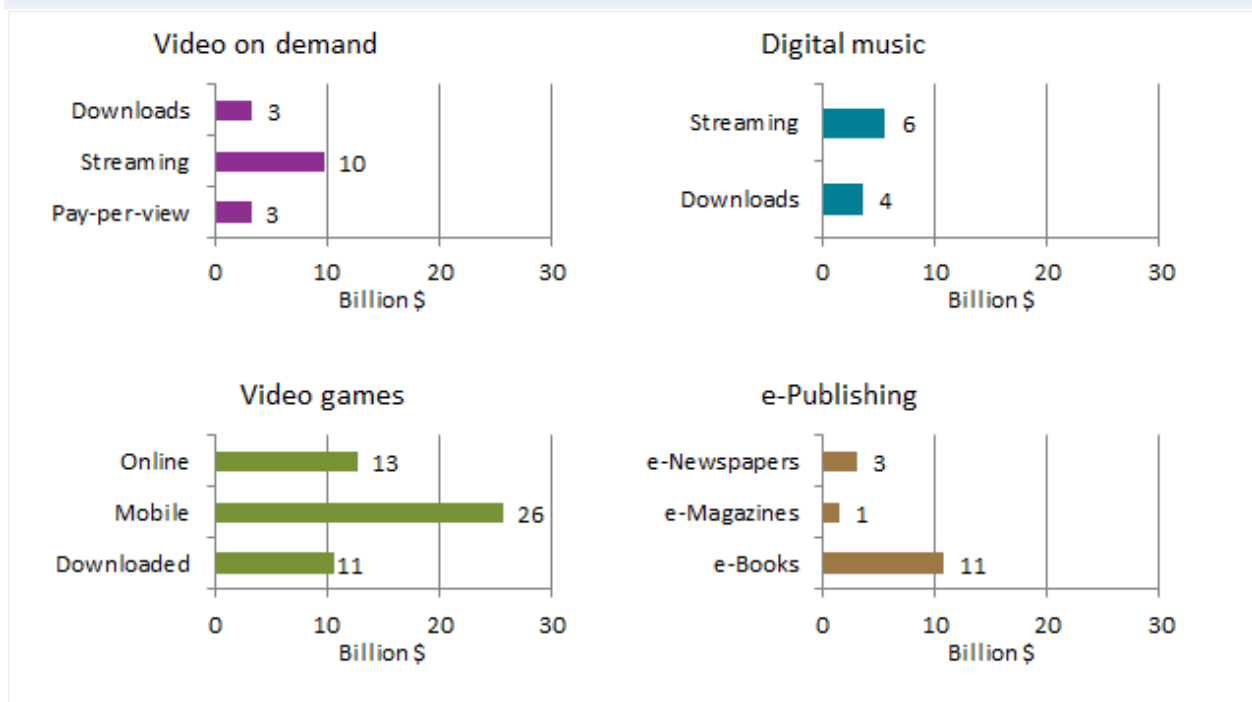
The following sections will examine recent innovations in the major digital content, search, and news industries. They will also describe developments and competitive conditions in the U.S. and international markets (especially in Brazil, China, Europe,¹¹⁹ India, Indonesia, and Russia), highlighting any relevant policy measures. The first part of this chapter will focus on digital content—specifically video games, videos (movies and TV), music, and published literature (e-books) delivered through the Internet. The second part of the chapter will focus on online search (horizontal and vertical), news aggregation, and social media. The sectors discussed in this section are primarily business-to-consumer.

¹¹⁹ Unless otherwise specified, any data sourced from Statista that references “EU” or “Europe” includes Austria, Belgium, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom. This is true even though Norway, Serbia, and Switzerland are not EU members.

U.S. and International Markets

In 2016, the global digital content market—video games, VoD, digital music, and e-publishing—reached \$89.5 billion in total revenue. The content segment was dominated by video games, with \$48.9 billion in revenue that year (figure 4.1). The United States led in most digital content sectors by relatively large margins. An exception was in the video games sector, where China—the second-largest market—was buoyed by its strong mobile games segment. (The United States earned \$11.6 billion and China earned \$10.7 billion in digital video games revenue in 2016.)¹²⁰

Figure 4.1: Global digital content revenues, by sector, 2016



Source: Statista, “Digital Media,” 2016.

Note: Sum of numbers may not equal totals due to rounding. Corresponds to [appendix table G.7](#).

With respect to advertising-driven content, online search companies—Baidu, Google, Microsoft, Naver, Yahoo, and Yandex—generated more than \$100 billion in combined revenue in 2016.¹²¹

¹²⁰ Statista, “Digital Media: Video Games,” 2016.

¹²¹ Baidu, “Baidu: Form 20-F,” 2016; Alphabet Inc., “Alphabet: Form 10-K,” 2016, 24; Microsoft, “Microsoft: Form 10-K,” 2016. Naver, “Naver Annual Report, 2016,” 2016; Yahoo! Inc., “Yahoo: Form 10-K, Selected Financial Data,” 2016; Yandex, “Yandex: Form 20-F,” 2016.

Video Games

Video games delivered over the Internet include downloads of full-format games and add-on content, as well as game subscriptions, mobile app games, social network games, other online and cloud-based games, and e-sports.¹²² Cloud technology has allowed the video game industry to better customize gaming experiences through increased consumer engagement (similar to personalizing one's digital video selections on Netflix or one's streaming music content on Pandora). Most video games today are delivered online and are available in multiplayer formats and "games as a service," or cloud gaming. This format allows gaming companies to provide regular updates, including new content, events, or options for downloadable content tailored to an individual gamer's preferences.¹²³ Consequently, fierce market competition has required digital game publishers to invest in continuous updates to keep users engaged. In many cases, customers may abandon a game if they are concerned about inadequate technical support, lack of updates, questionable data security, or transaction costs and fees.¹²⁴

Integration of user-friendly interfaces has also become particularly important for games that are played by broad online audiences. For instance, if players stop a game, their information is often automatically saved in the cloud and available on multiple devices, allowing the players to easily pick up where they left off. This type of game delivery requires a sophisticated Internet infrastructure with ultra-low-latency cloud connectivity (i.e., with minimal delays; see chapter 3) to ensure a highly responsive and dependable game experience for users, regardless of location or device.¹²⁵ Moreover, thanks to cloud gaming, players can rent games on demand and share replays from their games with friends without frequent hardware upgrades.¹²⁶ For

¹²² E-sports are video game competitions that are often played before live audiences and broadcast over the Internet. The most popular e-sports tournaments can offer large cash prizes and professional sponsorships for the best players/teams. Stewart, "eSports: Bigger and Smaller Than You Think," 2016.

¹²³ Accenture, "The Pulse of Gaming," 2014, 4–6. Downloadable content is extra content available for video game users to download from the Internet (either free or for a fee), and can be distributed by the game's official publisher, console online markets (e.g., content purchased through Microsoft Xbox Live's or Sony PlayStation's online networks), or a third-party platform. This content generally enhances or completes the video game's features (e.g., introducing new levels, characters, or items). For example, Steam, which is owned by Valve (U.S.), is a primary distribution platform for PC gamers. Steam offers games and updates for purchase, as well as a platform for multiplayer gaming, video streaming, and other social networking services.

¹²⁴ Blau, "Social Status: New Markets and Rising Incomes," July 2016, 16.

¹²⁵ Accenture, "The Pulse of Gaming," 2014, 8–11.

¹²⁶ Wei, "A Survey of Cloud Gaming: Future of Computer Games," 2016, 7606.

mobile players, 4G networks have improved cloud gaming performance thanks to their increased bandwidth and speed, which is almost twice as fast as that of 3G.¹²⁷

U.S. and International Markets

The global digital video game industry reached a total market size of about \$48.9 billion in 2016, accounting for 55 percent of digital content revenues (i.e., total revenues from video, music, video games, and e-publishing). The United States, China, and Europe together accounted for about \$31.0 billion (63 percent) of the global digital video game market in 2016, with the United States alone generating about \$11.6 billion of the total.¹²⁸ As noted above, by contrast with its standing in other digital content markets, the United States does not have a significant lead over other countries when it comes to digital video game revenues, primarily due to China's high mobile gaming revenues. China recorded about \$10.7 billion in digital video game revenue overall in 2016, followed by Europe with \$8.7 billion.¹²⁹

The largest segment within the digital video game sector for the United States, Europe, and China was mobile games. Mobile gaming revenue reached a new high in 2016, generating \$25.6 billion globally, an increase of about 11 percent over the previous year.¹³⁰ Mobile gaming revenue accounts for roughly the same share of the European (38 percent) and U.S. (37 percent) digital video game markets. The digital video game market in China, however, was dominated by mobile games, which comprised about 67 percent (\$7.1 billion) of China's digital video game market.¹³¹ Further, Chinese mobile gaming revenue accounted for more than half of the entire Chinese digital content market. Companies derive this revenue from China's large mobile gamer population, which reached 284 million users in 2016 (compared to 104 million in the United States and 140 million in Europe).¹³² Statista, an online statistics company, credits the worldwide growth in the use of mobile devices for video games to the high performance of contemporary smartphones and tablets, which allow very computation-intensive applications and games.¹³³

¹²⁷ 4G.co.uk, "4G for Gaming -- Reduced Latency, Improved Speeds," June 6, 2014. As of 2017, latency for 4G is down to 60–66 milliseconds for the four major U.S. cellular networks. Open Signal, "State of Mobile Networks: USA," February 2017.

¹²⁸ Statista, "Digital Media: Video Games," 2016.

¹²⁹ Ibid.

¹³⁰ Sherman, "Mobile Games' Booming Market: Opportunity," March 29, 2017; SuperData Research and Unity Technologies, "Can't Stop, Won't Stop: 2016 Mobile and VR Games," 2017, 7; Statista, "Digital Media: Video Games," 2016.

¹³¹ Statista, "Digital Media: Video Games," 2016.

¹³² Ibid.

¹³³ Statista, "Digital Media: Video Games," 2016; Perez, "App Annie: Android to Top iOS," March 29, 2017.

Another factor is the availability of mobile games that employ newer technologies such as augmented reality,¹³⁴ which was widely witnessed with the global popularity of the free-to-play (“freemium”) game *Pokémon GO* during mid-2016.¹³⁵ Overall, it is expected that more powerful mobile devices will continue to drive gaming revenues, particularly for firms that can incorporate more advanced technologies (e.g., virtual reality) into their mobile games.¹³⁶ Table 4.1 provides a summary of digital video game revenues for Brazil, China, Europe, India, Indonesia, Russia, and the United States. For more information, including market data, industry players, and policies and regulatory measures (where reported), see appendix H.¹³⁷

Table 4.1: Digital video games revenue, by selected country or region, 2016

Country/region	Revenue, million \$
Brazil	417
China	10,670
Europe	8,715
India	681
Indonesia	678
Russia	651
United States	11,594

Source: Statista, “Digital Media: Video Games,” 2016.

Market Competition and Trends

The digital video game industry has been buoyed by the emergence of new, digitally enabled consumers and markets that are embracing online (particularly mobile) gaming. The industry’s primary drivers of demand are diverse. They include people (particularly women) who increasingly use social media games to engage with friends and family; casual gamers who frequently download freemium games to their mobile devices and make microtransaction purchases to enhance their gaming experiences; and avid viewers and players of e-sports or

¹³⁴ Gurman, “Apple’s Next Big Thing: Augmented Reality,” March 20, 2017. Augmented reality is a technology that superimposes a computer-generated image on a user’s view of the real world, thus providing a composite view on the user’s screen.

¹³⁵ Statista, “Digital Media: Video Games,” 2016; Barrett, “Pokémon Go Is Doing Just Fine,” September 18, 2016.

¹³⁶ Statista, “Digital Media: Video Games,” 2016; SuperData Research and Unity Technologies, “Can’t Stop, Won’t Stop: 2016 Mobile and VR Games,” 2017, 16–17. Although technologies such as virtual reality (VR) remain a relatively nascent subsector, total revenue from VR gaming reached about \$1.8 billion in 2016. Gamers were initially slow to adopt the technology, but by 2016, nearly 6.3 million VR devices were shipped to consumers worldwide. Growing acceptance of VR gaming has largely been driven by the presence of high-quality manufacturers such as Facebook (Oculus Rift), Google (Daydream VR), HTC (Vive), PlayStation (VR), and Samsung (Gear VR).

¹³⁷ Only Brazil, China, Europe, India, Indonesia, and Russia are covered in appendix H.

online video game competitions who use video streaming platforms such as Twitch and Machinima, as well as live stadium events, to connect with gamers all over the world.¹³⁸

Mobile Games

The mobile games market has grown rapidly, helped by the recent release of popular games such as *Super Mario Run* and *Pokémon GO*. This growth has attracted the attention of major video game companies looking to expand into this sector (table 4.2). In 2016, for instance, Activision Blizzard (U.S.) acquired mobile game company King (UK/Sweden/Spain), the makers of the game *Candy Crush*, for \$5.9 billion, while Tencent (China) bought Supercell (Finland), the *Clash of Clans* game maker, for \$8.6 billion.¹³⁹ Accordingly, competition in the mobile games market is intense, with more than 800,000 mobile games available in app stores, compared to 17,000 game titles for consoles and PCs.¹⁴⁰

Table 4.2: Top 10 video game companies, by global revenue, December 2016

Company (headquarters)	Revenue, billion \$	Year-on-Year growth, %
Tencent (China)	10.20	17
Sony (Japan)	7.84	33
Activision Blizzard (U.S.)	6.61	42
Microsoft (U.S.)	6.48	9
Apple (U.S.)	5.86	32
Electronic Arts (U.S.)	4.63	8
NetEase (China)	4.18	50
Google (U.S.)	4.07	37
Bandai Namco (Japan)	1.99	19
Nintendo (Japan)	1.83	-6

Source: Newzoo, “Top 25 Companies by Game Revenues,” December 2016.

Note: Google and Apple sell games on their mobile platforms, but do not develop video games.

Although initial barriers to market entry remain low, the advertising and marketing investments required for new mobile game publishers to gain a market foothold are so high that small developers have found it increasingly difficult to compete.¹⁴¹ To illustrate, while there are tens of thousands of game publishers competing for market share, about 80 percent of mobile games revenue for the top 1,000 titles is earned by the largest 20 publishers in each region.¹⁴² Globally, by 2016 revenues, the largest video game makers are based in the United States, China, Japan, and Europe, with the three most prolific mobile game companies—Supercell

¹³⁸ Accenture, “The Pulse of Gaming,” 2014, 16–18.

¹³⁹ SuperData Research and Unity Technologies, “Can't Stop, Won't Stop: 2016 Mobile and VR Games,” 2017, 7.

¹⁴⁰ Sherman, “Mobile Games' Booming Market: Opportunity,” March 29, 2017.

¹⁴¹ Deloitte, “Mobile Games in Europe: Innovation,” September 2015, 14. It is still not impossible for small market entrants to succeed, as app stores are increasingly publicizing high-quality developers, no matter what their size.

¹⁴² Sherman, “Mobile Games' Booming Market: Opportunity,” March 29, 2017.

(Finland/China), King (UK/Sweden/Spain/U.S.), and Zynga (U.S.)—also based in those regions.¹⁴³

Social Network Games and Demographics

Social networks, and the accompanying technologies, have placed gaming within reach of the average computer user. Facebook, in particular, has played an important role in the development of the current mobile gaming industry. Its in-browser Canvas platform was the first to allow tens of millions of gamers to play against one another.¹⁴⁴ In 2016, revenue from U.S. social network games reached \$5.4 billion, recording an average annual growth rate of 15.7 percent during 2011–16.¹⁴⁵ Video games played on social network websites such as Facebook or other mobile apps are often free to play and do not require the user to own any additional software or a console to participate.¹⁴⁶

King (UK/Sweden/Spain/U.S.), Zynga (U.S.), and Electronic Arts (U.S.) were the leading companies by U.S. market share in the social network gaming segment, accounting for 21.3 percent, 8.4 percent, and 6.7 percent of revenue in 2016, respectively.¹⁴⁷ Rather than profit by selling the games themselves as in other models,¹⁴⁸ these companies generally earn most of their gaming revenue through the sale of virtual goods and services within a game and through advertisements (e.g., the freemium revenue model).¹⁴⁹ As a result, consumers who have not previously played video games have begun playing them. For instance, women over the age of 45 represent the largest and fastest-growing group playing social network games in the United States, having begun by participating more casually in occasional social games, but eventually becoming regular users. In 2016, women represented an estimated 44 percent of U.S. social network game players.¹⁵⁰ In addition, women under the age of 45 also account for a

¹⁴³ Newzoo, “Top 100 Countries by Game Revenues,” April 2017; Sonders, “The Top Mobile Game Publishers,” December 7, 2016.

¹⁴⁴ Deloitte, “Mobile Games in Europe: Innovation,” September 2015, 9.

¹⁴⁵ Blau, “Social Status: New Markets and Rising Incomes,” July 2016, 4.

¹⁴⁶ Popular social network games include Farmville, The Sims Social, and Mafia Wars.

¹⁴⁷ Blau, “Social Status: New Markets and Rising Incomes,” July 2016, 4.

¹⁴⁸ Deloitte, “Mobile Games in Europe: Innovation,” September 2015, 3. Other revenue models include free games (usually ad-based only), paid games (upfront fee with no in-app purchase options), and “paidmium” games (upfront fee with in-app purchase options).

¹⁴⁹ Accenture, “The Pulse of Gaming,” 2014, 14–15; Deloitte, “Mobile Games in Europe: Innovation,” September 2015, 3.

¹⁵⁰ Blau, “Social Status: New Markets and Rising Incomes,” July 2016, 16.

larger share (an estimated 21 percent) of total social network gaming revenue than their male counterparts (an estimated 18 percent).¹⁵¹

Microtransaction Purchases

As noted above, free game distribution offers developers and publishers a path to business success through monetizing their products. Not only are more people engaging in online gaming, but players are reportedly spending more on in-game or in-app microtransactions to unlock levels and enhance playability. While they are usually a small minority, such players typically pay a few dollars or less to reach a higher level of the game or to purchase a service, such as being able to unlock new maps, gain additional “lives,” or access virtual currency.¹⁵²

Large audiences are important for freemium game developers, because they allow developers to convert small payments from a tiny share of players into significant revenues.¹⁵³ On average, more than 90 percent of mobile gaming app revenues come from freemium games. By the end of 2016, in-app gaming purchases were estimated to have reached \$1.9 billion, with about half of that revenue (around \$900 million) coming from just 0.19 percent of mobile gamers worldwide.¹⁵⁴ The vast majority were reportedly casual game players who made most of their transactions within the first few days of downloading the game.¹⁵⁵ In 2016, mobile gaming reached new highs as most countries saw average revenue per user (ARPU) grow from the previous year. These countries included the United States, averaging about \$5 per user, and Japan, which reached an ARPU of about \$30.¹⁵⁶

With many entertainment products available, free-to-play or freemium games have helped to attract new gamers by allowing them to try new games without an upfront monetary commitment. Later they can choose to spend money and customize their experience through

¹⁵¹ Blau, “Social Status: New Markets and Rising Incomes,” July 2016, 8, 16. Although many women under 45 do have some exposure to traditional gaming (females 18 to 45 account for an estimated 29 percent of U.S. video game industry revenue), it is still less than males in this age group (about 36 percent). As a result, the increased ease of access brings in more women gamers than men. As of 2016, about 72 percent of adult women in the United States used at least one social media site, compared to 66 percent for adult men. Pew Research Center, “Social Media Fact Sheet,” January 12, 2017.

¹⁵² For example, players can play Candy Crush for free, but if they fail a few times in a given period of time they run out of “lives” and have to wait another fixed time period before they can play again—or they can buy more lives from the video game developer and play immediately. Blau, “Social Status: New Markets and Rising Incomes,” July 2016, 7–8.

¹⁵³ Deloitte, “Mobile Games in Europe: Innovation,” September 2015, 11–12, 18.

¹⁵⁴ Deloitte, “Mobile Games in Europe: Innovation,” September 2015, 3; Feist, “Report: Half of All Gaming Revenue Comes from 0.19%,” March 23, 2016.

¹⁵⁵ Feist, “Report: Half of All Gaming Revenue Comes from 0.19%,” March 23, 2016.

¹⁵⁶ Hindy, “2016 Recap: 90% of Google Play’s Revenue,” January 17, 2017.

microtransactions during the game.¹⁵⁷ The standout mobile game of 2016, *Pokémon GO*, developed by U.S. firm Niantic, earned \$800 million in its first 110 days of release (reaching that amount faster than any mobile game to date) and \$950 million overall that year.¹⁵⁸

E-sports

The popularity of video games as a spectator sport has grown dramatically in the past two years. E-sports fuse the multiplayer game experience with real-world physical sports, attracting viewers (primarily younger fans) as well as investors. Major game publishers and online retailers—including Activision Blizzard (U.S.), Tencent (China), and Alibaba (China)—have made significant investments in e-sports in recent years.¹⁵⁹ E-sports are most popular in Asia: China accounted for 57 percent of all e-sports viewing in 2016. However, the main enabler for the initial growth and popularity of e-sports was U.S.-based Twitch, a live-streaming video platform, which was acquired by Amazon for \$970 million in 2014.¹⁶⁰

The rise of e-sports has allowed gamers to make careers out of competing professionally in online video game tournaments. Four game franchises have held e-sports events with prize pools of more than \$1 million: *League of Legends*, *DoTA2*, *Call of Duty*, and *SMITE*. Investors from across industries have established teams to compete year-round in game-specific tournaments.¹⁶¹ Rising professionalization is one factor that suggests industry revenues will continue to mushroom: in its 2017 forecast, Newzoo, a video game market research company, estimates that revenues from e-sports will reach \$696 million in 2017, up from an estimated \$13.1 million in 2012.¹⁶²

¹⁵⁷ Deloitte, “Mobile Games in Europe: Innovation,” September 2015, 10–11; Hayward, “How to Dominate Pokémon Go without Spending Money,” July 12, 2016. In *Pokémon GO*, players can buy in-game currency (coins) to purchase items like pokéballs for catching pokémon, incense for luring them, and eggs that hatch potentially hard-to-find pokémon. Game publisher Niantic notes that if you are out and about playing the game as it is designed, you will regularly find these items without having to spend money on in-app purchases.

¹⁵⁸ Hindy, “2016 Recap: 90% of Google Play’s Revenue,” January 17, 2017.

¹⁵⁹ Bradshaw, “Esports Viewing Shoots Up,” May 8, 2017; Accenture, “The Pulse of Gaming,” 2014, 16; Lee and Stewart, “eSports: Bigger and Smaller Than You Think,” 2016. E-sports have also attracted advertising and sponsorships from consumer brands such as Coca-Cola and Red Bull.

¹⁶⁰ Bradshaw, “Esports Viewing Shoots Up,” May 8, 2017; Accenture, “The Pulse of Gaming,” 2014, 16; Lee and Stewart, “eSports: Bigger and Smaller Than You Think,” 2016.

¹⁶¹ Woods, “Why A-Rod and Shaq is Betting Big on Their own eSports Team,” October 29, 2016.

¹⁶² Newzoo, “Global ESports Market Report 2017,” 2017.

Video

Digital videos include content from broadcast TV, cable TV, movies, sporting events, music videos, and user-generated short-form videos (e.g., vlogs). Advances in cloud infrastructure have enabled newer video distribution pipelines (e.g., social media platforms, higher-capacity smartphones) to allow for expanded data storage, transfers, and processing (analytics) capabilities.¹⁶³ As a result, the video content industry has experienced rapid changes in the last few years as consumers increase their use of video on demand (VoD),¹⁶⁴ putting more pressure on the “bundled” subscription channel packages of television networks and conventional pay-TV.¹⁶⁵ The popularity of streaming video content, a cloud-enabled service that requires fast connection speeds,¹⁶⁶ has grown over the past five years. Leading online video providers, such as subscription-based services Amazon Prime, Hulu, and Netflix, and Google’s advertising-driven YouTube, continue to expand the range of available content and services to their growing multinational user base (figure 4.2).¹⁶⁷

Moreover, by increasing links with social media outlets—which largely cater to mobile audiences—content providers are signaling a shift in consumer viewing habits to include not only “time-shifting” but also “place-shifting,” thanks to advances in broadband and cloud technologies.¹⁶⁸

¹⁶³ Wagner, “Facebook, Amazon, Twitter and YouTube Are Bidding,” March 23, 2017. In 2016, the National Football League agreed to a deal of approximately \$10 million that enabled Twitter to live-stream 10 Thursday Night Football games during the season.

¹⁶⁴ Video on demand (VoD) refers to the viewing of live or recorded online programming either in real time (streaming), or via purchasing to own (download), or by accessing within a defined time period (pay-per-view). A VoD system can consist of a standard TV receiver along with a digitally enabled set-top box. The video content can also be delivered over the Internet to personal computers, smartphones, tablets, video game consoles, and other digital media players. The video content is delivered via the Internet without requiring users to subscribe to a traditional cable or satellite pay-TV service (e.g., Comcast or Time Warner Cable).

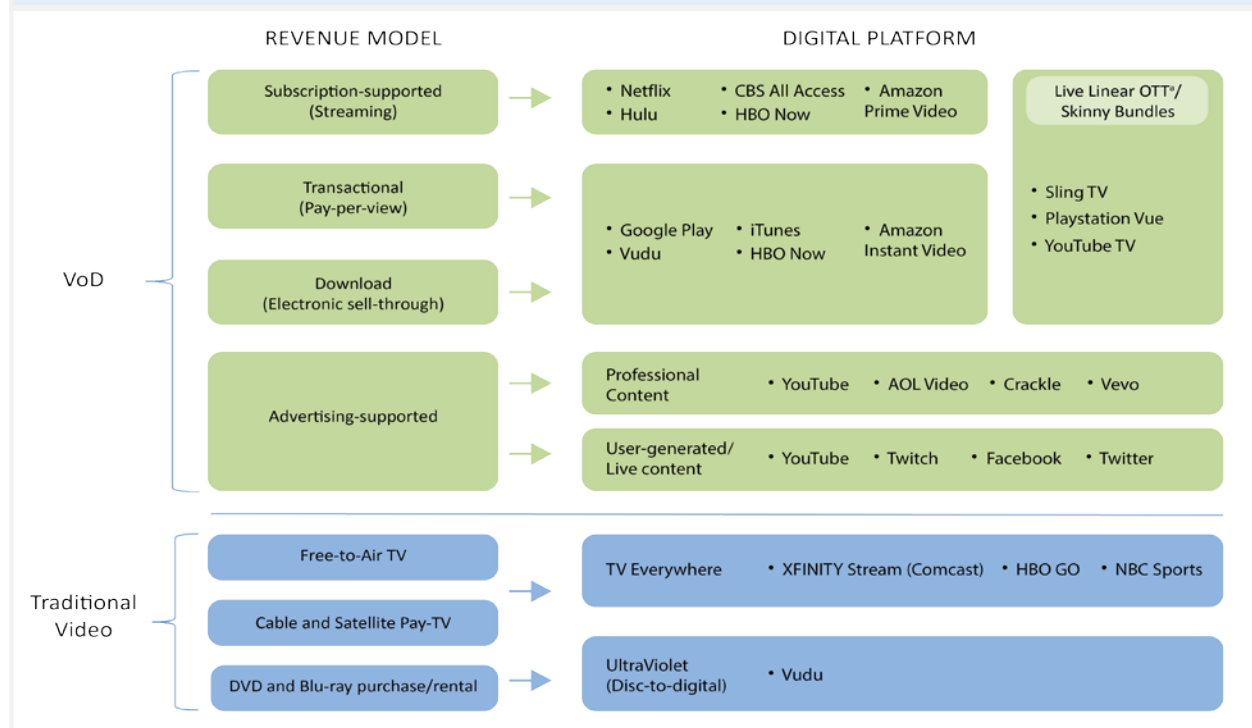
¹⁶⁵ Popper, “The Great Unbundling: Cable TV,” April 22, 2015. “Bundled” packages are the set of basic and premium channels offered by cable or satellite pay-TV providers (the packages are often predetermined by the provider).

¹⁶⁶ Costello, “Internet Streaming,” 2016. Streaming content provides a continuous flow of data that are delivered almost immediately, so that it requires a fast broadband connection: at least 2 Mbps (megabits per second) for standard-definition video, 5 Mbps for high-definition content, and 9 Mbps for ultra-high-definition content. If the Internet connection is slow or interrupted it results in content buffering—the buffer stores the next few minutes of video content. If the speed is too slow, the program will stop or degrade in quality.

¹⁶⁷ Arthofer et al., “The Future of Television,” 2016, 8; Bookman, “Where Netflix, YouTube and HBO Now Fit,” May 6, 2016; Wallenstein, “The OTT View-niverse: A Map,” April 29, 2015.

¹⁶⁸ “Place-shifting” means that people today can watch their preferred video content wherever they wish, particularly through their smartphones and tablets. Gibbs, “Welcome to the Sixth Evolution of Television: Place-Shifting,” January 29, 2016.

Figure 4.2: Breakout of the video on demand (VoD) ecosystem, by types of providers (non-exhaustive)



Source: Compiled by USITC; Arthofer et al., “The Future of Television,” 2016, 8.

^a Live linear over-the-top (OTT) service or “skinny bundles” combine VoD services with traditional broadcast and pay-TV content (see below for further discussion).

As more and more content is stored on the cloud, digital video providers increasingly conduct data analytics allowing them to better customize their extensive online catalog of titles to each customer’s perceived preferences or interests. For example, Netflix provides personalized content recommendations to its customers based on their past viewing sessions. In the past, Netflix could record that a customer rented a DVD, but it did not know if they even watched it. Now its algorithms can estimate viewers’ future viewing preferences based on which movies and television shows they are watching on its platform, how many of these programs are viewed from beginning to end, how often they are paused or reversed, how often they are searched for by particular users, and how frequently they are mentioned on social media platforms. Algorithms analyzing these data also help Netflix decide what type of content to invest in.¹⁶⁹ For example, analysis of user preference data led Netflix to invest in a remake of the British program *House of Cards* and even guided the selection of the cast.¹⁷⁰

¹⁶⁹ World Economic Forum, *Digital Transformation of Industries: Digital Enterprise*, January 2016, 10.

¹⁷⁰ Bulygo, “How Netflix Uses Analytics to Select Movies” (accessed June 28, 2017); Shaw, “Netflix’s Pursuit of TV Domination Has a New Step,” April 21, 2015; Swanson, “The Power of Big Data in China,” July 28, 2015.

U.S. and International Markets

The global VoD industry has grown rapidly over the past few years, reaching \$16.2 billion in 2016. The United States generated about \$9.5 billion in VoD revenue in 2016, accounting for 58.6 percent of the industry’s global market share that year.¹⁷¹ Video streaming accounted for \$5.5 billion of U.S. VoD revenue in 2016, more than double the revenue generated by either pay-per-view or video downloads (each earning about \$2 billion that year). Similarly, the VoD market in Europe, which accounted for \$3.5 billion in revenue in 2016, was also dominated by video streaming, which accounted for 61.6 percent (\$2.2 billion) of European digital VoD revenue. By comparison, European pay-per-view and video downloads accounted for \$774 million and \$556 million, respectively, in 2016.¹⁷²

China, on the other hand, generated only about \$934 million in total VoD revenue in 2016. Many observers note Chinese consumers’ reluctance to pay for digital media content, likely due to widespread piracy of intellectual property in China’s audiovisual services market (see chapter 8 for a discussion).¹⁷³ Only 3.1 percent of Chinese Internet users paid to stream videos in 2016 (\$602 million in revenue). Video downloads accounted for about 27.4 percent of total Chinese digital video revenue in 2016.¹⁷⁴ Table 4.3 provides VoD revenues for key markets. For snapshots of these markets, including market data, industry players, and policies and regulatory measures (where reported), see appendix H.

Table 4.3: Video on demand (VoD) revenue, by selected country or region, 2016

Country/region	Revenue, million \$
Brazil	204
China	934
Europe	3,497
India	49
Indonesia	152
Russia	93
United States	9,529

Source: Statista, “Digital Media: Video on demand,” 2016.

Market Competition and Trends

The evolving competitive landscape in the VoD market has required content providers to quickly adapt to the tastes of their consumers. This is particularly the case for younger, more tech-savvy millennials; these users often expect instant access to more personalized, higher-

¹⁷¹ Statista, “Digital Media: Video on demand,” 2016, 7.

¹⁷² Ibid.

¹⁷³ Ibid.

¹⁷⁴ Ibid.

quality content at lower cost, and they are generally more willing to forego conventional service providers.¹⁷⁵

Adaptations to this changing landscape have come in various forms. One form of adaptation is seen in the way both traditional pay-TV and VoD platforms are offering more flexible, less expensive “skinny bundle” subscription channel packages. Such packages include more cloud-based services, such as unlimited data storage for photos and other personal multimedia (e.g., Google Drive and iCloud). Other examples of adaptation include increasing global expansion by the largest U.S. streaming VoD providers; heavy investment by global players (including Netflix and Amazon, among others) in new and original content; and use of advanced data analytics to better attract and retain customers.¹⁷⁶

Skinny Bundles

Amid rising costs for traditional pay-TV services in the United States and abroad, the “skinny bundle” has recently emerged as an alternative video programming choice made possible due to increasing mobile and fixed bandwidth speeds and access.¹⁷⁷ These are delivered either through a cable provider (e.g., Comcast, Charter) or an Internet service (e.g., YouTube TV—announced in February 2017—and DISH Network’s Sling TV).¹⁷⁸ These packages typically include a limited selection of channels and sell at lower prices to consumers. These skinny packages provide live streaming of some of the most popular cable and broadcast channels, in addition to on-demand content for additional fees.¹⁷⁹

Nearly two-thirds (63 percent) of U.S. broadband households subscribe to at least one streaming service, with Netflix, Amazon Prime, and Hulu most prevalent.¹⁸⁰ Elsewhere, major U.S. cable providers such as Comcast, Charter, and Altice USA (formerly Cablevision) are in various stages of deploying cloud-based DVR and program guides. This comes as the pay-TV providers’ so-called “TV Everywhere” initiatives have been somewhat slow to gain traction.¹⁸¹

¹⁷⁵ Strategy+Business, *Global Entertainment and Media Outlook 2016–2020*, 2016, 11–15; Amobi, “Industry Surveys: Media,” September 2016, 75.

¹⁷⁶ Popper, “The Great Unbundling: Cable TV,” April 22, 2015.

¹⁷⁷ Bond and Bond, “Amazon to Offer Live TV Channels in Europe,” May 22, 2017. In May 2017, Amazon announced that Prime Video customers in Europe, for an extra fee, would be able to access live TV channels for the first time. Strategy+Business, *Global Entertainment and Media Outlook 2016–2020*, 2016, 14; Arthofer and Rose, “The Future of Television,” June 9, 2016. Skinny bundle streaming packages are generally subscription-based.

¹⁷⁸ Kuchler, “YouTube to Launch Cable TV Package,” February 28, 2017; Amobi, “Industry Surveys: Media,” September 2016, 52–54.

¹⁷⁹ Amobi, “Industry Surveys: Media,” September 2016, 52–54.

¹⁸⁰ O’Neill, “Top 10 US Streaming Services,” October 26, 2016.

¹⁸¹ Bothum and Vollmer, *2016 Entertainment and Media Industry Trends*, 2016, 5. TV Everywhere allows consumers with pay-TV subscriptions to view network content on any smart device.

In response, Comcast has deployed its cloud-based X1 platform (branded as Xfinity TV), enabling consumers to access content both in and out of the home (including on mobile devices) via any Internet connection.¹⁸²

Streaming VoD

The five largest players in the streaming VoD ecosystem are YouTube and Facebook (which are largely ad-supported) and Netflix, Amazon Prime, and Hulu (largely subscription-supported).¹⁸³ Hulu is available only in the United States and Japan, while the other four offer their services in many countries around the world. For example, Netflix currently operates in more than 190 countries, with almost 94 million subscribers worldwide; at the end of 2016, 46 percent of Netflix's base was outside the United States.¹⁸⁴ In December 2016, Amazon's streaming VoD service (Prime) was available in 200 countries (excluding China).¹⁸⁵ As of mid-2016, Netflix's market capitalization was approximately \$50 billion. Some equity research reports estimated that YouTube was worth as much as \$90 billion in 2016, and Hulu about \$6 billion.¹⁸⁶ Boston Consulting Group estimates total streaming VoD revenue at \$25 billion, with the top five VoD providers accounting for nearly half of global revenues in 2016 (figure 4.3).

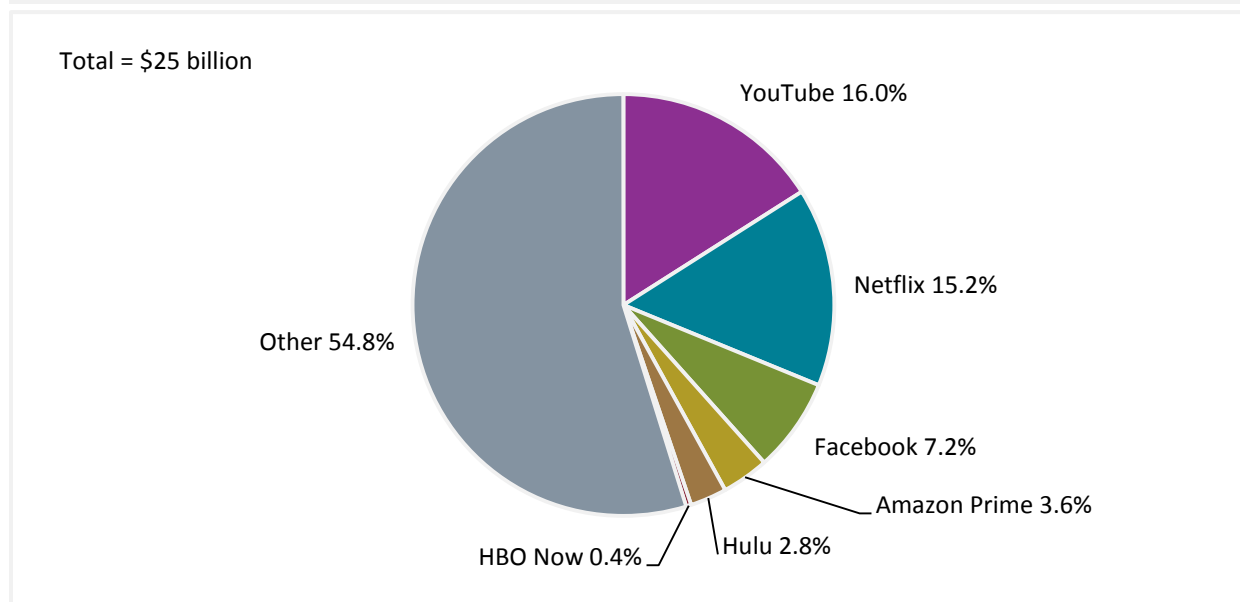
¹⁸² Amobi, "Industry Surveys: Media," September 2016, 52–53.

¹⁸³ Hulu is a joint venture between Comcast's NBC Universal, Disney, Fox, and Time Warner.

¹⁸⁴ Trefis Team, "Netflix Subscriber Growth Continues Unabated," January 19, 2017; Mulligan, "Netflix Flexes its Licensing Muscle," December 1, 2016.

¹⁸⁵ Chadha, "Amazon's Global Rollout of Prime Video," December 15, 2016.

¹⁸⁶ Arthofer et al., "The Future of Television," September 20, 2016, 14–15.

Figure 4.3: Global streaming VoD revenue, by company, 2016

Source: Arthofer et al., “The Future of Television,” September 20, 2016, 14–15.

Note: These company-level revenue totals will not match country-level estimates noted earlier, due to sources’ differing accounting methodologies. Corresponds to [appendix table G.8](#).

In international markets where Netflix is present, only a few local players have been able to gain more than 25 percent of the subscription VoD market. For example, maxdome, a leader among German VoD companies, had only 15 percent of Germany’s domestic market share by the end of 2015.¹⁸⁷ Other international VoD providers have had to close down completely or contract, including Shomi (a Canadian VoD provider—closed), Ximon (a Dutch VoD provider—closed), and Vivendi (a French media conglomerate—stopped offering VoD service in Germany).¹⁸⁸ Exceptions to this trend include China and Russia, where there are established local competitors and/or presence of intellectual property piracy. Overall, however, U.S. VoD providers usually account for a large share—or the largest share—of any overseas VoD market.¹⁸⁹

In China, the streaming of videos, particularly through smartphones, has grown in popularity and acceptance over the last few years. Based on a survey targeting China’s 1.3 billion TV viewers by Amplifi China, a media investment firm, the share of Chinese consumers watching through streaming devices has grown from 13 percent in 2013 to 30 percent in 2015, and will

¹⁸⁷ Arthofer et al., “The Future of Television,” September 20, 2016, 14–16.

¹⁸⁸ Bookman, “More International SVOD Services Bite the Dust,” October 5, 2016; Wallenstein, “Netflix Loses Overseas Rival,” January 30, 2014; Thomson, “Vivendi to Close SVOD Net Watchever,” July 22, 2016; Keslassy, “Vivendi to Close Watchever’s SVOD Service in Germany,” July 22, 2016; Krieger, “Vivendi to close German SVOD Service Watchever,” July 22, 2016.

¹⁸⁹ Arthofer et al., “The Future of Television,” September 20, 2016, 14–16.

reach an estimated 49 percent by 2017. (Only 21 percent of those surveyed were willing to pay for streaming video content, though.)¹⁹⁰ The share of mobile viewers in China has also grown dramatically: more than three-quarters (76.7 percent) of digital video viewers aged 6 or older who were living in major Chinese cities watched videos on smartphones in 2015, compared to 49.4 percent in 2012. This was well ahead of China’s share of digital video viewers who watched on desktop and laptop PCs that year (54.2 percent); indeed, the latter figure represents a major decline from the 96.0 percent share who watched videos on PCs in 2012.¹⁹¹

Investment in Video Content

Investment in new and original programming has continued to grow. In an effort to build on major popular and critical hit series such as *House of Cards*, *Orange is the New Black*, and more recently *The Crown*, Netflix more than doubled its investment in original video programming from \$2.38 billion in 2013 to \$4.91 billion in 2015.¹⁹² Its primary subscription competitor in the video streaming space, Amazon, also more than doubled its original program spending during that same two-year period, from \$1.22 billion to \$2.67 billion. In 2015, Netflix and Amazon’s investments in video content were exceeded only by traditional media players Disney (\$11.84 billion) and NBC (\$10.27 billion). Other streaming platforms such as Hulu, as well as China’s Youku Tudou (owned by Alibaba), iQiyi (owned by Baidu), and Tencent, have also reportedly increased investments in original programs and licensing. In terms of overall investment in television programming, the United States accounted for about 33 percent of global expenditures with \$43 billion spent on content for free-to-air, pay TV, and online platforms in 2015. The United States was followed by the UK (\$10.7 billion), Japan (\$9.8 billion), China (\$8.4 billion), and Germany (\$7.3 billion).¹⁹³

Music

Digital music encompasses streamed or downloaded content such as recorded songs, concerts (live and recorded), online radio, and podcasts. Digital streaming has overtaken all other modes of music consumption to become the largest driver of growth for the music industry.¹⁹⁴ Similar to video, technology advances and changing consumer habits have led the music industry from

¹⁹⁰ Chan, “OTT in China: Viewership Grows More Quickly,” August 15, 2016.

¹⁹¹ eMarketer.com, “Digital Video in China Shifts to Mobile,” December 31, 2015.

¹⁹² Briel, “Netflix, Amazon Ramp Up Investment,” October 17, 2016; Castillo, “Netflix Plans to Spend \$6 Billion on New Shows,” October 17, 2016.

¹⁹³ Briel, “Netflix, Amazon Ramp Up Investment,” October 17, 2016. Investments include domestic and foreign co-productions and licensing deals.

¹⁹⁴ IFPI, *Global Music Report*, 2016, 8–13. Globally, about 68 million consumers paid for a music subscription service in 2015, up from just 8 million in 2010. In 2016, it is widely expected within the music industry that revenue from streaming will officially overtake download revenue worldwide.

a traditional per-song and per-album model to formats that provide unlimited streaming content. This change has largely been spurred by the spread of smartphones and advancements in cloud technologies that support large-scale data storage and transfer.¹⁹⁵ Cloud technology has enabled music streaming companies to provide consumers with seamless access (whether subscription- or advertising-supported) to a global catalog of music without costly storage requirements.¹⁹⁶

Further, as cloud-based data analytics become more refined, music streaming companies continue to capture additional value from the use of social recommendations, mood-based curation, and even celebrity recommendations—helping listeners more efficiently find or discover the music that most interests them.¹⁹⁷ Music streaming services also use “big data” to deliver more targeted advertising and marketing messages.¹⁹⁸

U.S. and International Markets

Global revenue for digital music streaming—which accounts for about 19 percent of total global music revenue—reached \$2.9 billion in 2015. This was up 45.2 percent from the previous year, and up nearly 400 percent from 2010 (figure 4.4).¹⁹⁹ U.S. digital streaming revenue surpassed digital downloads in 2015 to reach a record high of more than \$2.4 billion.²⁰⁰

¹⁹⁵ Deloitte, “Digital Media: Rise of On-demand Content,” 2015, 23.

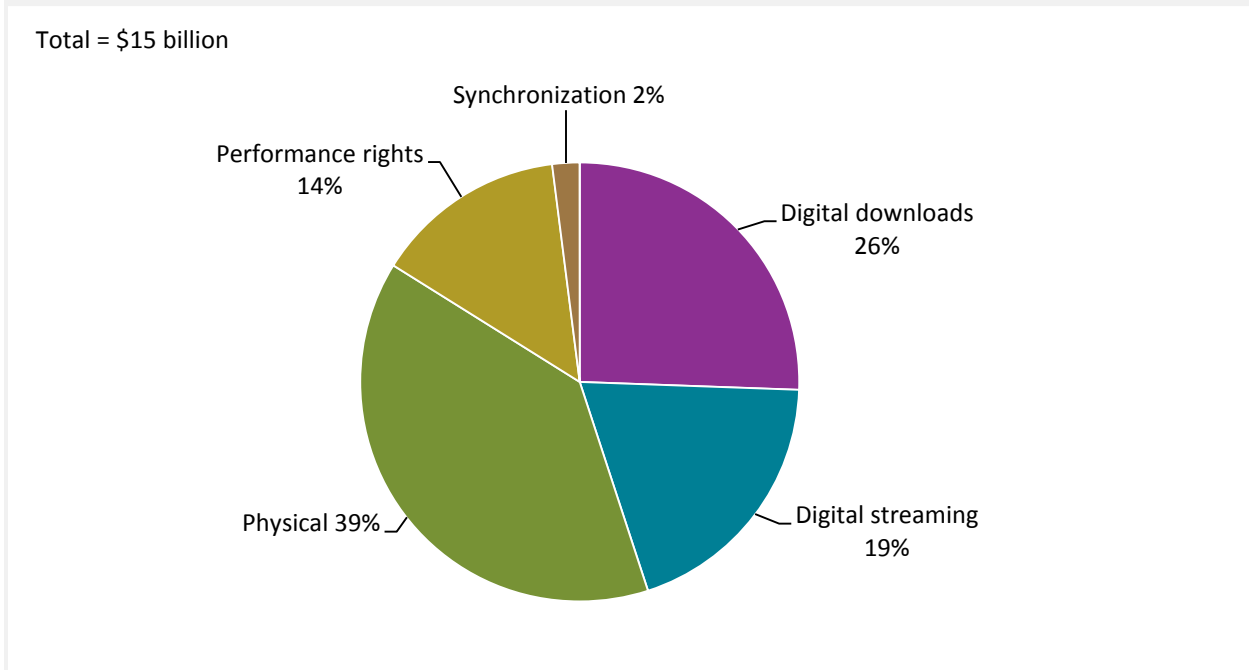
¹⁹⁶ IBISWorld, *Global Music Production and Distribution*, January 2017, 4–5; Villas-Boas and Gould, “How the Top Music Streaming Services Compare,” March 30, 2016; Deloitte, “Digital Media: Rise of On-demand Content,” 2015, 23.

¹⁹⁷ Mood-based curation offers a pre-selected playlist of songs that fit a particular mood. Users can select “happy” or “tranquil” playlists for example and listen to songs, generated by algorithms (or people) that match this mood. Bundgaard et al., “The Beat of Progress: The Rise of Music Streaming in Asia,” November 2016, 18.

¹⁹⁸ Bothum and Vollmer, *2016 Entertainment and Media Industry Trends*, 2016, 7.

¹⁹⁹ IFPI, *Global Music Report*, 2016, 9, 15. Total global digital music revenue reached \$6.7 billion in 2015. Note that due to differing accounting methods, global revenue data from the International Federation of the Phonographic Industry (IFPI) and Statista will not match.

²⁰⁰ Roettgers, “Streaming Overtakes Downloads, CDs,” March 22, 2016.

Figure 4.4: Global music revenue, by segment, 2015

Source: IFPI, *Global Music Report*, 2016, 9, 15.

Note: Synchronization is the licensing of artistic material to other media outlets for royalty payments (e.g., using copyrighted music for a TV commercial or a video game). IBISWorld, "Global Music Production and Distribution," January 2017, 12.

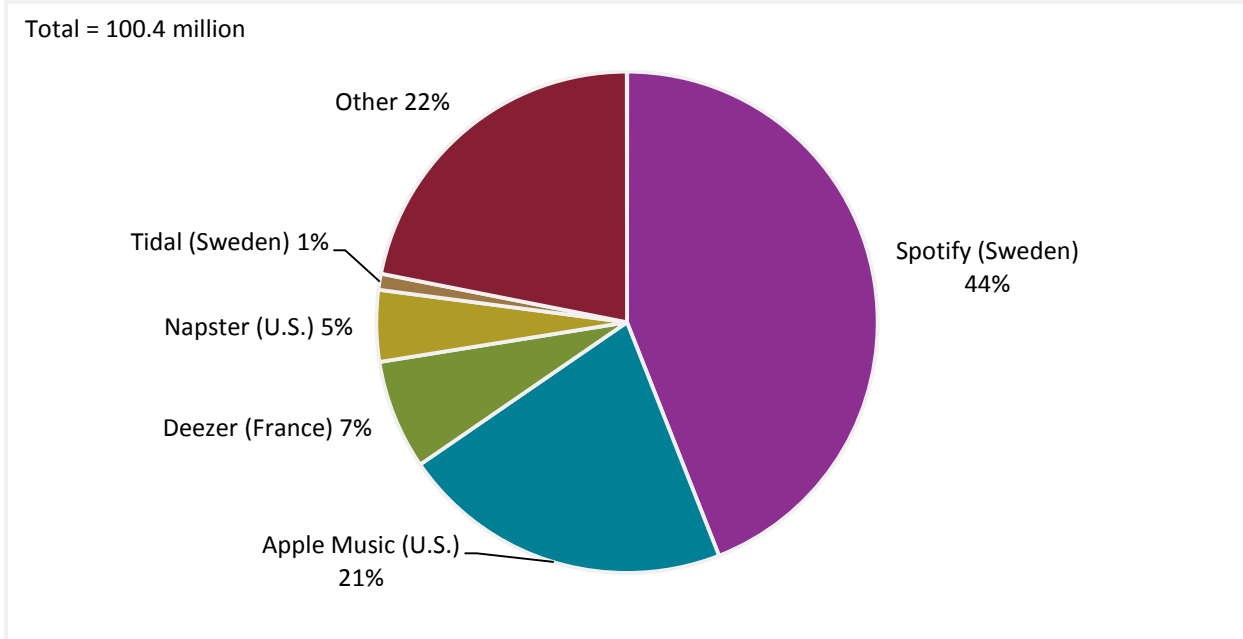
Corresponds to [appendix table G.9](#).

The global digital music industry has grown steadily over the last few years, largely due to the popularity of streaming music platforms such as Spotify (Sweden) and Apple Music (U.S.) (figure 4.5). In 2011, only 13 percent of global digital music revenue came from streaming services, versus 72 percent from download. By 2015, this ratio had shifted to 43 percent from streaming versus 45 percent from downloads (the remaining 12 percent came from downloads of ringtones).²⁰¹ European countries are adapting to changing preferences for certain formats and channels (e.g., streaming, digital downloads, vinyl records, CDs, etc.) at variable rates. For instance, music streaming accounted for about 67 percent of Sweden's music revenues in 2015 (compared to 34 percent in the United States), while in Germany, CDs accounted for 60 percent of record company trade revenues.²⁰²

²⁰¹ IFPI, *Global Music Report*, 2016, 8–13; Bundgaard et al., "The Beat of Progress: The Rise of Music Streaming," November 2016, 2.

²⁰² IFPI, *Global Music Report*, 2016, 11; Friedlander, "News and Notes on 2015 RIAA Shipment and Revenue Statistics," 2015.

Figure 4.5: Global streaming music subscriptions, by company, December 2016



Source: Mulligan, “Music Subscriptions Passed 100 Million in December,” January 6, 2017.

Note: Corresponds to [appendix table G.10](#).

Table 4.4 provides digital music revenues in key markets. For more, including market data, industry players, and policies and regulatory measures see appendix H.

Table 4.4: Digital music revenue, by selected country or region, 2016

Country/region	Revenue, million \$
Brazil	123
China	390
Europe	2,848
India	58
Indonesia	21
Russia	28
United States	4,201

Source: Statista, “Digital Media: Digital Music,” 2016.

Market Competition and Trends

As the online streaming of music overtakes other sources of industry revenue, providers—whether they are independent artists looking to start a career, or large multinational music labels—all face similar competitive pressures. Specifically, they must weigh how to adapt to technological advances and the growing influence of a concentrated group of online music streaming platforms that may dictate future growth. They must also consider how revenues from music streaming (royalties) can be most equitably shared among industry players. Artists

have growing concerns about how best to protect copyrighted works and access global markets as streaming offers solutions to old problems along with new potential threats.²⁰³

Subscription Streaming

Subscription streaming services, such as Spotify and Apple Music, have been performing strongly in recent years. According to the International Federation of the Phonographic Industry (IFPI), these services crossed the \$1 billion threshold for the first time in 2013, and generated about \$2 billion in revenue in 2015. Subscription music streaming providers are expected to represent an estimated 45 percent of industry revenue in 2017.²⁰⁴

The launch of Apple Music in June 2015 reportedly gave a major boost to overall revenues from digital music streaming, and other streaming companies likely benefited from the enhanced awareness that Apple Music created among consumers.²⁰⁵ However, the music industry is concerned that online music streaming through YouTube will cut into the profitability of subscription-based services.²⁰⁶ Google's YouTube is reported to have accounted for 4 percent (\$634 million) of global music revenue in 2015.²⁰⁷ YouTube has more than 1 billion regular users globally and reportedly delivers more music streams a year than Spotify, Apple Music, and Tidal combined, though it generates much less revenue.²⁰⁸

Revenues from Streaming Royalties

Despite recent growth, generating income from music streaming royalties continues to pose a challenge for both content creators and distributors.²⁰⁹ While music streaming has made it possible for artists to gain unprecedented exposure to global audiences, artists and music labels have struggled with the relatively small licensing royalties generated from music streaming platforms (about \$0.005 per song stream).²¹⁰ Consequently, many small or independent labels, who are most vulnerable to low profit margins, are choosing to sell stakes to one of the three

²⁰³ USITC, hearing transcript, April 4, 2017, 28–46.

²⁰⁴ IFPI, *Global Music Report*, 2016, 8, 15–19, 22–23; IBISWorld, “Global Music Production and Distribution,” January 2017, 11; Cookson, “Music Sales Growing at Fastest Rate since 1998,” April 12, 2016.

²⁰⁵ IFPI, *Global Music Report*, 2016, 17–19.

²⁰⁶ Industry representative, interview by USITC staff, London, March 14, 2017.

²⁰⁷ IFPI, *Global Music Report*, 2016, 8, 15–19; IBISWorld, “Global Music Production and Distribution,” January 2017, 11; Cookson, “Music Sales Growing at Fastest Rate since 1998,” April 12, 2016.

²⁰⁸ Shaw, “The Music Industry Is Finally Making Money on Streaming,” September 20, 2016; Cookson, “Music Sales Growing at Fastest Rate since 1998,” April 12, 2016; Bundgaard et al., “The Beat of Progress: The Rise of Music Streaming,” November 2016, 8.

²⁰⁹ Nicolaou, “Songwriters Call for Bigger Cut,” March 8, 2017.

²¹⁰ Hassan, “Apple Music Proposes Increased Songwriter Royalties,” July 18, 2016; Grasmayer, “How Much Are Pay Per Stream Royalties?” July 13, 2016; Resnikoff, “My Band Has 1,000,000 Spotify Streams,” May 26, 2016. Licensing fees are fees earned by granting media outlets the right to use registered artistic material.

largest international music labels—Universal Music Group (France), Sony Music Entertainment (Japan), and Warner Music Group (U.S.)—which together account for nearly two-thirds of the industry’s global revenue.²¹¹

At the same time, the rise of music streaming has benefited some new artists wanting to circumvent traditional music distributors in search of wider audiences. In some cases, new and established artists alike are choosing to distribute their music exclusively through the Internet without the help of a large record company. For instance, an artist wanting to avoid contractual obligations may decide to work independently online or pursue more favorable contracts with niche or regional labels.²¹² Nonetheless, major record labels will continue to play an essential role in developing the careers of their clients, particularly as record sales (e.g., digital royalties) become only one of many income-generating activities for performers: other income sources include live concerts, merchandise, and synchronization rights.²¹³

E-books

E-books, a subsector of e-publishing, include digital or electronic versions of consumer trade titles (encompassing adult fiction and nonfiction, young adult, and children’s genres), as well as educational textbooks and professional or scientific publications. E-book sales initially surged following the introduction of new mobile devices such as Amazon’s dedicated e-reading device in 2007. However, revenue growth has slowed over the past five years as e-book sales have matured. Suggestions vary as to why this decline is occurring. For instance, some industry sources point to signs that consumers may be tiring of e-books and that many continue to consume printed material (either entirely or in tandem with e-books), particularly when buying longer-form book content within similar price ranges. Further, some contend that as smartphones continue to advance as the primary device for consuming digital content, declining purchases of e-book devices—and therefore e-books overall—has caused the industry to stagnate.²¹⁴ Others have argued that the e-book industry has been stifled technologically by

²¹¹ IBISWorld, “Global Music Production and Distribution,” January 2017, 6, 16; USITC, hearing transcript, April 4, 2017, 28–46.

²¹² IBISWorld, “Global Music Production and Distribution,” January 2017, 16.

²¹³ Synchronization is the licensing of artistic material to other media outlets in exchange for royalty payments (e.g., usually paying a one-time fee for using copyrighted music for a TV commercial, video game, movie, etc.). USLegal.com, “Synchronization Rights,” 2017. IBISWorld, “Global Music Production and Distribution,” January 2017, 7, 12.

²¹⁴ McGinley, “Bookworms,” December 2016, 7–9; Milliot, “The Bad News about E-books,” January 20, 2017. According to *Publishers Weekly*, a U.S. trade news magazine for publishers, consumers who use dedicated e-book readers consistently buy more e-books than consumers who use smartphones or tablets to read. In the first quarter of 2011, more than 70 percent of e-book consumers used a dedicated e-book reader, but by the second quarter of 2016, this percentage had dropped to 24 percent.

the continued use of closed platforms—for example, e-books purchased on Amazon’s Kindle or Barnes & Noble’s Nook stores cannot be read on the other’s e-reader.²¹⁵ They also contend that strict digital rights management constraints imposed by vendors on e-book owners has discouraged customer growth.²¹⁶

U.S. and International Markets

The global e-book industry has grown moderately over the past few years, reaching about \$10.8 billion in 2016. U.S. e-book sales were about \$5.3 billion in 2016, accounting for about 50 percent of the global market.²¹⁷ Notably, U.S. e-book revenues for traditional publishers²¹⁸ fell by about 16 percent in 2016 compared to the previous year.²¹⁹ The e-book market in Europe, which accounted for about \$2.3 billion in sales in 2016, is also stagnating. This is particularly true in mature markets such as Germany and the UK, where e-books are experiencing the effects of market saturation.²²⁰ China, the third-largest consumer of e-books behind the United States and Japan, generated \$933 million in e-book revenue in 2016.²²¹ In Brazil, a lack of technological infrastructure to support wide e-book distribution and production has limited growth, and as a result, smaller self-publishers of e-books (with lower technology needs) are seen as the primary market drivers.²²² Table 4.5 provides e-book revenues for key markets. For more on these markets, including market data, industry players, and policies and regulatory measures (where reported), see appendix H.

²¹⁵ A user can lend an e-book purchased for a Kindle to other Kindle owners (on a limited basis).

²¹⁶ Masnick, “The Stagnation of eBooks,” October 5, 2015.

²¹⁷ Statista, “Digital Media: ePublishing,” 2016.

²¹⁸ “Traditional publishers” refers to established publication houses with major print operations, such as the global book industry’s five largest English-language publishers—Penguin Random House (U.S.), Hachette Livre (France), HarperCollins (U.S.), Macmillan (Germany), and Simon & Schuster (U.S.).

²¹⁹ Milliot, “The Bad News about E-books,” January 20, 2017; Spinak, “eBooks—Global Market and Trends—Part I,” June 22, 2016; AuthorEarnings, “February 2016 Author Earnings Report,” 2016.

²²⁰ Statista, “Digital Media: ePublishing,” 2016.

²²¹ Ibid.

²²² Smaller self-publishers often use low-cost no-frills websites that publish only e-books. Do-it-yourself e-book publishing sites such as Smashwords (U.S.) often offer authors higher percentage returns on sales compared to major retailers such as Amazon. However, sales volumes are often much lower and lack many personalized services usually found on the more well-known and well-connected e-book sales sites. Spinak, “eBooks—Global Market and Trends—Part I,” June 22, 2016.

Table 4.5: E-books revenue, by selected country or region, 2016

Country/region	Revenue, million \$
Brazil	74
China	933
Europe	2,342
India	85
Indonesia	17
Russia	49
United States	5,289

Source: Statista, “Digital Media: ePublishing,” 2016.

Market Competition and Trends

The slowdown and decline of e-book sales by traditional publishers in the United States and Western Europe can be attributed to several possible issues, including rising prices for e-book titles; a growing sense of “digital fatigue” among e-book users, as noted earlier; Amazon’s continuing dominance throughout the global e-book industry’s value chain; and the growing market prominence of independent e-book authors.

Causes for the Decline in E-book Sales

The recent rise in e-book prices likely has contributed to traditional e-book publishers’ sales declines. Amazon’s Kindle Store was initially successful with e-books priced \$9.99 or lower. Such low prices likely helped e-books (particularly Kindle e-books) to gain mainstream popularity.²²³ However, Amazon now allows e-book publishers to set their own Kindle e-book prices (after conflicts with traditional publishers, including multiple lawsuits), resulting in significant e-book price increases.²²⁴ These may have helped to depress e-book sales. Globally, for the United States and other similarly mature e-book markets, the ratio of hardcover book prices to e-book prices is about 1:0.78, which is much higher than in developing markets. For instance, in China this ratio is about 1:0.25.²²⁵ Further, a 2015 Nielsen’s Books and Consumers survey revealed that price is the top consideration for the majority (60 percent) of potential e-book customers.²²⁶

²²³ McGinley, “Bookworms: The Growing Popularity of E-readers,” December 2016, 7. Concurrent declines in electronic component prices, which made the Kindle and similar e-book reading devices more affordable for consumers to buy, added to their fast rise in popularity.

²²⁴ McGinley, “Bookworms: The Growing Popularity of E-readers,” December 2016, 8. Incidents included an antitrust suit brought against major book publishers and Apple by the U.S. government with charges of price collusion in 2012 and a series of negotiating conflicts between Amazon and Hachette Book Group in 2014.

²²⁵ Statista, “Digital Media: ePublishing,” 2016.

²²⁶ Milliot, “The Bad News about E-books,” January 20, 2017; Olive Software, “U.S. Book Publishing Industry Stats from Nielsen,” November 16, 2015.

A second, and more debated, reason for the industry’s decline is that consumers may be tiring of using dedicated digital media to read books. This phenomenon, often referred to as “digital fatigue,” has reportedly been a growing trend in the e-book industry, with more consumers showing a preference for tablets or smartphones over dedicated e-readers, and hardcover books over e-books.²²⁷

There are several arguments for and against this reasoning. Those that support it note that by contrast with video and music content, no electronic device is inherently needed to read a book. Moreover, despite certain price and convenience factors (including the growing catalog of free e-books), it is argued that e-book reading devices, including smartphones and tablets, simply have not delivered the quality of long-form reading experience needed to completely replace physical books.²²⁸ Other industry observers, however, assign more of the blame to the closed technological platforms that the e-book industry operates within and its strict digital rights management policies.²²⁹ Publishers, in these observers’ views, have tied the user’s reading experience to the vendor’s closed environment in a way that inconveniences customers. Once customers have purchased their e-readers, they are locked into their chosen brand’s format—for example, making Amazon’s e-books unusable on Nook devices and vice-versa.²³⁰ E-books are also bound by digital rights management policies set by vendors which limit transfers, while a traditional book can be passed repeatedly from reader to reader.²³¹

Amazon’s Growing Footprint

Amazon continues to dominate the global e-book industry. As of February 2017, Amazon accounted for 82 percent of all English-language e-book sales (406 million units) in the United States and in four other predominantly English-speaking countries: Australia, Canada, New Zealand, and the UK.²³² Within those English-speaking markets (where company e-book data are most reliably comparable), Amazon’s e-book sales were followed by those of Apple iBooks (U.S.) (10 percent); Ratuken Kobo (Japan/Canada) (2 percent); Barnes & Noble Nook (U.S.) (3 percent); and Google Play (U.S.) (less than 3 percent).²³³ In terms of U.S. revenue, Amazon

²²⁷ Milliot, “As E-book Sales Decline, Digital Fatigue Grows,” June 17, 2016; Milliot, “The Bad News about E-books,” January 20, 2017. For the first time since 2012, sales of hardcover units surpassed unit sales of e-books in 2016.

²²⁸ Milliot, “As E-book Sales Decline, Digital Fatigue Grows,” June 17, 2016; Spinak, “eBooks—Global Market and Trends—Part II,” June 22, 2016; Anand, “Amazon Kindle Sales Up 200% in India,” February 19, 2016.

²²⁹ Masnick, “The Stagnation of eBooks,” October 5, 2015.

²³⁰ Ibid.

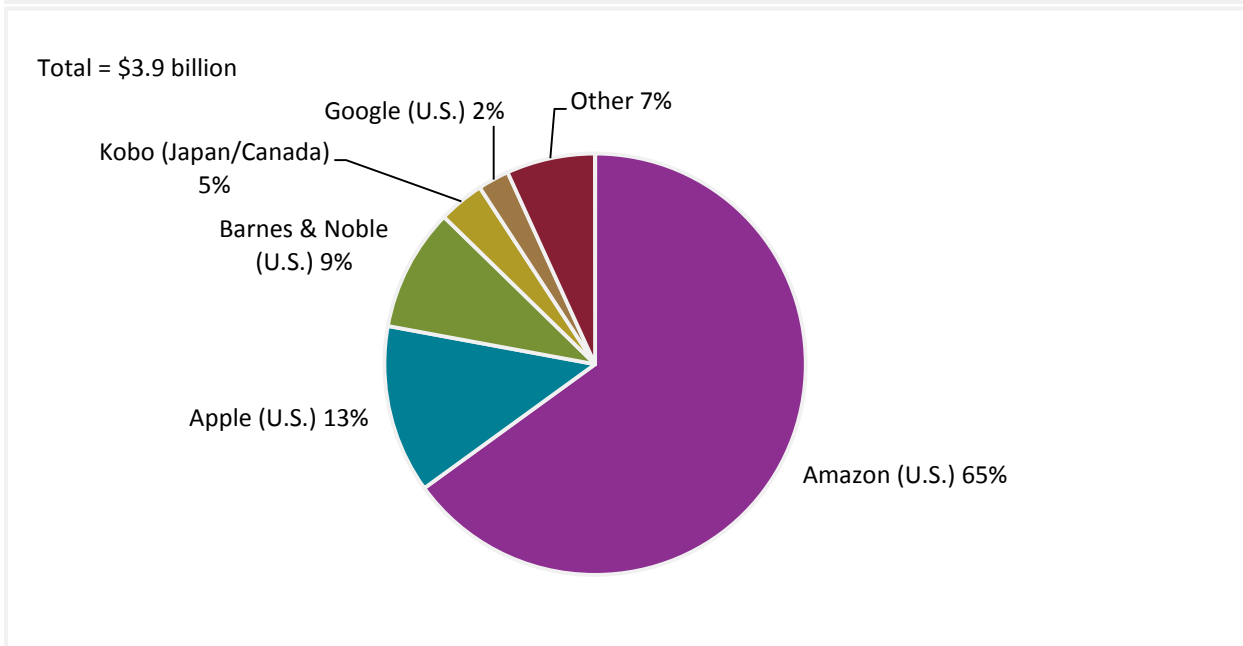
²³¹ Meadows, “Consumers Believe They Have More Rights,” May 26, 2016.

²³² AuthorEarnings.com, “February 2017 Big, Bad, Wide and International Report,” 2017; Wischenbart et al., *Global eBook*, 2016, 14; Spinak, “eBooks—Global Market and Trends—Part I,” June 22, 2016; Spinak, “eBooks—Global Market and Trends—Part III,” July 27, 2016.

²³³ AuthorEarnings.com, “February 2017 Big, Bad, Wide and International Report,” 2017.

was also the clear market leader (figure 4.6). In response to Amazon’s growing global reach, in March 2013, German booksellers set up the Tolino Alliance (including offering its own e-book reading device) to provide an alternative e-book platform for European consumers. It was announced in the beginning of 2017 that Kobo would enter into a strategic alliance with the Tolino e-book system.²³⁴ On the other hand, Amazon offers its Kindle e-books in only 13 countries (not including the United States),²³⁵ while Apple offers e-books in over 50 countries, Google Play offers them in around 75 countries, and Kobo offers them in about 190 countries.²³⁶

Figure 4.6: Top e-book companies, by U.S. revenue, 2016^a



Source: McGinley, “Bookworms,” December 2016, 17.

Note: Corresponds to [appendix table G.11](#).

^a Company-level revenue totals will not match country-level estimates noted earlier, due to differing accounting methodologies by the sources.

²³⁴ Anderson, “Rakuten Kobo Becoming Tolino’s Tech Partner,” January 3, 2017.

²³⁵ Amazon.com, “Help and Customer Service,”

https://smile.amazon.com/gp/help/customer/display.html/ref=hp_left_v4_sib?ie=UTF8&nodeId=201265630 (accessed June 16, 2017).

²³⁶ AuthorEarnings.com, “February 2017 Big, Bad, Wide and International Report,” 2017; Google Play, “Help: Connectivity and Availability,” <https://support.google.com/googleplay/answer/2843119?hl=en> (accessed June 16, 2017). The number of countries in which firms operate are general estimates, since they can change quickly or be accounted for differently across providers. Brown, “You Might Think Twice about Buying Ebooks,” March 8, 2016. In March 2016, Barnes & Noble discontinued its Nook e-book services in the UK, which was their last remaining foreign market operation.

In addition to being the world’s largest distributor of e-books, Amazon is an e-book publisher through Kindle Direct Publishing/KDP Select (which provides editorial and promotional services for authors). It also offers Amazon Prime subscribers access to its Kindle Owners’ Lender Library and, more recently, access to more rotating popular/current e-book titles through Prime Reading.²³⁷ Further, it offers downloadable audiobooks, which is one of the e-book industry’s fastest-growing segments, through its Audible service, and it accounts for the vast majority of total online audiobook purchases. (As of January 2016, Audible was selling about 119,000 audiobooks daily, which translates to about \$767 million a year).²³⁸ Lastly, in July 2014, Amazon introduced Kindle Unlimited, a monthly subscription service that allows unlimited reading for over 1.4 million e-book titles (as of February 2017)—more than doubling the 650,000 titles offered when the service first began.²³⁹

Self-publishers

Finally, the market prominence of independent e-book authors has grown. Between 2014 and 2015, almost 460,000 new e-book titles were published worldwide, with 75 percent of these being published on three platforms for independent authors: Smashwords (U.S.), Amazon’s CreateSpace (which offers publishing via the Kindle Store and paperback), and Lulu (U.S.).²⁴⁰ The top self-publishing platform, Smashwords, generated about 437,000 titles by 127,500 individual authors in 2016.²⁴¹ Moreover, self-published authors made up 20–35 percent of all international sales by major e-book retailers (Amazon, Apple, Kobo, and Barnes & Noble), with independent authors accounting for about 42 percent of Amazon’s e-book sales as of mid-January 2016.²⁴²

Search

Online search engines catalog and aggregate information (including creative content), using algorithms that facilitate connections between information providers and consumers.²⁴³

Typically, search engines rely on automated software processes to scan and catalog the content

²³⁷ McGinley, “Bookworms: The Growing Popularity of E-readers,” December 2016, 16–17; Kowalczyk, “Kindle Unlimited Ebook Subscription,” February 19, 2017; Rubin, “Amazon Prime Reading Gives Members Even More E-books,” October 5, 2016.

²³⁸ AuthorEarnings.com, “February 2016 Author Earnings Report,” 2016.

²³⁹ Kowalczyk, “Kindle Unlimited Ebook Subscription,” February 19, 2017. Notably, Oyster, a popular competing subscription-based e-book service, shut down in September 2015. Mance, “Ebook Service Oyster to Close,” September 22, 2015.

²⁴⁰ Spinak, “eBooks—Global Market and Trends—Part I,” June 22, 2016.

²⁴¹ Coker, “Smashwords Year in Review 2016 and 2017 Preview,” December 31, 2016.

²⁴² AuthorEarnings, “February 2017 Big, Bad, Wide and International Report,” 2017; AuthorEarnings, “February 2016 Author Earnings Report,” 2016.

²⁴³ Jawadekar, “Knowledge Management,” 2011, 278.

of websites for subsequent indexing and cross-referencing, as well as ranking of available information against other entries in the search engine's database.²⁴⁴ When a user searches for a keyword, the search algorithm compares it to this database before selecting the most relevant websites to return to the user. Algorithmic differences in search engines' designs lead to variation in output results for an identical keyword search. Therefore, search engine developers focus on constantly improving their algorithms to provide the most relevant results to their customers and advertisers in as short a time possible.²⁴⁵

U.S. and International Markets

Internet search platforms can be broadly categorized by their scale and scope. Horizontal search engines such as Google, Bing, and Yahoo provide search results for a wide range of topics, from the local weather in Fiji to techniques for doing barrel rolls in small aircraft. Vertical search engines, by contrast, focus on specific segments of online content, allowing them to offer more depth on a search topic within their chosen domain.²⁴⁶ These search engines may provide results on topics such as health (WebMD), travel (Kayak), or real estate (Trulia), and have been gaining prominence for over a decade.²⁴⁷ In 2012, the increasing popularity of these specialty platforms led to a 3 percent decline in traditional search engine use in the United States, while vertical search saw an 8 percent increase.²⁴⁸

Horizontal Search

Globally, the horizontal search engine sector consists of a few large firms, with Google (U.S.) accounting for 80.5 percent of the global market, followed by Bing (U.S., 7.0 percent), Baidu (China, 5.8 percent), and Yahoo (U.S., 5.5 percent) (table 4.6). Google has increased its desktop search market share by 9 percentage points between 2016 and 2017, while Bing, Baidu, and Yahoo all lost market share compared with the previous year. However, there are some international markets—such as China, Russia, and South Korea—where Google faces significant competition from local firms.

²⁴⁴ Science Daily, "Web Crawler," https://www.sciencedaily.com/terms/web_crawler.htm (accessed June 16, 2017).

²⁴⁵ Kosir, "#TBT: Why Google Won the Search Engine War," February 6, 2014.

²⁴⁶ Searching for the keyword "cold" in Google returns over one billion links describing a health condition, a dog breed, and a song by the band Maroon 5, among others. The same search on WebMD, a health-oriented vertical search engine, produces roughly 4,000 results related to cold, flu, and allergy relief.

²⁴⁷ Enge, "Are Vertical Search Engines the Answer to Relevance?" January 3, 2007.

²⁴⁸ Lipsman, Aquino, and Adamo, "2013 U.S. Digital Future in Focus," February 14, 2013.

Table 4.6: Global search engine market share, desktop, 2012–17

Search engine	2012	2013	2014	2015	2016	2017
Google	81.6	77.5	67.5	66.4	71.4	80.5
Bing	4.5	5.5	6.6	10.2	11.3	7.0
Baidu	5.1	8.2	18.4	12.3	8.0	5.8
Yahoo Global	6.8	7.3	6.2	8.8	7.4	5.5
Ask	0.6	0.4	0.1	0.2	0.2	0.2
AOL	0.4	0.4	0.2	0.7	0.1	0.04

Source: NetMarketShare.com, “Desktop Search Engine Market Share,” 2017.

In the United States, Google, Yahoo, and Bing are the market leaders for search. ComScore estimates that Google has 64 percent of the domestic desktop search market, with Bing and Yahoo trailing with 21 and 12 percent, respectively.²⁴⁹ This sector has also consolidated over the last few years, with smaller search platforms such as AOL Inc. and Ask Network losing their remaining market shares to Bing and Yahoo.²⁵⁰

Although Baidu has a 60 percent market share in China, it has been unable to break into other key markets, such as Japan. Baidu was reportedly looking to expand into Thailand, Egypt, and Brazil, and briefly launched local versions of its search engine in those countries.²⁵¹ However, these efforts seem to have been withdrawn, except for the Thai version. Baidu is reportedly still attempting to gain market share in Brazil and India, where it has acquired office space. It has developed a localized product to capitalize on the potential for significant growth in advertising revenue in India.²⁵²

Statista estimates that desktop search still outperforms mobile search globally, despite desktop’s declining market share. In the last quarter of 2015, 62 percent of global search revenue derived from desktop searches, down from 69 percent in the last quarter of 2014.²⁵³ Since either the Android or the iOS operating systems are on nearly every smartphone and since Google is the default search engine for these operating systems, it is unsurprising that Google has 95.4 percent of the global market for mobile search.²⁵⁴

In addition, the spread of mobile broadband technologies has increased both access to and the speed of mobile search, boosting growth in this market. In 2013, only 33 percent of U.S. search

²⁴⁹ comScore, “comScore Releases February 2016 U.S. Desktop Search Engine Rankings,” March 16, 2016.

²⁵⁰ Statista, “Share of Search Queries Handled” (accessed March 13, 2017).

²⁵¹ Kan, “Baidu Launches Search Engine for Brazil,” July 18, 2014; Millward, “Baidu Launches Search Engine in Thailand, Brazil, and Egypt,” January 26, 2014.

²⁵² Kan, “Baidu Launches Search Engine for Brazil,” July 18, 2014; Trefis Team, “Google Is Growing in India, but Competition,” December 5, 2016.

²⁵³ Statista, “Distribution of Search Spending Worldwide” (accessed May 23, 2017).

²⁵⁴ IDC, “Worldwide Quarterly Mobile Phone Tracker,” 2017; Rosenblatt and Satariano, “Google Paid Apple \$1 Billion,” January 21, 2016.

engine visits originated on a mobile device, but by 2016 such searches had grown to nearly 50 percent.²⁵⁵ Mobile search offers innovations that let users access information based on their location. Maps, shopping, weather, user review sites, and dating applications rely heavily on location-specific mobile search. Mobile search is also important for businesses that depend on search engines to match their business information, such as opening hours and directions, with local consumers.²⁵⁶

Vertical Search

Vertical search platforms are competing directly with horizontal search engines both in domestic and international markets.²⁵⁷ Online marketplaces such as Amazon (the world's largest online retailer)²⁵⁸ and eBay (the world's largest online auction site)²⁵⁹ have become leaders in product searches.²⁶⁰ Instead of searching for products on a traditional search engine, consumers navigate directly to the e-commerce marketplaces for their shopping needs. Forrester reports that 31 percent of U.S. adults who have made an online purchase in the previous three months started their shopping research on Amazon.²⁶¹ Google introduced Google Shopping, a product comparison service redesigned to its current format in 2012, allowing merchants to feature products in shopping searches for a fee.²⁶² Instead of creating its own review platform, Microsoft created a partnership between Bing, Facebook, and Yelp to display business reviews.²⁶³ Another area where vertical search has gained more prominence is travel searches. Domestically, the Priceline Group competes with other travel booking providers, such as Expedia.com and Hotels.com, as well as travel review websites TripAdvisor and Yelp.²⁶⁴

Horizontal search engine companies have responded to competition from vertical search travel engines by creating or expanding their native vertical search platforms. In 2011, Google established Google Flights, an online platform for search and purchase of airline tickets. Google

²⁵⁵ Statista, "Statistics and Facts about Mobile Search" (accessed May 23, 2017).

²⁵⁶ Statista, "Statistics and Facts about Mobile Search" (accessed May 23, 2017).

²⁵⁷ Google, "Form 10-K," 2016; Microsoft, "Form 10-K," 2014; Yahoo, "Form 10-K," 2013.

²⁵⁸ Deloitte, "Global Powers of Retailing 2016," 2015.

²⁵⁹ Alexa, "Ebay.com Traffic Statistics," 2017. eBay also owns a large product comparison website, shopping.com.

²⁶⁰ Miller, "As Web Search Goes Mobile, Competitors Chip," April 3, 2013; Rodriguez, "Google Faces Threats from Amazon, Yelp, Retailers," March 27, 2015.

²⁶¹ Colburn, "Google's Biggest Threat? Amazon," April 6, 2017.

²⁶² Sullivan, "Google Product Search to Become Google Shopping," May 31, 2012. This shopping search service was the subject of a recent EU antitrust investigation. In June 2017, EU regulators imposed a 2.4 billion euro fine on Google, saying that the company had abused its dominant position in the search market by promoting its own shopping comparison service. Google responded to the announcement, saying that it respectfully disagreed and is considering its response. Kelion, "Google Hit with Record EU Fine over Shopping Service," June 27, 2017.

²⁶³ Roat, "Why Social Recommendations Might Be the Smartest Move," July 13, 2012.

²⁶⁴ Priceline Group, "Form 10-K," 2016.

also acquired Zagat—a restaurant, hotel, and store review company—in 2011, and launched Google Local Search in 2012.²⁶⁵ More recently, Facebook reviews have been gaining in popularity among travelers and growing more important for businesses.²⁶⁶

User review sites, a variant of vertical search platforms, allow consumers to search for and learn about businesses and products available both on- and off-line, similar to the word-of-mouth recommendation process (table 4.7). Nielsen reports that 66 percent of surveyed Americans trust consumer opinions posted online, a higher level of trust than any other form of advertising in their study.²⁶⁷ These sites make up a large share of the vertical search market. Yelp is one of the most popular user review sites in the United States, currently listing about 121 million reviews of local businesses in the retail, restaurant, home and local services, beauty and fitness, health, and travel industries, among others. By 2014, Yelp had expanded its business to 20 countries throughout Europe and the Asia – Pacific region.²⁶⁸

Table 4.7: Top five user review websites, 2017

User review website	Monthly U.S. users	Businesses reviewed
Google My Business	158 million	Any business
Facebook	86 million	Any business
Amazon	86 million	E-commerce
Yelp	41 million	Any business
TripAdvisor	28 million	Travel, food

Source: Abramyk, “Top 10 Review Websites to Get More,” February 27, 2017.

Vertical search firms in the United States face international competition in several key markets. In China, Alibaba and Baidu provide shopping, travel, health, and review services, and the Alibaba Group is active in other Asian markets, particularly Indonesia.²⁶⁹ Russian search providers Yandex, Mail.Ru Group, and Rambler own vertical search subsidiaries that help consumers plan travel, get education and health advice, and search for jobs, as well as shop and compare prices.²⁷⁰ In Brazil, local websites for Amazon and Hotels.com compete with Brazil’s native firms: Americanas, Submarino, and Dafiti.²⁷¹

²⁶⁵ Pritchett and Troper, “Help Your Business Shine with Google My Business,” June 11, 2014.

²⁶⁶ DiSilvestro, “Yelp vs. Google vs. Facebook Reviews,” September 19, 2016.

²⁶⁷ Nielsen, “Global Trust in Advertising Survey,” September 2015.

²⁶⁸ Russell, “Yelp Goes Live in Japan,” April 9, 2014.

²⁶⁹ Alibaba Group Holding Limited, “Form 20-F,” 2016; Baidu, Inc., “Form 20-F,” 2016.

²⁷⁰ Russian Search Marketing, “Russia’s Top 10 Websites 2016,” September 19, 2016.

²⁷¹ Carrenho, “Is Amazon Really Buying Brazil’s Biggest Bookstore Chain?” October 19, 2012; Israel, “Brazil Retailer Dafiti Secures \$70 Million,” September 17, 2013.

India's market is similar to that of Brazil. Amazon entered India in 2012 and now competes with two large domestic firms: Flipkart and Snapdeal.²⁷² Expedia, the Priceline Group, and eBay all have local websites as well. TripAdvisor is active in India, but faces competition from local review platforms Yatra, Revaalo, and Burrp.²⁷³

Market Competition and Trends

Horizontal and vertical search firms are leveraging their large stores of data—such as photo uploads or search terms—to improve their metrics using ML algorithms.²⁷⁴ Based on available data, search engines can provide a range of sophisticated products. This section discusses these innovations both for horizontal and vertical search.

Horizontal Search

In an effort to increase the relevance and sophistication of its search algorithm, Google is increasing its investment in ML to analyze digital data, including voice commands on a smartphone, image searches, or keystroke searches.²⁷⁵ For example, if a machine processes enough photos of dogs that include the tag “dog,” the search engine can then learn to find dogs in never-before-seen photos on request.²⁷⁶

This analytical innovation marks an evolution from the past, when a search for “Elvis” would have only returned pages with the word Elvis in them.²⁷⁷ Google’s “Hummingbird” algorithm studied the relationship between words so that, for example, searches for “Elvis” would also return results for “Elvis Presley.” In 2015, Google’s RankBrain evolved search further: instead of relying on a static formula, it can draw on a large volume of users’ historical searches to learn to predict what users are looking for. Even if the search does not recognize a word or phrase, RankBrain can then guess at the context and find websites accordingly.²⁷⁸ In short, RankBrain’s search results are not ranked by static attributes such as the number of keywords or links, but

²⁷² Bhattacharya, “One of Amazon's Fiercest Competitors in India,” February 6, 2017; D'Onfro, “Amazon and One of its Biggest Competitors in India,” February 21, 2015.

²⁷³ MBA Skool, “TripAdvisor SWOT Analysis, USP and Competitors” (accessed on May 23, 2017).

²⁷⁴ Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of computer programs that can change when exposed to new data (e.g., neural networks). Neural networks are biologically inspired programming paradigms that enable computers to learn from observational data. TechTarget, “WhatIs.com Search Engine” (accessed June 29, 2017).

²⁷⁵ Kickstart, “Search Engine Marketing Studies,” November 7, 2016.

²⁷⁶ Metz, “AI Is Transforming Google Search,” 2016.

²⁷⁷ Sullivan, “Meet RankBrain,” May 9, 2015.

²⁷⁸ Clark, “Google Turning Its Lucrative Web Search Over,” October 26, 2015.

by a machine's estimation of a page's relevance based on what it thinks the webpage is about.²⁷⁹

Other search engines are also investing in AI. For example, the Android launcher and web browser developed by Russia's Yandex uses the firm's AI program, Zen; Yandex is marketing it to smaller handset makers (who represent about one-half of the Russian market). Zen, which is available in 24 countries and in 15 languages, tracks users' scrolling patterns and where they pause on links.²⁸⁰ These factors inform Yandex's search algorithm (MatrixNet) to help determine which advertisements to deliver to the consumer.²⁸¹

China's Baidu is also investing much of its \$2.9 billion research and development budget on AI and ML.²⁸² Baidu is well positioned to leverage this technology, as its online search app alone has 665 million monthly users; this large user population generates a wealth of search data and behavior patterns to be fed to the company's deep learning machines. The company has a staff of 1,700 employees working on ML projects in four research laboratories in China and Silicon Valley, focusing on driverless cars, a voice assistant called DuerOs (similar to Amazon's bot, Alexa), and face recognition.²⁸³

Vertical Search

Vertical search engines for travel websites such as Kayak or Expedia are also investing in ML. Kayak is working on a way to search for travel information through Facebook Messenger or Amazon Echo, while Expedia plans to use ML for repeatable tasks, like flight changes.²⁸⁴ Priceline is investing in ML to personalize travel preferences in its mobile app, and is also developing virtual reality capability that will enable travelers to virtually visit a destination ahead of a trip, letting them better decide what they would like to do when they actually arrive.²⁸⁵ Further, Priceline is considering augmented reality innovations that will enable tourists to access real-time data as they walk through a city, show them what sites looked like in the historical past.²⁸⁶

²⁷⁹ Knauff, "I, Search," February 16, 2017.

²⁸⁰ Yandex, "Yandex Unveils First Browser," June 9, 2016.

²⁸¹ Lunden, "Yandex Woos Smartphone Makers with AI," October 12, 2016.

²⁸² Cheh, "China's Baidu Bets Big on AI," March 18, 2017.

²⁸³ Wang, "Inside Baidu's Billion Dollar Push," May 8, 2017.

²⁸⁴ Biesiada, "Expedia and Priceline Explore the Possibilities," 2017.

²⁸⁵ Chhatwal, "Priceline Hopes to Increase Customer Loyalty," 2016.

²⁸⁶ Ackerman, "To Priceline, VR Will Become Key to Millennial Travel Planning," September 30, 2016.

In the online review business, Yelp is working on ML algorithms²⁸⁷ to augment its search function. The firm is developing a large database of user-posted photographs, and its algorithm can be trained to study these pictures in order to answer questions such as whether a restaurant is dog-friendly, has an ocean view, or serves burritos.²⁸⁸ Google is working on a deep-learning solution that could gauge the caloric content of food from pictures, while Facebook wants to use ML to make personalized restaurant recommendations.²⁸⁹

News Aggregators and Social Media

The growth of Internet search, the increasing popularity of social media platforms, and growing access to mobile devices has changed how audiences access news content. The rise of the Internet and proliferation of mobile technology have allowed both traditional and new digital media outlets to offer increasingly specialized news to their customers. In recent years, social media sites such as Facebook and Twitter have also competed to generate, aggregate, and disseminate news content.²⁹⁰

The Pew Research Center reports that 36 percent of U.S. consumers of digital news navigated directly to publisher websites, 35 percent were referred by social media sites, and 20 percent were referred by search engines.²⁹¹ News aggregators, web services, and online applications dedicated to collecting syndicated content in one location for convenient viewing serve as the primary source of news for 15 percent of smartphone users in the United States. In all, 46 to 49 percent of Americans reported getting some or most of their news from social media sites in 2016, up from 27 percent in 2013.²⁹²

News aggregators are gaining in popularity for several reasons. Aggregators provide digital consumers with instant access to breaking news on a variety of topics and areas. The articles accessed through aggregators are easy to share, and aggregation algorithms learn about consumer preferences to deliver more personalized content. News aggregators are also increasingly relying on ML to recommend new content to users; they use this tool to develop “artificial reporters” that can generate automated content, tracking users’ reading habits for better content curation and establishing detection systems for fake news.²⁹³ For example,

²⁸⁷ This is machine learning that employs neural networks to process big data.

²⁸⁸ Finley, “Yelp’s Using Image Search,” October 19, 2015.

²⁸⁹ Filloon, “Yelp Is Using Artificial Intelligence,” July 19, 2016.

²⁹⁰ Graham et al., *Content is King: News Media Management*, 2015.

²⁹¹ Mitchell et al., “How Americans Encounter, Recall and Act,” February 9, 2017.

²⁹² Newman, “Digital News Report 2016: Overview and Key Findings,” 2016, 7; Gottfried and Shearer, “News Use Across Social Media Platforms 2016,” May 26, 2016.

²⁹³ Knight, “The Insanely Popular Chinese News App,” January 26, 2017; Tang, “Report: News Consumption Shifts to News Aggregators,” February 14, 2016.

India-based Pipes has built a personalized news aggregator that uses neural networks and AI to provide individualized news to users, while Quartz (an online media company) has developed a “witty” bot that learns users’ preferences for news stories.²⁹⁴

U.S. and International Markets

Globally, news consumers are shifting from traditional formats of news to digital content, either through a news publisher’s online channel or a digital aggregator. Google News remains the top international news aggregator, monitoring over 25,000 publishers worldwide. It is available in 70 regional editions and a total of 35 languages, including versions for Brazil, China, Indonesia, and Russia, as well as five separate versions for India (in English, Hindi, Malayalam, Tamil, and Telugu).²⁹⁵ Apple News, with a 4 percent U.S. market share, also claims 3 percent of market share in the UK.²⁹⁶ Flipboard, the leading U.S. news aggregation app, shares content from over 4,000 publishing partners with over 100 million active monthly users worldwide.²⁹⁷

Firms outside the United States are also expanding beyond their home markets. Russian aggregator Anews expanded into Brazil in August 2015. Hong Kong-based News Dog is tailored specifically for Indian readers,²⁹⁸ while Hong Kong-based News in Palm—which owns Indonesia-based content aggregator Baca—has expanded to Brazil by offering a new content aggregation service specific to that country. Baca is monetized through the placement of ads and app links at the end of each article featured on the service.²⁹⁹

In the European Union, 10 percent of news consumers used social media as their main news source in 2016. This share stood at 14 percent in the United States that year, and 18 percent in Brazil.³⁰⁰

News aggregation services are becoming increasingly popular in China, with more than 900 million people using mobile news apps in 2015. The most popular mobile news apps in

²⁹⁴ Chopra, “Exclusive: Analytics Company Trybeca Acquires,” 2016; Popomaronis, “Why Quartz’s News App Is Bigger than News,” March 22, 2016.

²⁹⁵ Google News, “About Google News,” https://www.google.com/intl/en_us/about_google_news.html (accessed June 16, 2017); Newman et al., *Digital News Report 2017*, 2017, 13. Google News claimed market shares of 13 percent in North America; 10 percent in the EU; and 21 percent in both Asia and Latin America.

²⁹⁶ Newman, “Digital News Report 2016: Overview and Key Findings,” 2016, 10.

²⁹⁷ Flipboard, “Brands on Flipboard,” <https://about.flipboard.com/advertisers/> (accessed June 16, 2017); Newman et al., *Digital News Report 2017*, 2017, 13. Flipboard claimed market shares of 5 percent in North America; 2 percent in the EU; 5 percent in Asia; and 3 percent in Latin America.

²⁹⁸ East-West Digital News, “News Aggregator Anews Launches App in Brazil,” August 12, 2015; Bagchi, “How Did an Obscure Chinese News Aggregator?” July 6, 2016.

²⁹⁹ Freischlad, “News Aggregator for Indonesia Raises \$20m,” July 28, 2016.

³⁰⁰ Newman, “Digital News Report 2016: Overview and Key Findings,” 2016, 10.

China that year included Tencent (140 million monthly active users), Toutiao (70 million monthly active users), and Yidian Zixun (15.2 million monthly active users).³⁰¹ These services are increasingly linked with social media and track user reading habits to make it easier to curate content.³⁰²

Growth has accelerated rapidly since 2015, with Toutiao having about 600 million users in 2017; the company recently acquired Flipagram, a one-time Instagram competitor, and it has begun expanding into Brazil, India, Japan, North America, and Southeast Asia.³⁰³ Valuations of news aggregators have also risen rapidly in China. Toutiao was valued at \$500 million in 2014, but was seeking a valuation of \$10 billion in 2016, which would represent annual growth of 9,500 percent.³⁰⁴

Market Competition and Trends

With declining print circulation, newspapers are finding digital subscriptions ever more important. Pew Research Center reports that newspaper industry revenues fell by an average of 8 percent annually between 2012 and 2015.³⁰⁵ At the same time, digital advertising revenues for newspapers increased from \$36.8 billion in 2012 to \$59.8 billion in 2015.³⁰⁶ However, this may not fully benefit newspapers, as technology companies—and not journalism organizations—have been the primary financial beneficiaries. Close to 65 percent of the nearly \$60 billion made in digital ad revenue in 2015 went to Google (about \$30 billion) and Facebook (about \$8 billion).³⁰⁷

Traditional and Digital News Sources

With continuously declining print circulation, traditional news publishing powerhouses have been transitioning from print to digital content distribution. In 1997 the *Wall Street Journal* was the only large newspaper requiring a subscription to access its digital content, but by 2015, 77 of 98 large U.S. newspapers offered digital subscriptions.³⁰⁸ In 2013, 61 percent of *New York Times* subscribers had a digital-only subscription, the highest share among leading legacy

³⁰¹ Tang, “Report: News Consumption Shifts to News Aggregators,” February 14, 2016.

³⁰² Ibid.

³⁰³ Xinhua, “Chinese News Aggregator Toutiao Acquires Flipagram,” February 2, 2017.

³⁰⁴ Solomon, “The Owner of This Hot Chinese App,” November 8, 2016.

³⁰⁵ Mitchel and Rosenstiel, “The State of the News Media 2012,” 2012.

³⁰⁶ Pew Research Center, “State of News Media,” 2016.

³⁰⁷ Pew Research Center, “State of News Media,” 2016; Ingram, “How Google and Facebook Have Taken Over,” January 4, 2017.

³⁰⁸ Williams, “How Digital Subscriptions Took Over,” February 29, 2016.

newspapers. The *Washington Post* trailed all other leading legacy newspapers with just 9 percent.³⁰⁹

Online traffic to major newspapers has increased, but few Americans pay for online news services. Instead, most users access online news through social media and other free, ad-supported websites. Only 9 percent of American adults paid to access online news services in 2015, but some of those websites are nonetheless seeing growth.³¹⁰ For example, the *Washington Post* experienced a 56 percent increase in its digital traffic between 2013 and 2015, while traffic to the *Wall Street Journal* was up 47 percent.³¹¹

As the Internet approaches television as the main source of news, and traditional newspapers downsize their newsrooms, native digital news outlets are becoming more prominent.³¹² There are now nearly 500 online-only news outlets that employ nearly 5,000 journalists, many of whom come from legacy media jobs.³¹³ While 57 percent of American adults still receive at least some of their news from television, 38 percent cite digital platforms as the main source of their news.³¹⁴

News Aggregators and Social Networks

News aggregators and social networks provide the majority of referral traffic to traditional news and media outlets. Facebook and Google sites (mainly Google News) are the leading sources of referral traffic for over 400 major news and media outlets around the world, accounting for an estimated 42 percent and 31 percent of all referral traffic, respectively.³¹⁵ The remainder of the referral traffic comes from aggregator apps such as Flipboard (U.S.), SmartNews (Japan), and Yahoo News Digest (U.S.), along with digital news aggregators such as the *Drudge Report* (U.S.) and *HuffPost* (formerly the *Huffington Post*, U.S.).³¹⁶

In addition, the majority of adults in the United States receive at least some of their news from social media, and the proportion is growing. In 2012, 49 percent of Americans named social media as one of their news sources, compared to 62 percent in 2016. The majority of Reddit,

³⁰⁹ Richter, "The *Washington Post* Lags Peers in Shift to Digital," August 6, 2013.

³¹⁰ Newman et al., *Digital News Report 2016*, 2016.

³¹¹ Bilton, "There's Been a Mindset Change: Legacy Publishers," January 8, 2016.

³¹² In the past year, some legacy outlets have seen an increase in subscriptions, both for online and print newspapers. NPR reports that a surge in subscriptions, and the resulting increase in newsroom sizes, is due to the 2016 presidential election in the United States. Wamsley, "Big Newspapers Are Booming," December 27, 2016.

³¹³ Jurkowitz, "The Growth in Digital Reporting," March 26, 2014.

³¹⁴ Mitchell et al., "Pathways to News," July 7, 2016.

³¹⁵ VanNest, "Where Is Your Site Traffic Coming From?" December 14, 2016.

³¹⁶ Woods, "Aggregator Apps: Friend or Foe to Publishers?" January 7, 2015; Rosenstein, "The Stats Don't Lie," October 6, 2015.

Facebook, and Twitter users report getting news through their social media accounts (table 4.8).³¹⁷ Legacy and native digital publishers are adapting to this change by using Facebook, Twitter, YouTube, Instagram, Snapchat, newsletters, and, more recently, podcasts, to reach consumers beyond their own homepage.³¹⁸

Table 4.8: Proportion of Americans who get news on social media, 2013–16

Social media website	% of U.S. adults who get news on each website		% of social media website users who get news on each website	
	2013	2016	2013	2016
Facebook	30	44	47	66
Twitter	8	9	52	59
Reddit	2	2	62	70

Source: Gottfried and Shearer, “News Use Across Social Media Platforms 2016,” May 26, 2016.

Podcasts³¹⁹

Podcasts are growing in popularity among consumers of news. About 20 percent of Americans aged 12 and older listened to a podcast at least once in the month leading up to a 2016 survey, up from 12 percent in 2010. Further, more than a third of Americans have listened to at least one podcast. Data from the largest U.S. podcast hosting company, Libsyn, show a 38 percent average annual increase in the number of podcasts available (from 12,000 in 2012 to 28,000 in 2015) and a 27 percent average annual increase in the number of podcast downloads (from 1.6 billion in 2012 to 3.3 billion in 2015).³²⁰ Large legacy publishers such as the *New York Times* and the *Wall Street Journal*, as well as digital news providers such as *HuffPost*, *Buzzfeed*, and *Slate*, increased their production of podcasts in 2015 and 2016.³²¹

Even though the number of podcasts has increased, only a handful of publishers dominate the market. The *Wall Street Journal* reports that the top 10 podcast publishers account for as much as 40 percent of all podcasts on the market. National Public Radio (NPR), one of the leaders in the podcast industry, estimates having 2.5 million unique weekly podcast listeners in 2015, a 25 percent increase from 2 million in 2014.³²² Despite this relatively high market concentration, it has been difficult to measure how many people actually listen to the podcasts they download, and even more difficult to estimate the effects of podcast advertising on advertisers’

³¹⁷ Gottfried and Shearer, “News Use Across Social Media Platforms 2016,” May 26, 2016.

³¹⁸ Pew Research Center, “How Digital News Outlets Are Extending Their Reach,” June 14, 2016.

³¹⁹ A podcast is a digital audio file made available on the Internet for downloading to a computer or mobile device. Typically it is available as a series, new installments of which can be received by subscribers automatically.

³²⁰ Gottfried and Shearer, “News Use Across Social Media Platforms 2016,” May 26, 2016.

³²¹ Vogt, “Podcasting: Fact Sheet, State of the News Media,” June 15, 2016.

³²² Ibid.

sales.³²³ These difficulties notwithstanding, more advertisers are looking to invest into podcast advertising.³²⁴

Digital Video News

Online video news is another area of rapid growth. By 2016, 33 percent of Americans consumed news online, evenly split between those predominantly watching the news on news sites and those predominantly watching videos on social networks. This growth coincided with a decline in TV viewership.³²⁵ For example, according to one estimate, 20 percent of American adults will not watch traditional TV in 2017.³²⁶ This coincides with general growth in online video. U.S. YouTube viewership grew from 5 billion views per day in 2013 to 8 billion views in 2015 (a 26 percent average annual increase). Facebook video has expanded even more rapidly, from less than a billion online video views in 2013 to 8 billion in 2015.³²⁷

Legacy publishers such as CNN and native digital publishers such as *HuffPost* responded to this shift in video consumption by increasing their Facebook exposure up to 10-fold between June 2015 and February 2016.³²⁸ Almost 80 percent of video media leaders surveyed by Reuters have stated that they plan to expand their online video investments.³²⁹

The Challenge of Information Quality

The rise of the Internet as the source of news and user product reviews created a platform for a deliberate, non-satirical production and dissemination of false or misleading information, commonly known as fake news and fake reviews. The dissemination of false and misleading information in one form or another and for most any purpose dates back to the beginning of human communication itself. Fake product reviews had become such a large problem by 2012 that Yelp began flagging businesses that offered rewards for removing negative and posting positive reviews.³³⁰ Amazon filed a lawsuit against over 1,000 people offering to write fake

³²³ Perlberg, "Podcasts Face Advertising Hurdles," February 18, 2016.

³²⁴ Barr, "More Advertisers Say They Are Buying Into Podcasts," September 7, 2016.

³²⁵ Kalogeropoulos, Cherubini, and Newman, "The Future of Online News Video," 2016, 10.

³²⁶ eMarketer, "New eMarketer Estimates Show Pay TV Audience," January 17, 2017.

³²⁷ Constine, "Facebook Hits 8 Billion Daily Video Views," November 4, 2015.

³²⁸ Kalogeropoulos, Cherubini, and Newman, "The Future of Online News Video," 2016, 8.

³²⁹ *Ibid.*

³³⁰ CBS News, "How Yelp Is Weeding Out Fake Reviews," May 3, 2016; Luca and Zervas, "Fake It Till You Make It," July 20, 2015.

product reviews for a nominal fee in 2015.³³¹ A data analytics company, FakeSpot, allows consumers to check the veracity of product reviews left online.³³²

Social media services are often blamed for the spread of fake news. By the end of 2016, a third of American adults had reported seeing fake political news online, primarily on social media.³³³ However, a recent study on the role of social media in the spread of news finds that fake news shared online may not have as persuasive an effect as television ads.³³⁴

Fake news is not solely a U.S. phenomenon. France, Germany, Brazil, Austria, Canada, Italy, and the UK have been contending with the rise of fake news as well.³³⁵ For example, when 10 European countries and the United States came together to establish a joint center against hybrid warfare, the creation and dissemination of fake news featured prominently in their description of hybrid warfare methods.³³⁶ Some governments are considering an official response; in Germany, the government has recently passed a law that from October 2017 onward would compel social media platforms such as Facebook and Twitter to rapidly remove fake news items that incite hate or include other illegal content, or face fines.³³⁷

Many large publishers have created guides to help consumers identify fake news stories.³³⁸ Facebook partnered with First Draft, a nonprofit organization focused on improving the quality of content shared online, to introduce an educational tool for spotting fake stories available to users in 14 countries.³³⁹ Google unveiled “Fact Check,” a fake news identification tool supported by 115 large publishers, available to Google News and Google Search users worldwide.³⁴⁰ Google also launched a workshop to teach UK teens to spot fake news on

³³¹ Weise, “Amazon Cracks Down on Fake Reviews,” October 19, 2015.

³³² FakeSpot, <http://fakespot.com/> (accessed June 11, 2017).

³³³ Barthel, Mitchell, and Holcomb, “Many Americans Believe Fake News Is Sowing Confusion,” December 15, 2016.

³³⁴ Allcott and Genzkow, “Social Media and Fake News in the 2016 Election,” Spring 2017.

³³⁵ Johnson, “The Rise of Fake News in France,” February 9, 2017; Chazan, “Rise of Refugee ‘Fake News’ Rattles German Politics,” February 14, 2017.

³³⁶ Finnish Broadcasting Company, “Helsinki to Host a Hub,” November 21, 2016.

³³⁷ Miller, “Germany Votes for 50m Euro Social Media Fines,” June 30, 2017.

³³⁸ Hunt, “What Is Fake News? How to Spot It,” December 17, 2016; Davis, “Fake Or Real? How to Self-Check the News,” December 5, 2016; International Federation of Library Associations, “How To Spot Fake News,” 2017; Kiely and Robertson, “How to Spot Fake News,” November 18, 2016.

³³⁹ Mosseri, “A New Educational Tool against Misinformation,” April 6, 2017.

³⁴⁰ Kosslyn, “Fact Check Now Available in Google Search,” April 7, 2017. Publishers’ participation is free and voluntary, but to use Fact Check in Google News, publishers’ websites have to satisfy technical requirements.

YouTube.³⁴¹ Reuters has developed its own algorithm that can identify fake news posted on Twitter.³⁴²

³⁴¹ Internet Citizens, "About," <https://internetcitizens.withyoutube.com/#about> (accessed June 11, 2017).

³⁴² Iozzio, "Reuters Built a Bot That Can Identify Real News," December 2, 2016; Waddell, "Algorithms Can Help Stomp Out Fake News," December 7, 2016.

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Chapter 5

E-commerce, Digital Payments, and Records

Introduction

The \$27.7 trillion global electronic commerce (e-commerce) market is growing rapidly as business-to-business (B2B), business-to-consumer (B2C), and consumer-to-consumer (C2C) transactions continue to move online.³⁴³ In all e-commerce categories, growing use of mobile devices is driving industry growth. B2B e-commerce has been upgrading from relatively expensive and inefficient legacy systems to modern cloud-based platforms facilitated by digital payment services. Meanwhile, B2C e-commerce has been transforming the global retail sector as consumers increasingly make their purchases online. Both businesses and consumers are increasingly using digital payments for routine transactions, enabling e-commerce in global markets. In addition, digital payments allow the unbanked to participate in e-commerce and are a helpful spur to economic growth in developing markets. Electronic records using technologies such as blockchains and digital signatures are facilitating digital payments, and therefore e-commerce, around the world. Express delivery and logistics services are other important industries that are enabling e-commerce to expand, especially B2C and C2C e-commerce, as they respond to the growing demand for delivery of smaller packages.

Despite the growth in online commercial transactions, industry sources report that cross-border e-commerce and digital payments-services face a number of impediments. These include varying customs procedures; discriminatory tax policies; low de minimis thresholds;³⁴⁴ diverse regulatory approaches; and licensing restrictions.³⁴⁵ For more on policies and regulatory measures, see chapter 8.

³⁴³ The \$27.7 trillion figure comes from the IDC, “Worldwide and U.S. Ecommerce,” July 31, 2017 (accessed August 21, 2017). This figure only refers to B2B and B2C e-commerce. Consumer-to-consumer (C2C) firms also operate on business-to-consumer (B2C) platforms such as eBay and Etsy. Consequently, the discussion of B2C trends in this report also covers the C2C industry.

³⁴⁴ De minimis is a customs rule under which shipments worth less than a certain dollar amount do not pay customs duties. For more on this and other regulatory and policy measures, see chapter 8.

³⁴⁵ U.S. industry representative, interview by USITC staff, Washington, DC, March 13, 2017. In China, for example, U.S. payment services firms are reportedly unable to obtain licenses to operate, which the country limits to certain foreign firms. U.S. industry representative, interview by USITC staff, Washington, DC, May 2, 2017.

This chapter describes recent innovations in B2B and B2C e-commerce platforms, and in the transaction and logistics services that enable e-commerce. The first section shows the rapid growth of B2B and B2C e-commerce in the past few years, and explains why B2C has developed more quickly than B2B (though B2B growth is catching up). The second section covers digital payment services, exploring how their use increases electronic and in-person commerce. The third section describes new digital technologies such as blockchain. The next section explains the importance of digital signatures for facilitating electronic transactions. The final section covers logistics and express-delivery services—which are fundamental to successful e-commerce, and which have also been adopting digital technologies.

E-commerce

Introduction

E-commerce refers to the sale of goods or services conducted over computer networks, especially networks connected by the Internet.³⁴⁶ Online networks are widely used for making and receiving orders and payments. For certain services, delivery may be conducted online as well, or, in the case of goods, handled physically through logistics networks.³⁴⁷ The platform-based model of e-commerce trade relies on five key components: (1) consumers who have access to online information and websites; (2) e-commerce platforms that include an effective search function (see chapter 4 for a more detailed discussion of “vertical search”); (3) commercial enterprises that have reliable Internet access to customers and marketplaces; (4) financial/payment services that are available to verify and execute transactions; and (5) express-delivery and logistics services providers that can transfer goods from vendors to customers.³⁴⁸

Volumes traded in each e-commerce segment—B2B, B2C, and C2C—have grown rapidly in recent years, as businesses and individual consumers increasingly use online platforms to sell and purchase goods and services. With consumers in many markets already doing most of their product research via their smartphones, mobile technologies are increasingly being used to complete transactions.³⁴⁹ According to one report, 80 percent of B2C and over 50 percent of

³⁴⁶ This section primarily focuses on e-commerce goods trade. Starting in the 1980s, many companies invested in hardwired electronic data interchange (EDI) networks to exchange information with suppliers and distributors, for example, and many of these remain in use today. However, they are gradually being replaced by networks connected by cloud computing (discussed in chapter 3). See the B2B e-commerce section below for a discussion of EDI.

³⁴⁷ OECD, “Glossary of Statistical Terms,” January 17, 2013.

³⁴⁸ U.S. industry representative, interview by USITC staff, Washington, DC, March 13, 2017.

³⁴⁹ Bachalli, “5 B2B E-Commerce Trends,” January 5, 2016.

B2B buyers use smartphones to facilitate research.³⁵⁰ Final purchases are increasingly being made with smartphones or tablets as well.³⁵¹

E-commerce firms that engage in cross-border trade face many challenges. In some respects, these challenges are more prominent for B2C firms, because vendors in this segment are primarily individual operators or small and medium-sized enterprises (SMEs) that may not have the capacity to manage many of the issues related to international trade, including foreign currency payments, customs processes, and logistics.³⁵²

Nonetheless, platform-based cross-border trade helps SMEs expand their market reach significantly and has been noted for its economic development potential.³⁵³ Web-based commerce through platforms lowers barriers to exporting for SMEs, enabling them to overcome a lack of dedicated information and communications technology (ICT) infrastructure and inadequate knowledge of the market or of international trade rules and processes.³⁵⁴ Some of the world's largest and fastest-growing e-commerce firms, including B2B and B2C platforms Amazon, Alibaba, eBay, and Etsy, are spurring SMEs' cross-border trade growth. They do so by reducing the costs associated with physical distance between sellers and consumers, fostering information sharing and trust, and facilitating payments and logistics. These firms, and a myriad of other online e-commerce platforms, are eliminating the need for firms of all sizes to invest in their own e-commerce hardware and software. As e-commerce lowers barriers to entry, international markets become more competitive and consumers enjoy greater choice and commercial power.³⁵⁵

The substantial recent growth in e-commerce is reflected in global investment data. During 2010–15, investment in e-commerce platforms (B2B and B2C) was concentrated in China (\$10.0 billion), the United States (\$9.8 billion), and India (\$5.6 billion), which together accounted for roughly two-thirds of the more than \$36.2 billion invested globally.³⁵⁶ Among other large markets, Germany (\$2.8 billion) and the United Kingdom (UK) (\$1.2 billion) also received very substantial e-commerce investment.³⁵⁷ Global e-commerce platform investment included late-

³⁵⁰ Smith, "Mobile eCommerce Stats in 2017," May 4, 2017; Bachalli, "5 B2B E-Commerce Trends," January 5, 2016.

³⁵¹ Bachalli, "5 B2B E-Commerce Trends," January 5, 2016.

³⁵² U.S. industry representative, interview by USITC staff, Washington, DC, March 13, 2017.

³⁵³ E-commerce offers growth opportunities, especially to SMEs in developing countries. WTO, *World Trade Report 2016: Leveling the Trading Field for SMEs*, 2016.

³⁵⁴ USITC, hearing transcript, April 4, 2017, 287 (testimony of Julie Stizel, Etsy).

³⁵⁵ Relatively inexpensive storefronts on Amazon, eBay, and Alibaba's Tmall Global allow firms of any size located anywhere to sell goods and services. Barns, "Global E-Commerce Becoming the Great Equalizer," January 20, 2016; WCO, *WCO Study Report on Cross-Border E-Commerce*, March 2017, 5.

³⁵⁶ *CB Insights Blog*, "The US, China, and India Take Lion's Share," July, 21, 2015.

³⁵⁷ *Ibid.*

stage spending on already established platforms, such as Tokopedia in Indonesia, and Flipkart, Quickr, and Snapdeal in India. Meanwhile, the United States—the home of many innovative digital firms—saw the most early-stage funding (seed/angel investment) in e-commerce startups.³⁵⁸ In China and large European Union (EU) markets such as Germany and the UK, e-commerce investment was distributed more evenly across all investment stages.³⁵⁹

B2B E-commerce

Although B2B e-commerce is much larger in value and volumes than B2C, it is generally regarded as less developed. B2B e-commerce was slower to evolve than B2C, but has been accelerating dramatically in recent years. The shift is occurring as firms replace relatively expensive and inefficient legacy systems that use technologies such as electronic data interchange, which is cumbersome and relatively expensive, and catalog-based systems. One important reason for the change is the cloud's more efficient processing capacities and lower costs.³⁶⁰ This trend is also being driven by businesses' growing use of the Internet to research commercial purchases. According to one industry survey in 2014, about three-quarters of U.S. enterprises' purchases were researched online.³⁶¹

Cloud and Other Key Digital Technologies for B2B E-Commerce

Cloud-based platforms allow firms to synchronize order processing across channels (electronic, phone, in-person, etc.), and they can be scaled for just-in-time and automatic replenishment, as well as to integrate logistics operations from multiple warehouses. They are also easy to configure, which helps customize support for a wide variety of innovative e-commerce business models.³⁶² Firms are also increasingly using cloud-based digital technologies to integrate back-end systems such as order management, enterprise resource planning,³⁶³ and customer relationship management. Another important advantage of cloud-based systems is that they more easily allow for “multi-tier distribution networking,” which links distributors, dealers, resellers, and services providers to the same platform ecosystem.

Demand for cloud technologies is rising quickly in e-commerce. Although only one in five firms surveyed in one industry study said that they currently use these technologies for e-commerce and order management, nearly half reported that they would like to move to a cloud-based

³⁵⁸ *CB Insights Blog*, “The US, China, and India Take Lion’s Share,” July, 21, 2015; Wee, “Indonesian Marketplace Tokopedia Raises \$147M,” April 8, 2016.

³⁵⁹ *CB Insights Blog*, “The US, China, and India Take Lion’s Share,” July, 21, 2015.

³⁶⁰ Columbus, “Predicting the Future of B2B E-Commerce,” September 12, 2017.

³⁶¹ Hoar, “Latest Trends in B2B E-Commerce Strategies and Tech Investment,” June 2, 2015, 11.

³⁶² Columbus, “Predicting the Future of B2B E-Commerce,” September 12, 2017.

³⁶³ These systems integrate company operations such as planning, purchasing, inventory, sales, and marketing.

system due to its inherent scalability and lower cost.³⁶⁴ In 2015, U.S. expenditures on B2B digital e-commerce software totaled \$4.7 billion, a 15 percent increase from 2014.³⁶⁵

B2B e-commerce platforms using the cloud can take advantage of several specific digital technologies:

- **Configure-price-quote (CPQ) software.** Used along with price optimization algorithms, CPQ allows firms to structure complex transactions that include variable prices, quantities, and sales timeframes.
- **Software-as-a-service (SaaS).** B2B firms use SaaS for a variety of operations, such as file and document sharing; data analysis; and providing security for websites, orders, and email.³⁶⁶
- **Platform-as-a-service (PaaS).** PaaS will be deployed at twice the rate of SaaS in the next few years. PaaS allows application programming interfaces (APIs) that make it possible to customize applications for particular firms or clients.³⁶⁷ PaaS-based systems may also work better with mobile devices than SaaS and improve data security, with faster rollout and updating.³⁶⁸
- **Artificial intelligence (AI).** AI is being used to create more efficient, client-specific marketing campaigns and to predict future demand and market trends.³⁶⁹ Such AI technologies include online help from a software robot device or agent (bot), a function that has grown rapidly.
- **Big data/predictive analytics.** Firms use these technologies to optimize distribution and supply chain management and to develop more effective marketing strategies.³⁷⁰ Consumer analytics show what consumers are looking for and help companies know what to market.³⁷¹

Direct vs. Marketplace B2B Platforms

B2B firms are working towards creating digital sales platforms that match the “seamlessness” and convenience of the customer experience characteristic of such B2C firms as Amazon and Alibaba’s Taobao and Tmall.³⁷² However, B2B transactions are generally more complex and include more variables than B2C transactions, with widely varying order sizes, customer-specific

³⁶⁴ For more on the scalability of the cloud, see chapter 3. *Four51* (blog), “Distributor Survey Says eCommerce Will Be King,” January 5, 2017.

³⁶⁵ Gartner data reported in Columbus, “Predicting the Future of B2B E-Commerce,” September 12, 2016.

³⁶⁶ McTigue, “Website Review: 10 Best B2B SaaS Websites,” February 24, 2014.

³⁶⁷ Demery, “PaaS Beats SaaS among B2B E-commerce,” May 12, 2016.

³⁶⁸ *Ibid.*

³⁶⁹ Poladian, “3 Ways Artificial Intelligence Is Transforming B2B Marketing,” February 27, 2017.

³⁷⁰ For more on big data analytics, see chapter 6. Loh et al., “Leveraging Big Data to Manage Logistics,” February 16, 2016; Innovation Enterprise, “How Big Data is Transforming B2B Marketing,” March 16, 2016.

³⁷¹ U.S. industry representatives, interview by USITC staff, Washington, DC, March 21, 2017.

³⁷² Columbus, “Predicting the Future of B2B E-Commerce,” September 12, 2016.

pricing models, volume-based discounting, and longer sales cycles, for example.³⁷³ To meet these expectations and deal with the additional complexities of B2B transactions, e-commerce firms are increasingly using new technologies—both consumer-facing and back-end—to modernize their supply chains.

There are two main models for B2B platforms globally: the direct model, in which a company (such as a large manufacturer) sets up its own platform to service customers; and the marketplace model, where sellers list their products on a third-party website that showcases a variety of suppliers and purchasers.³⁷⁴ U.S. examples of the direct model include ExxonMobil, Apple, Ford, Nike, and Archer Daniels Midland, which all sell their products directly to distributors, wholesalers, and retailers through their own platforms. Examples of businesses using the marketplace model include Amazon Business and eBay Business Supply, each of which allows SMEs and other businesses to use a single third-party platform to connect with a wide range of suppliers, manage purchases, and develop supplier relationships.³⁷⁵ Foreign-based marketplace platforms include major global firms like Alibaba (the world's largest SME B2B platform) and IndiaMART (India's largest B2B e-commerce company), among others.

Market Size

Global expenditures on B2B e-commerce reached \$23.9 trillion in 2016, marking 8.9 percent average annual growth since 2012.³⁷⁶ This section focuses on the market in the United States and China as recent data for other leading markets were not available. Data on leading industries for global B2B e-commerce sales are not readily available, but the key industries globally are likely similar to those of the United States, with petroleum, automotive products, pharmaceuticals, and electronic goods leading such sales in 2015.

In the United States, B2B e-commerce sales were estimated at \$855 billion in 2016, representing about 9 percent of all domestic B2B sales (see figure 5.1).³⁷⁷ According to official U.S. government data, manufactured products led U.S. B2B e-commerce by total value, accounting for 63 percent of shipments sold through web-based channels (including platforms, electronic data interchange, and electronic mail). In 2015 (latest available data), the leading industries were transportation equipment, petroleum, and food manufacturing. U.S. industries with the highest rates of e-commerce as a share of shipment value were transportation

³⁷³ Brown and Frederick, *B2B E-Commerce: The Trillion Dollar Industry*, 2015, 12.

³⁷⁴ Bachalli, "5 B2B E-Commerce Trends," January 5, 2016.

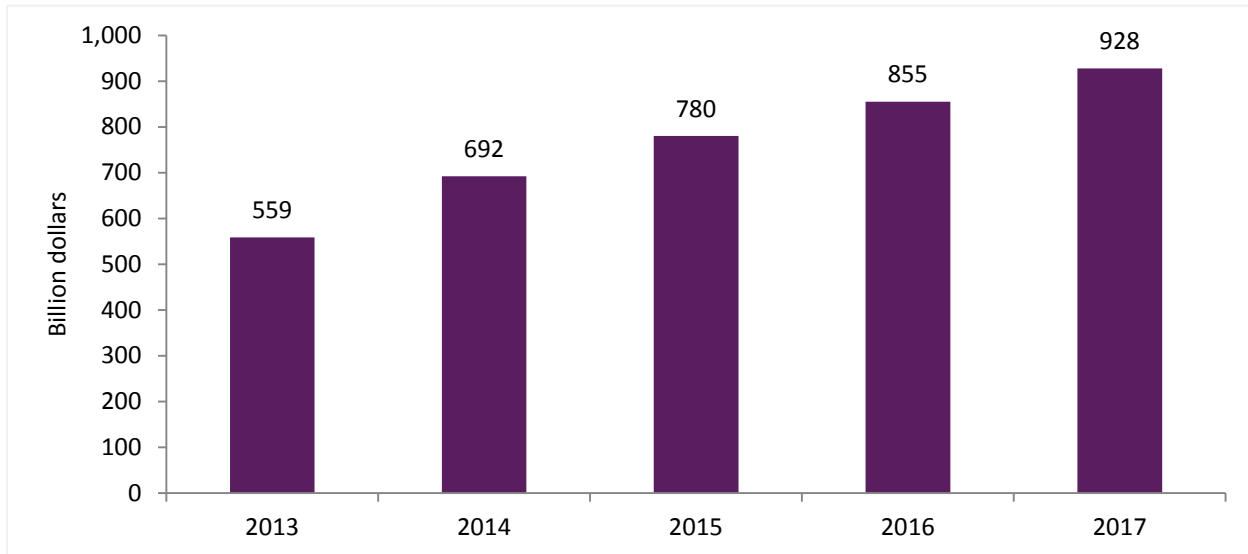
³⁷⁵ Forrester, "Building the B2B Omnichannel Commerce Platform," November 2014.

³⁷⁶ IDC, "Worldwide and U.S. Ecommerce," July 2013, 2017.

³⁷⁷ These country specific values exclude electronic data interchange (EDI) and may not add to the overall global total cited above. Statista (Forrester data estimates).

equipment (83 percent), beverage and tobacco manufacturing (73 percent), and paper manufacturing (69 percent). Wholesale trade accounted for 30 percent of e-commerce shipments that year, led by pharmaceuticals and motor vehicles and parts.³⁷⁸ Although official U.S. trade data do not measure cross-border e-commerce sales, pharmaceuticals and motor vehicles and parts are industries in which the United States is globally competitive, and which may generate increased U.S. exports as a result as B2B e-commerce continues to expand.

Figure 5.1: U.S. B2B e-commerce sales volume, 2013–17



Source: Statista, “Projected B2B E-commerce Volume in the United States from 2014 to 2020,” 2014 (accessed July 11, 2017, fee-based) (Forrester data estimates); Hoar, “U.S. B2B E-commerce Sales,” October 18, 2012.

Note: Corresponds to [appendix table G.12](#).

Leading U.S. B2B e-commerce suppliers include large corporations in major U.S. industries such as petroleum, automotive products, computer technology, and foods (table 5.1). The U.S. B2B e-commerce market is relatively concentrated, with the 20 leading U.S. firms accounting for 38 percent of the total for that market.³⁷⁹ All of these firms have experienced robust year-on-year sales growth since 2014.³⁸⁰

Table 5.1: Leading U.S. B2B E-commerce companies, 2015

Firm	B2B E-commerce sales (billion \$)
Exxon Mobil Corp.	43.5
Chevron Corp.	22.3
Apple Inc.	21.9

³⁷⁸ USDOC, “U.S. Manufacturing Shipments—Total and E-commerce Value: 2015 and 2014,” May 24, 2017.

³⁷⁹ Data from *Internet Retailer*, reported in Bollinger, “The Top B2B E-Commerce Companies in the U.S.,” May 26, 2016.

³⁸⁰ *Ibid.*

Firm	B2B E-commerce sales (billion \$)
General Motors Company	18.1
Phillips 66 Company	17.6
Ford Motor Company	16.7
General Electric Corp.	16.6
Valero Energy Corp.	14.3
Dell Inc.	14.0
US Foods, Inc.	13.8

Source: Data from *Internet Retailer*, reported in Bollinger, “The Top B2B E-Commerce Companies in the U.S.,” May 26, 2016.

China’s B2B e-commerce transactions grew from \$900 billion (RMB 6.2 trillion) in 2012 to a total of about \$2.0 trillion (RMB 13.8 trillion) in 2016.³⁸¹ The Chinese SME B2B sector is relatively concentrated, with Alibaba generating 48 percent of total sales in 2016, and eight other firms accounting for another quarter of the market.³⁸² Other large B2B markets among key foreign markets include India and Russia. In India, B2B e-commerce sales totaled about \$300 billion in 2014, a figure that is expected to grow to \$700 billion by 2020.³⁸³ India’s leading B2B SME platforms are IndiaMART (Tolexo); Industrybuying; Moglix; mSupply; and Amazon Business.³⁸⁴ In Russia, the B2B market has reportedly become an “essential tool” for businesses in recent years, growing from \$609 billion in 2014 to an estimated value of \$700 billion in 2015.³⁸⁵

B2C E-commerce

B2C e-commerce is transforming the global retail sector. Online competition is leading many traditional retailers, including large brick-and-mortar incumbents, to set up their own online platforms to meet rising consumer demand for convenience in ordering, delivery, and comparison shopping. Many retailers offer multichannel or omni-channel services that integrate in-store brick-and-mortar operations with online services. E-commerce platforms have also been quick to innovate, adopting new digital technologies to improve the online shopping experience for consumers by offering simple and successful end-to-end transactions, such as one click to order, pay, and facilitate delivery. As a result of these trends, the growth of e-commerce has been “startling” in recent years.³⁸⁶ Since 2010, U.S. B2C e-commerce sales

³⁸¹ Transaction volume. iResearch, *B2B E-Commerce Market in China: 2016 Report*, 2016.

³⁸² Data refer to SME B2B platforms. iResearch, “Alibaba Still Dominated China’s SME B2B E-commerce,” February 9, 2017; iResearch, *B2B E-commerce Market in China: 2016 Report*, 2016.

³⁸³ USDOC, ITA, Export.gov, “India Country Commercial Guide: India—eCommerce,” January 3, 2017.

³⁸⁴ Ibid.

³⁸⁵ EIU, *Country Commerce: Russia*, June 2016, 74.

³⁸⁶ U.S. industry representative, interview by USITC staff, Washington, DC, March 13, 2017.

have doubled and have captured a growing share of total retail sales (from 4.4 percent in 2010 to 7.2 percent in 2015).³⁸⁷

Cross-border B2C e-commerce is also significant and growing. According to one estimate, approximately 16 percent of total global B2C transactions were cross-border in 2016.³⁸⁸ Among U.S. consumers, nearly half (47 percent) made at least one purchase from an international retailer in the first half of 2017, up from 43 percent in 2016. Many of these purchases were facilitated by U.S. retail platforms such as eBay, Etsy, and Amazon.³⁸⁹ Most large U.S.-based express delivery firms handle e-commerce trade, particularly for SME transactions. According to one express delivery industry observer, over the past four years B2C has grown to account for a larger share of packages than B2B.³⁹⁰ As with the growth of B2B e-commerce, the spread of mobile technology and of enhanced, flexible payment options is driving global demand for B2C e-commerce—both in developed markets and, increasingly, in developing ones.

B2C E-commerce Technology

Software and digital technologies used by B2C firms are similar to those used by B2B firms, and include SaaS, PaaS, AI, and big data analytics geared towards retail consumers. B2C firms employ software and digital technologies designed to target and optimize retail customer relationship management services across various information and delivery channels (online and in-store). These technologies also enable firms to personalize content designed for web, mobile, and tablet technologies. Retail e-commerce software and digital technologies are also critical to back-end and logistics operations. Such digital applications geared towards B2C firms include Oracle ATG Web Commerce, IBM WebSphere, Pepperjam (formerly eBay Enterprise), MICROS, JDA Software (which acquired RedPrairie in 2012), and SAP Hybris.

E-commerce providers are working to facilitate consumers' ability to rapidly purchase products through improved search, along with company-specific software applications (apps) and bots. Effective "vertical search" (as discussed in chapter 4) is important for all e-commerce companies, as they want consumers to be able to rapidly find what they're looking for. Companies also use bots and apps to facilitate purchases by consumers. For example, Facebook's Messenger bots allow Facebook users to interact with store-specific e-commerce

³⁸⁷ USDOC, Census Bureau, "Table 4. U.S. Retail Trade Sales—Total and E-Commerce: 2015 and 2014," May 25, 2017; USDOC, Census Bureau, E-stats, "Table 5, U.S. Retail Trade Sales—Total and E-commerce: 2010 and 2009," n.d (accessed February 16, 2017).

³⁸⁸ McKinsey, MGI, "Digital Globalization: The New Era of Global Flows," February 2016, 34.

³⁸⁹ eMarketer, "For U.S. Retailers, A Competitive Threat from Overseas," June 7, 2017.

³⁹⁰ U.S. industry representatives, telephone interview by USITC staff, Washington, DC, March 13, 2017.

bots, such as 1-800-Flowers.com and Burger King, to order products without leaving the Facebook Messenger app.³⁹¹

Leading B2C E-commerce Platforms

Amazon led all U.S. B2C e-commerce firms in 2015 with \$94.7 billion in e-commerce sales (table 5.2). Most other leading B2C e-commerce companies have sizable brick-and-mortar operations and still predominantly sell through their physical stores. Leading market segments for U.S. B2C e-commerce in 2015 (latest data available) were media and entertainment, clothing, household electronics, information technology, home and garden, and health and beauty.³⁹²

Table 5.2: Leading U.S. business-to-consumer (B2C) e-commerce firms, 2015

Company	B2C E-commerce sales (billion \$)	Percent of total sales
Amazon.com, Inc.	94.7	69.6
Apple Inc.	16.8	7.7
Walmart	14.4	3.0
Macy's, Inc.	4.6	17.9
Costco Wholesale Corp.	4.2	3.5
QVC, Inc.	4.0	46.6
Nordstrom, Inc.	3.2	21.8
Target Corp.	3.1	4.4
Kohl's Corp.	2.9	15.4
Gap, Inc.	2.5	16.3

Source: E-marketer data as reported in Zaczekiewicz, "Amazon, Wal-Mart and Apple Top List," April 7, 2017.

Market Size

For 2016, IDC reports global B2C e-commerce sales of \$3.8 trillion, having grown on average by 13.8 percent annually since 2012.³⁹³ The Ecommerce Foundation estimates that the global B2C market totaled \$2.3 trillion in 2015, having grown by nearly 20 percent since 2014. According to Ecommerce Foundation estimates, regional markets all experienced double-digit growth during 2014–15 (table 5.3). The Asia-Pacific region was the largest and fastest growing, driven by strong growth in China.³⁹⁴ North America and Europe—both relatively mature e-commerce markets—were the second- and third-largest regional markets by value, but posted the lowest growth rates.

³⁹¹ Fidelman, "10 Facebook Messenger Bots," May 19, 2016.

³⁹² Ecommerce Foundation, *Global B2C E-commerce Report 2016*, 2016, 39.

³⁹³ IDC, "Worldwide and U.S. E-commerce," July 31, 2017.

³⁹⁴ Ecommerce Foundation, *Global B2C E-commerce Report 2016*, 2016, 21.

Table 5.3: Business-to-business (B2C) e-commerce sales and shares by region in 2014–15

Region	2014 (billion)	2015 (billion)	Growth percentage
Asia-Pacific	\$822.8	\$1,056.8	28.4
North America	\$572.5	\$644.0	12.5
Europe	\$446.0	\$505.1	13.3
Latin America	\$25.8	\$33.0	28.0
Middle East and North Africa	\$21.7	\$25.8	18.6
World	\$1,895.3	\$2,272.7	19.9

Source: Ecommerce Foundation, *Global B2C E-Commerce Report 2016*, 2016, 11.

China and the United States were by far the largest single-country markets for B2C e-commerce, together accounting for 60 percent of global B2C e-commerce sales in 2015 (table 5.4). Among key markets discussed in this report, the UK, France, Germany, India, and Russia were also in the top 10 B2C e-commerce markets in 2015.

Table 5.4: Top 10 national markets for business-to-consumer (B2C) e-commerce sales in 2015

Country	2015 (billion \$)	2015 market share (percent)
China	766.5	34
United States	595.1	26
United Kingdom	174.2	8
Japan	114.4	5
France	71.9	3
Germany	66.2	3
South Korea	64.8	3
Canada	35.7	2
India	25.5	1
Russia	22.8	1
Rest of world	336.4	15
Total	2,273.5	

Source: Ecommerce Foundation, *Global B2C E-commerce Report 2016*, 2016, 15.

Market Competition and Trends

China

China, with its large and growing e-commerce market, is home to several world-leading B2B and B2C e-commerce firms.³⁹⁵ Alibaba's chief platforms (Alibaba.com, Taobao Marketplace, and Alipay³⁹⁶) are the largest competitors in the Chinese market and are also increasing their presence in third-country markets. In addition, Alibaba has made large investments in Indian platforms Snapdeal and Paytm, seeking to expand its share of India's \$20 billion e-commerce

³⁹⁵ EIU, *Country Commerce: China*, February 2017, 79–81. China's \$3 trillion (RMB 21.8 trillion) e-commerce market is estimated to be split 3-to-1 between two segments: 75 percent B2B and 25 percent B2C.

³⁹⁶ Alipay is China's largest digital payments company.

market.³⁹⁷ Alibaba has also invested in a variety of U.S. e-commerce businesses, such as Fanatics (an online sports retailer), ShopRunner (a provider of online shopping services), Tango (a mobile messaging app), Quixey (an app search engine, defunct February 2017), and Lyft (a transportation network company).³⁹⁸ Moreover, the company is seeking to reduce barriers to e-commerce through trade agreements. The company recently supported the development of an agreement between China and Malaysia that aimed to facilitate goods trade between small businesses in both countries. The agreement seeks to mitigate key impediments to cross-border e-commerce trade, with an emphasis on infrastructure, fulfillment centers, electronic payments, and financing services.³⁹⁹ This initiative is part of Alibaba chairman Jack Ma's effort to promote open global trade for e-commerce firms.⁴⁰⁰

According to industry sources, Alibaba benefits from a supportive policy environment in its large home market that has allowed it to expand rapidly abroad.⁴⁰¹ These sources note that Alibaba and other Chinese e-commerce firms have been more effective than U.S. firms in adapting their platforms to meet the needs of the Chinese consumer.⁴⁰² For example, Alibaba has facilitated payments between Chinese companies and consumers through an innovation in the payment process that links consumers' bank accounts to their mobile phones, tablets, and computers using the Alipay app.⁴⁰³ U.S. firms such as Amazon and eBay are operating in China, but focus on selling Chinese goods to global consumers outside of China.⁴⁰⁴

India

India is an important e-commerce market with a large and growing mobile-device and online population. It is also an important base for global information technology (IT) research, as Amazon and other large U.S. IT companies have significant research and development operations in India.⁴⁰⁵

India's e-commerce sector is one of the world's fastest-growing markets for B2B and B2C e-commerce; its annual growth rate of 51 percent in 2016 was among the world's highest.⁴⁰⁶ The government now allows 100 percent foreign direct investment in B2B e-commerce, enabling

³⁹⁷ Sen, "Jack Ma Has Global Plans for Alibaba," February 6, 2017.

³⁹⁸ Henry, "Alibaba's Nine Most High-Profile Investments in U.S. Start-ups," October 14, 2016.

³⁹⁹ Lucas, "Alibaba Kicks Off Ambitious Plan for Frontier-Free Global Trade," March 22, 2017.

⁴⁰⁰ Alizila, "Jack Ma Interview on Hangzhou, the G20 and Globalization," August 29, 2016.

⁴⁰¹ U.S. industry representative, interview by USITC staff, March 8, 2017.

⁴⁰² U.S. industry representatives, interviews by USITC staff, March 8, 2017.

⁴⁰³ Cho, USITC hearing testimony, April 4, 2017.

⁴⁰⁴ U.S. industry representative, interview by USITC staff, March 8, 2017.

⁴⁰⁵ U.S. industry representatives, interviews by USITC staff, March 8, 2017.

⁴⁰⁶ USDOC, ITA, Export.gov, "India E-Commerce," January 3, 2017; Associated Chambers of Commerce & Industry of India, "India's E-tailing Growing Fastest in the World," May 8, 2016.

global companies such as Walmart and Alibaba to expand their Indian operations.⁴⁰⁷ Both Amazon and eBay are large investors in the Indian e-commerce sector. eBay is a major investor in Flipkart, which is negotiating to acquire India's other large B2C e-commerce platform, Snapdeal.⁴⁰⁸ Since 2014, Amazon has invested \$5 billion in its Indian operations as it seeks to broaden its international revenue base beyond its large operations in the EU (most notably in the UK and Germany) and Japan.⁴⁰⁹

Europe

Europe is one of the world's largest e-commerce markets. The UK and France accounted for nearly half of EU B2C sales, with Germany a close third. All three countries are global leaders in online shopping. U.S. e-commerce firms are major competitors in Europe.⁴¹⁰ In B2C, U.S.-based Amazon and Apple are among the three leading platforms, with Amazon leading all e-commerce providers in the region. Notably, an estimated 25 percent of sellers on Amazon's European platform are China-based firms.⁴¹¹

Russia

In 2015, B2B dominated Russia's e-commerce market with \$700 billion in sales, while B2C generated sales of only \$10 billion. AliExpress, Alibaba's B2C e-commerce platform, is a major online retailer in Russia. The forecasting and advisory group Economist Intelligence Unit credits AliExpress as being partly responsible for China's large share (80 percent) of Russian online cross-border purchases.⁴¹²

Indonesia

The Indonesian e-commerce marketplace, which is primarily B2C, grew from an estimated \$12 billion in 2014 to \$18 billion in 2015. The top two e-commerce sites are Lazada (based in Singapore) and Tokopedia. While the majority of e-commerce in Indonesia is cash-on-delivery,

⁴⁰⁷ USDOC, ITA, Export.gov, "India E-Commerce," January 3, 2017; Associated Chambers of Commerce & Industry of India, "India's E-tailing Growing Fastest in the World," May 8, 2016.

⁴⁰⁸ Stacey, Massoudi, and Inagaki, "SoftBank Pushes for Merger," April 9, 2017; USDOC, ITA, Export.gov, "India E-Commerce," January 3, 2017; Associated Chambers of Commerce & Industry of India, "India's E-tailing Growing Fastest in the World," May 8, 2016.

⁴⁰⁹ Soper and Rai, "Amazon Targets India Growth," June 7, 2016.

⁴¹⁰ E-Commerce Foundation, *Global B2C E-Commerce Report 2016*, 2016, 15.

⁴¹¹ E-Commerce Foundation, *European B2C E-commerce Report 2016*, 2016, 38; E-commerce News Europe, "25 Percent of European Amazon Marketplace Sellers are Based in China," April 14, 2017.

⁴¹² EIU, *Country Commerce: Russia Report*, January 2017, 74–75.

the emergence of electronic payment mechanisms has reportedly boosted e-commerce sales.⁴¹³

Brazil

Latin American e-commerce companies are top competitors in Brazil's e-commerce market. Total e-commerce in Brazil increased from \$8.5 billion in 2013 to \$12.6 billion in 2015, and was forecast to reach \$14 billion in 2016.⁴¹⁴ In 2014, the Centro Regional de Estudos para o Desenvolvimento da Sociedade da Informação (the Regional Center for Studies on the Development of the Information Society, or CETIC) estimated that 62 percent of Brazilian companies with Internet access placed orders online, but few Brazilian companies sold goods or services online.⁴¹⁵ The top five e-commerce companies in Brazil include an Argentinian company (MercadoLibre), three Brazilian companies (B2W Digital, Magazine Luiza, and Nova Pontocom), and a Brazilian subsidiary of a South African company (Buscapé of Cnova).⁴¹⁶

Digital Payments

Introduction

Digital payments refer to financial transactions that are facilitated by digital technologies. Exchange methods include credit card transactions, direct deposit and direct debit payments, wire transfers, electronic bill payments, and transactions in electronic currencies. Digital payments may involve digital wallets that can be preloaded or linked to credit or checking accounts. Smartphones generally contain chips that can emit short-distance radio signals, allowing them to be swiped or bumped against point-of-sale devices. Digital wallets on smartphones are increasingly used by consumers to make routine retail purchases.

Providers of Payments Services and the Digital Payments Ecosystem

Companies that provide digital payments as their primary business include PayPal, Square, Stripe, Amazon Pay, Alipay, Tencent, and Paytm, among others. Veteran financial companies like MasterCard and Citibank, and companies that have not previously provided financial services such as Samsung, Facebook, Walmart, and Vodafone, have also entered the sector.

⁴¹³ EIU, *Country Commerce: Indonesia* January 2017, 67–68.

⁴¹⁴ EIU, *Country Commerce: Brazil*, September 2016, 73.

⁴¹⁵ Ibid.

⁴¹⁶ Ibid.

Further, restaurants and coffee shops like Starbucks and Sweetgreen offer rewards for making digital purchases at their stores.

Different companies offer different advantages in providing digital payment services. For example, while traditional financial companies have more experience with financial regulations, technology firms have more experience with data security and privacy regulations. Companies with large customer bases, such as Apple, Google, and JPMorgan Chase, are able to take advantage of network effects and economies of scale when they integrate digital payment services with their hardware, social media, and other financial services. In contrast, smaller start-ups may struggle to compete.⁴¹⁷ In some cases companies build digital payment capacity through mergers and acquisitions. For example, Capital One recently acquired Adaptive Path (a web design firm) and Monsoon (a mobile development firm),⁴¹⁸ while Spanish bank Banco Bilbao Vizcaya Argentaria acquired Simple (a digital banking app) in 2014.⁴¹⁹

Payment services firms, including both newer digital payment platforms and established banks and credit card networks, tend to make money in four ways: transaction charges on merchants, fees on transfers, interest income, and maintenance fees. Most payment service providers either levy a transaction charge on merchants, or take a fee when money leaves the system through a transfer to another account. Some charge users directly for digital payments, which may increase transparency, but could also discourage adoption by people not used to paying fees. Payment services providers also earn money through interest income and maintenance fees on accounts. By one estimate, in 2014 payment services providers earned \$10 billion in trade finance and cross-border payment fees; \$55 billion in fee, float, and interest income on credit card accounts and domestic transactions; and \$70 billion in interest income and maintenance fees on liquid assets and deposits.⁴²⁰

Digital payment providers sit at the center of valuable data streams. Digital transactions constitute a record of consumer habits, which is valuable to advertisers and to sellers of services like transportation and asset management.⁴²¹ Digital payment services providers can also use data generated by smartphones and other devices. For example, smartphone location data can be used to detect when customers enter or are near a store, allowing retailers to offer targeted coupons or advertisements. The likelihood of repayment may be correlated with digital indicators of general conscientiousness, like keeping a smartphone's operating system

⁴¹⁷ By one estimate, fewer than 10 out of 450 payments startups in 1997–2000 survived. McKinsey, *Global Payments 2015*, October 2015, 15.

⁴¹⁸ Perez, "Capital One Acquires Oakland-Based Design and Development Firm," July 8, 2015.

⁴¹⁹ Aldeon, "BBVA Buys Banking Start-Up Simple for \$117 Million," February 20, 2014.

⁴²⁰ McKinsey, *Global Payments 2015*, October 2015, 7.

⁴²¹ Shah et al., *Digital Payments 2020*, July 2016, 43.

up to date.⁴²² Additionally, financial companies may be able to more accurately measure their customers' tolerance for financial risk by using location and transaction data. Platforms that facilitate payments get unique access to the valuable data they generate. For example, when a Chinese consumer uses Alipay, Alipay generates a record of the merchant's name and location, but the linked bank account only receives a record showing Alipay as the recipient of the payment.⁴²³ These data allow digital payment companies to become more competitive by offering more tailored services.

Payment Services, Global Growth in E-commerce, and Rising Incomes in Emerging Markets

People use digital payment services largely because they are convenient. Consumers can increasingly scan "Quick Response" codes (square barcodes that contain digitized information) at retailers and make digital purchases from a rising number of sellers, including street vendors. Adoption is also motivated by the cost reductions that come from cutting out middlemen ("disintermediation"). By one estimate, the substitution of mobile wallets for credit cards in China cut banks' transaction fee income by \$20 billion in 2015.⁴²⁴ Brazil's use of digital payments in its Bolsa Família ("Family Grant") social assistance program saved an estimated 75 percent on administrative costs.⁴²⁵ Additionally, India's distribution of social security pension payments through electronic smart cards instead of cash reportedly lowered bribe demands and reduced the number of "ghost recipients."⁴²⁶

Even a slight reduction in payment friction can increase spending on goods and services. Many online purchases are tenuous, with low completion rates. One survey found that 25 percent of shoppers abandon purchases when they are forced to create an account, and another a survey conducted in Germany found that 50 percent abandoned purchases when their preferred payment method was not available.⁴²⁷ By reducing such friction, the use of electronic payments may significantly increase commerce. Across 70 countries in a Moody's analytics report on e-payments, a 1 percent increase in a country's use of electronic payments is correlated with a \$104 billion increase in annual purchases of goods and services.⁴²⁸ Digital payment systems can also nudge users into making additional purchases. For example, Alipay has an "ask your boyfriend to pay for shopping" feature that prompts users to transfer money, and Domino's

⁴²² U.S. industry representative, interview by USITC staff, Austin, TX, March 11, 2017.

⁴²³ Wildau, "China Banks Starved of Big Data," August 28, 2016.

⁴²⁴ Ibid.

⁴²⁵ World Bank, "Governments Can Save Up to 75 Percent," August 2, 2012.

⁴²⁶ Muralidharan, Niehaus, and Sukhtankar, "Payments Infrastructure and the Performance of Public Programs," 2014.

⁴²⁷ Lupu, Mual, and van Stiphout, *Ecommerce Payment Methods Report 2016*, July 2016, 54–55.

⁴²⁸ Zandi et al., *The Impact of Electronic Payments on Economic Growth*, February 2016, 1.

Pizza has a Zero Click app with a purchase option that automatically places a preset order 10 seconds after the consumer opens the app.⁴²⁹

In addition to facilitating commerce, digital payment firms provide services that connect savers to borrowers. The most common of these services is consumer credit, which lets people smooth their consumption by aligning periodic incomes with continuous spending. Large credit card companies provide this service. There are also services like Venmo (owned by PayPal) which allow individuals to send money to each other. The availability of digital savings and investment products has expanded people's access to credit and asset management tools globally—a potentially valuable service, as many populations lack access to traditional banks.

Digital payments can also facilitate international commerce. Cross-border transactions are complicated because countries have different languages and legal systems. Sellers face the risk that they will not get paid, buyers face the risk that they will not get what they purchased, and both parties are concerned about their access to legal recourse if they are unsatisfied with the transaction. Historically, cross-border trade has been facilitated by differing financial methods. “Cash-in-advance” arrangements load all of the risk on the buyer, while open accounts and sales on consignment place risk on the seller. Letters of credit (where the buyer's bank promises the exporter that payment will be made once the contract terms have been met) and documentary collections (where the exporter's remitting bank sends documents to the importer's collecting bank) distribute the risk between buyers and sellers.

All these methods suffer, to varying degrees, from risks, frictions, slow processing times, and/or lack of transparency. Their drawbacks have driven the adoption of digital payments for cross-border financial transactions, some facilitated by distributed ledger or “blockchain” techniques. (See the following section for more on blockchain.)⁴³⁰

Market Competition and Trends

There is a virtuous circle in digital payment services. As more people participate in a particular payment system, more merchants accept such payments, and the growing number of participating merchants attracts more participating customers. The growth of online retailers (who generally require electronic payments) motivated consumers to acquire credit or debit cards and use them for more transactions, which prompted increased acceptance of these payment instruments by brick-and-mortar retailers. Digital payment companies try to take advantage of the same virtuous circle by expanding their offerings and coverage to keep

⁴²⁹ Shah et al., *Digital Payments 2020*, July 2016, 10; *Economist*, “The Case for an Efficiency Tax,” March 30, 2017.

⁴³⁰ Chavez-Dreyfuss, “U.S. Start-Up R3, Banks Test Ripple's,” October 20, 2016.

customers and merchants within their ecosystem. For example, Amazon provides both payment and cloud storage services to online retailers, and platforms like Facebook, Google, and Tencent incorporate digital payment technologies to reduce the friction between browsing, social interaction, and commerce.

By one estimate, a third of retail banking customers worldwide use mobile devices for banking and payments at least once a week.⁴³¹ In the United States, noncash payments amounted to about \$178 trillion in 2015, reflecting a 3.4 percent average annual increase since 2012.⁴³² Debit card payments accounted for \$2.6 trillion, credit card payments were \$3.2 trillion, check payments were \$26.8 trillion, and automated clearinghouse transfers were \$145.3 trillion. (Automated clearinghouse, or ACH, transfers include direct deposit payroll payments and scheduled mortgage and insurance payments pulled from checking accounts.)⁴³³

This shift away from cash represents a change in consumer habits and routines. The use of cash is partly driven by cultural factors, as well as by demographics: older consumers tend to pay with cash more often, though such differences are not always significant.⁴³⁴ Credit cards are widely used in developed countries; for example, credit cards account for 49 percent of all payments in the United States and 59 percent in the UK. By contrast, cash is a much larger part of the economy in emerging markets, accounting for 44 percent of all payments in Brazil, 47 percent in China, 69 percent in Russia, and 78 percent in India.⁴³⁵ As figure 5.2 shows, the United States and EU markets appear to conduct a comparatively large number of noncash payments per person.

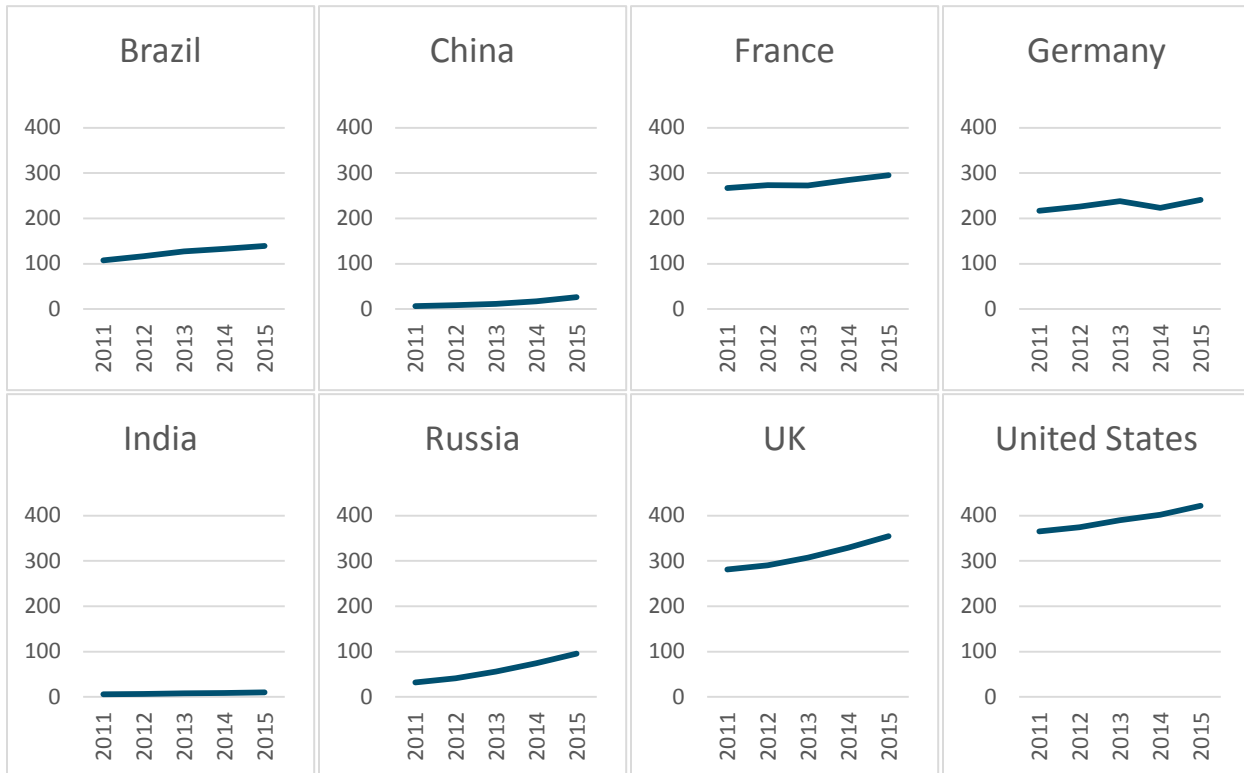
⁴³¹ Capgemini and BNP Paribas, *2016 World Payments Report*, 2016, 14.

⁴³² Federal Reserve System, *The Federal Reserve Payments Study 2016*, December 2016, 2.

⁴³³ Check payments accounted for the remaining \$27 trillion.

⁴³⁴ Deutsche Bundesbank, *Payment Behavior in Germany in 2014*, February 2015, 21.

⁴³⁵ Shah et al., *Digital Payments 2020*, July 2016, 34.

Figure 5.2: Number of noncash payments per person, 2011–15

Source: BIS, “Statistics on Payment, Clearing and Settlement Systems in the CPMI Countries—Figures for 2015,” country tables (table 7 for each country in the figure), December 2016; World Bank, World Development Indicators, “Population” (accessed April 12, 2017). Noncash payments include credit transfers, direct debits, checks, e-money, and credit and debit card payments. Note: Corresponds to [appendix table G.13](#).

Some countries have effectively encouraged the use of digital payments by imposing limits on cash transactions in order to combat money laundering, terrorist financing, and grey and black market activity. In Italy, all purchases over 3,000 euros (about \$3,300) now must be paid electronically. In 2016, India demonetized all 500 rupee (about \$8) and 1,000 rupee (about \$16) banknotes to reduce the use of counterfeit cash. Unlike cash, digital payments leave auditable records, so cash-intensive grey economy activities are negatively affected by the growth of ecommerce. Electronic cryptocurrencies, however, are used in online grey and black market transactions, for example on the (now defunct) Silk Road online market.

Digital payments meet urgent financial needs in countries with few ATMs and high risks attached to carrying or storing cash. In such countries, consumers and entrepreneurs have difficulty accessing credit, and savers struggle to find productive investments. Some emerging markets had little financial infrastructure (such as physical bank branches) before the introduction of digital payments. Many still rely on informal savings and borrowing systems: by one measure, only 24 percent of adults in low-income countries have a formal deposit

account.⁴³⁶ Some developing countries also rely heavily on remittances from citizens working abroad, which can incur high charges; for example, sending \$200 to sub-Saharan Africa cost an average fee of 9.5 percent in 2015.⁴³⁷ Historically, these transfers have not always been trackable, and took five or more business days to process.

Electronic payments represent a qualitative change in financial infrastructure in these countries, and can bring people into the formal economy. Just as mobile phones leapfrogged landline technology in many developing countries, some countries have essentially skipped over credit cards and moved directly from cash to digital payments. However, digital payments still require electric and telecommunications infrastructure, as well as physical cash-out points, which may be less than adequate in some developing-country markets.

China

China accounts for nearly half of global digital payments.⁴³⁸ China's middle-class consumers tend to shop online and were early adopters of e-commerce technology. Although many Chinese consumers do not own computers, 620 million (nearly half the population) have mobile access to the Internet, and 65 percent of China's mobile subscribers use their phones to make purchases.⁴³⁹ One factor driving the use of digital payments is that state-owned banks were slow to innovate, which created opportunities for digital companies to enter the financial sector.⁴⁴⁰ Digital payments have significantly outpaced credit card use in China: they account for two-thirds of noncash transactions (a category that includes credit cards).⁴⁴¹ Shopkeepers and restaurants in China display Quick Response matrix barcodes; customers scan them with mobile phones running WeChat or Alipay apps, and the apps facilitate payments. Due in part to the development and increasing availability of digital payment technologies, Chinese e-commerce grew by almost 600 percent from 2010 to 2014.⁴⁴²

Alipay is China's largest digital payments company. It facilitates transactions between buyers and sellers, and holds customers' money in escrow until they have received their goods. Sixty percent of consumers who borrow small amounts of money on Alipay's platform had never used a credit card before.⁴⁴³ The company has been making investments abroad, including in

⁴³⁶ Klapper and Singer, "The Opportunities of Digitizing Payments," August 28, 2014, 2.

⁴³⁷ World Bank, "Remittances to Developing Countries Edge Up Slightly," April 13, 2016.

⁴³⁸ *Economist*, "In Fintech, China Shows the Way," February 25, 2017.

⁴³⁹ Huang, "More than Half of China's Population Is Online," January 26, 2016; *Economist*, "In Fintech, China Shows the Way," February 25, 2017.

⁴⁴⁰ Rabinovitch, "Chinese Banks Venture into Ecommerce," February 3, 2013.

⁴⁴¹ *Economist*, "In Fintech, China Shows the Way," February 25, 2017.

⁴⁴² *Economist*, "The Great Race," March 5, 2016.

⁴⁴³ *Economist*, "In Fintech, China Shows the Way," February 25, 2017.

the Philippines' Mynt (a financial venture by Globe Telecom, the Philippines' largest telecommunications company), Thailand's Ascend Money, India's Paytm, and the United States' MoneyGram.⁴⁴⁴ Another Chinese company, WeChat, is a mobile messaging service that lets users conduct and manage several activities, including payments, messaging, transportation, movie tickets, food delivery, medical appointments, and games, entirely within a single ecosystem. Half of WeChat users have linked their bank accounts to the app, reflecting trust in the platform. WeChat also offers Tencent's wealth management vehicle, Licitong, letting it act as an all-in-one financial services platform.⁴⁴⁵

India

India also has significant numbers of digital payment users, though they make up a relatively small portion of India's population of more than 1.3 billion people. In India, 80 million consumers use digital wallets, and 60 million use online banking.⁴⁴⁶ Many use digital payments to recharge their prepaid mobile phones and pay bills. India's Paytm (which is backed by China's Ant Financial, an Alibaba affiliate) has 120 million accounts; by comparison, there are just over 20 million credit cards in India.⁴⁴⁷

Indonesia

Since 2012, there has been an increase in the availability of mobile and electronic payment services in Indonesia, but most e-commerce transactions continue to be cash-on-delivery. Two Indonesian companies (iPaymu and DOKU) partnered with PayPal in 2012 to provide secure electronic-payment services to customers inside and outside of Indonesia. In 2015, Indonesia's largest mobile operator by number of subscribers (Telkomsel) collaborated with Verifone (U.S.) and PT. Finnet Indonesia to create a mobile payment service. Indonesia's central bank (Bank Indonesia) has also introduced an electronic money program to allow merchants to accept mobile payments, but it has reportedly not been very successful.⁴⁴⁸

⁴⁴⁴ Russell, "Alibaba's Ant Financial Extends Global Reach," February 20, 2017.

⁴⁴⁵ *Economist*, "WeChat's World," August 6, 2016.

⁴⁴⁶ Shah et al., *Digital Payments 2020*, July 2016, 17.

⁴⁴⁷ *Economist*, "The Great Race," March 5, 2016.

⁴⁴⁸ EIU, *Indonesia Country Commerce Report*, January 2017, 67–68.

Electronic Records

Blockchains

Another digital innovation that facilitates payments and other transactions is the blockchain. Blockchains are digital ledgers that are maintained by decentralized networks. They keep time-stamped records in a secure way, allowing users to quickly make and verify transactions without a single coordinating actor. Each block in a blockchain combines a hash, or digital fingerprint, of all previous transactions, together with a hash of the current period's transactions, which means that no record can be modified after the fact without altering all subsequent records. Because the ledger is maintained by a peer-to-peer network, (i.e., a set of connected computers that share computational tasks), there is no single point of vulnerability. In contrast, when entities like banks maintain records of holdings and transactions in a single database, they may be more exposed to hacking, manipulation, or fraud. Blockchains were pioneered by the developers of bitcoin, a digital currency that relies on encryption, first released in January 2009. Bitcoin's blockchain records bitcoin transactions in a block about once every 10 minutes, and these transactions are linked to all previous blocks in the chain.

Blockchains may enable the automation of back-office operations, increase settlement speed, and reduce supervisory and infrastructure costs. One U.S. financial services firm recently started using a blockchain to maintain data on credit derivatives deals,⁴⁴⁹ and a French bank uses blockchains to settle oil market deals.⁴⁵⁰ By one estimate, distributed ledgers could reduce bank infrastructure costs by \$15 to \$20 billion annually by 2022.⁴⁵¹ Investors committed \$290 million to bitcoin and blockchain technologies in the first six months of 2016.⁴⁵²

Blockchains can be used to establish trust and create efficiencies in non-financial markets. For example, in real estate, blockchains can be used to document ownership and title transfers. In Ghana, a blockchain application called Bitland maintains a record of land registrations, which may help to address the widespread problem of incomplete records and to limit corruption.⁴⁵³ Since banks are often reluctant to lend against unregistered land, these blockchain applications could facilitate economic activity in the country. Additionally, blockchains can streamline supply chains. Maersk, a Danish business conglomerate, and IBM use blockchains to record virtual

⁴⁴⁹ Murphy, "Database Move Gives Blockchain Its First Big Test," January 9, 2017.

⁴⁵⁰ Meyer and Hume, "Trafigura Tests Blockchain," March 27, 2017.

⁴⁵¹ Santander InnoVentures et al., *The Fintech 2.0 Paper*, 2015, 15.

⁴⁵² Juniper Research, "VC Blockchain Investments Approach \$300 Million," August 16, 2016.

⁴⁵³ Aitken, "Bitland's African Blockchain Initiative Putting Land on the Ledger," April 5, 2016.

signatures by customs authorities on international shipments,⁴⁵⁴ while Wells Fargo and the Commonwealth Bank of Australia use blockchains to track shipments of cotton from the United States to China.⁴⁵⁵ Australia's state-owned postal service has suggested using blockchains for voting in parliamentary elections.⁴⁵⁶

Blockchains can also automatically execute “smart contracts” once certain conditions have been met. For example, payouts to swap contracts (in which counterparties exchange financial instruments) can be automated. In the insurance sector, crop insurance payments can be triggered if sensors indicate that rainfall falls below a stipulated threshold. One source estimates that blockchain-based “smart contracts” could reduce insurers’ operating and claims costs by 13 percent.⁴⁵⁷

Further, blockchains have been used to record doctor-patient encounters (including vaccination records) in developing countries.⁴⁵⁸ This can be beneficial because some rural areas are subject to high turnover rates for their doctors, while clinics are difficult to secure. When blockchained health records are stored in an encrypted public database, new doctors and patients can more easily access medical records by using a private key, often in the form of a unique biometric identifier, a printed barcode, or a series of words. This technology makes data security and access possible in places where legal and regulatory protections may be inadequate or unenforced.

Digital Signatures

The digital signature is another digital technology that is likely to play an important role in facilitating e-commerce and lowering the cost of transactions. Digital signatures are used to verify and authenticate individuals’ identities in order to legitimize contracts. People provide unencrypted electronic signatures in many contexts—for example, when accepting terms and conditions on a website. By contrast, digital signatures typically use encrypted certificates in an effort to ensure that digital transfers actually come from the purported sender, were not altered in transit, and cannot be repudiated by that sender afterwards. Three U.S. companies that provide digital signature services include Adobe, RPost, and PandaDoc. The widespread adoption of digital signatures can reduce paper usage and the turnaround time on contracts, although excessively complicated procedures for producing signatures can increase the cost and friction of transactions.

⁴⁵⁴ Popper and Lohr, “Blockchain,” March 4, 2017.

⁴⁵⁵ Lucas, “Supermarkets, Pig Farmers and Cotton Traders Turn to Blockchain,” December 5, 2016.

⁴⁵⁶ Duckett, “Australia Post Details Plan to Use Blockchain for Voting,” August 22, 2016.

⁴⁵⁷ Ralph, “Insurers Team Up to Study Benefits of Blockchain,” October 18, 2016.

⁴⁵⁸ U.S. industry representative, interview by USITC staff, Austin, TX, March 12, 2017.

Digital signatures work because they are embedded in laws that give them standing and make signed contracts enforceable. In 2000, the United States enacted the Electronic Signatures in Global and National Commerce Act, which asserted that digital signatures are legally valid and enforceable. The National Conference of Commissioners on Uniform State Laws developed the Uniform Electronic Transactions Act for U.S. states, which allows notaries to sign electronic documents. In the EU, the Electronic Signatures Directive establishes conditions under which electronic signatures are legally equivalent to paper-based signatures. The EU's Electronic Identification and Trust Services Regulation took effect in 2016 and established a single market for the recognition of electronic signatures and verification. Additionally, the United Nations Commission on International Trade Law adopted a "Model Law on Electronic Signatures" in 2001 that established rules allowing equivalence between electronic and handwritten signatures.⁴⁵⁹ A number of countries, including Brazil, follow this model law. Indonesia's 2008 "Law on Information and Electronic Transactions" legalized electronic signatures for commercial use in that country.⁴⁶⁰

Technology can also help verify identities and provide substitutes for written signatures in other ways. Biometric authentication is becoming more common as many smartphones are able to read fingerprints (and, increasingly, irises). Banks and credit card companies can now look at consumption locations and patterns, and flag purchases that seem out of the ordinary as potentially fraudulent. Further, companies are investigating nontraditional identity verification methods, such as looking at social media profiles.⁴⁶¹

Express Delivery and Logistics Services in E-commerce

Logistics and delivery services, particularly package and express delivery, are essential to the e-commerce process. Consumer demand for speed and convenience is driving the expansion of delivery options and individual services.⁴⁶² Large firms such as Amazon are investing heavily in fulfillment networks, while smaller firms are increasingly turning to third-party logistics (3PL) firms to assist with deliveries.⁴⁶³ There have been sizable investments in "mega e-fulfillment" centers that stock tens of thousands of individual products, in parcel hubs and sorting centers,

⁴⁵⁹ UNCITRAL, "UNCITRAL Model Law on Electronic Signatures," 2001.

⁴⁶⁰ EIU, *Indonesia Country Commerce Report 2017*, January 2017, 68.

⁴⁶¹ U.S. industry representative, interview by USITC staff, March 11, 2017.

⁴⁶² Ecommerce News, "DHL: These 6 Technologies Will Change Logistics," 2016, 4.

⁴⁶³ *Barcoding Connected Blog*, "Logistics Technology's Increasing Role in E-Commerce," August 1, 2016; Robinson, "The Evolution of E-Commerce and Logistics," April 30, 2014.

and in parcel delivery facilities that handle the “last mile” of delivery.⁴⁶⁴ These dynamic and complex logistics functions rely on critical digital technologies that link online shopping carts with supply chains and transportation management systems.⁴⁶⁵

U.S. and Global Delivery Markets

The United States is the global leader in package and parcel delivery services. U.S. e-commerce deliveries were roughly \$30–\$35 billion in 2015, representing about 10 percent of total online sales.⁴⁶⁶ Two of the three largest global express delivery companies in 2016 were U.S. firms: UPS (19.7 percent global market share) and FedEx (15.0 percent). Germany’s Deutsche Post AG, which includes the Deutsche Post DHL Group, ranked third (10.8 percent).⁴⁶⁷ Among U.S. e-commerce deliveries, roughly 60 percent of the volume was in transporting shipments from large e-commerce retailers such as Amazon and Walmart, while 40 percent were SME e-commerce deliveries, including from firms that operate through marketplace platforms such as eBay and Etsy.⁴⁶⁸

The global market for parcel delivery services is concentrated in the world’s leading economies: the United States, China, and Germany accounted for nearly half of total parcel revenues in 2015.⁴⁶⁹ In recent years, volumes in these markets have shifted from B2B to B2C.⁴⁷⁰ In mature markets such as the United States and certain EU markets, parcel delivery growth ranged between 7 and 10 percent in 2015, while many developing markets experienced particularly rapid growth. For example, India’s parcel delivery revenues expanded by 300 percent in 2015.⁴⁷¹ Cross-border parcel deliveries from developed countries have also grown rapidly since 2000, which likely parallels the strong growth in cross-border e-commerce trade.⁴⁷²

⁴⁶⁴ IBISWorld, *Global Courier and Delivery Services*, October, 2016, 13.

⁴⁶⁵ For example, Amazon operates multiple distribution centers in strategic locations to reach customers and has invested \$13 billion in 50 forward fulfillment centers in the last five years. Robinson, “The Evolution of E-Commerce and Logistics,” April 30, 2014.

⁴⁶⁶ Primarily B2C deliveries. AT Kearney, “U.S. E-commerce Trends and the Impact on Logistics,” April 2017.

⁴⁶⁷ The next-largest provider, Yamato Holdings (Japan), has a 4 percent global market share. IBISWorld, *Global Courier and Delivery Services*, October 2016, 13. The U.S. Postal Service (USPS) is reportedly the leading e-commerce delivery provider in the United States by volume of deliveries; the providers are USPS (57 percent); UPS (29 percent); FedEx (12 percent); and other (3 percent). O’Brien, “The USPS Ups Its E-Commerce Parcel Game,” August 24, 2016.

⁴⁶⁸ O’Brien, “The USPS Ups Its E-Commerce Parcel Game,” August 24, 2016.

⁴⁶⁹ IBISWorld, *Global Courier and Delivery Services*, October 2016.

⁴⁷⁰ U.S. industry representative, interview by USITC staff, March 15, 2017.

⁴⁷¹ McKinsey, *Parcel Delivery: The Future of Last Mile*, September 2016, 6.

⁴⁷² Currently, there are no official data for cross-border trade in e-commerce. UNCTAD, *In Search of Cross-Border E-commerce Trade Data*, April 2016, 14.

Consumer Expectations

Online consumer purchasing decisions, in many cases, hinge on the delivery component of the transaction. In one recent study, nearly half of consumers surveyed stated that they would abandon their virtual shopping basket if the delivery details and options did not meet delivery time and cost expectations.⁴⁷³ Consumers are demanding a variety of delivery options and price points, including expedited, free, and low-cost deliveries. Providers are responding; for example, Amazon Prime recently added free two-hour and same-day delivery on certain orders; Apple offers free next-day delivery and free two-day shipping; and Walmart is offering free two-day shipping on staples such as diapers, coffee, and laundry detergent.⁴⁷⁴ The increase in expedited delivery is reflected in reduced e-commerce delivery times, which declined from an average of eight days in 2014 to less than five days in 2017.⁴⁷⁵

A variety of delivery providers have emerged to meet the increasing demand for e-commerce, including crowdsourced⁴⁷⁶ providers and individual operators. Examples include firms such as LaserShip, OnTrac, and Uber that meet business and consumer demand for flexibility and price.⁴⁷⁷ Amazon is hiring individual operators to deliver packages in a number of large U.S. urban centers.⁴⁷⁸ Same-day delivery specialists, such as Instacart and TaskRabbit, are also growing rapidly and use crowdsourcing for deliveries. Some firms serve niche markets such as restaurants and grocery stores, while others deliver a range of products ordered online from nearby physical stores.⁴⁷⁹ Longer-haul delivery is also being transformed by new entrants like Convoy, CargoX, and Uber, which are reducing the need for a middleman to coordinate transactions between drivers and those needing longer-haul delivery by providing real-time delivery pricing.⁴⁸⁰

Digital Technology

Logistics and delivery firms are increasingly dependent on digital technologies to manage orders and the supply chain. The growth of e-commerce has resulted in automation at every

⁴⁷³ Metapack, *Metapack 2016 State of E-Commerce Delivery*, 2016.

⁴⁷⁴ Amazon, "PrimeNow"; Walmart, "Introducing Free 2-Day Shipping" (both accessed May 18, 2017).

⁴⁷⁵ AT Kearney, "U.S. E-commerce Trends and the Impact on Logistics," April 2017. Same-day delivery for B2C e-commerce is benefiting large brick-and-mortar retailers, such as Walmart, which have extensive capacity in physical stores and distribution networks.

⁴⁷⁶ To crowdsource is to obtain a good (information or input into a particular task or project) by enlisting the services of a large number of people, either paid or unpaid, typically via the Internet.

⁴⁷⁷ AT Kearney, "U.S. E-commerce Trends and the Impact on Logistics," April 2017.

⁴⁷⁸ Amazon Logistics, "Logistics: Deliver with Amazon" (accessed May 23, 2017).

⁴⁷⁹ H. Lee et al., *Technological Disruption and Innovation in Last-Mile Delivery*, June 2016, 6.

⁴⁸⁰ Carson, "Uber Is Now Officially in the Trucking Business," October 2016.

stage of the value chain.⁴⁸¹ For example, logistics firms are rapidly replacing older electronic data interchange systems with web-based applications that integrate warehouse, transportation, and labor management systems.⁴⁸² Algorithms and data analytics are being used by delivery services for integrated inventory management, product search and match, delivery price calculations, courier selection, dynamic routing, and communicating with customers.⁴⁸³ Moreover, supply chain logistics are moving toward cloud-based applications, and warehousing technology is transitioning to full automation.⁴⁸⁴

Digital innovations help cut the cost of the last mile in delivering a product (i.e., delivery of a product to its final destination), which can account for as much as 50 percent of delivery costs.⁴⁸⁵ The traditional hub-and-spoke model used by incumbents UPS and FedEx is expensive for final customer delivery. Consequently, new technologies—including delivery bots, driverless vehicles, and drones—are being envisaged and, in some cases, tested in certain European and U.S. cities.⁴⁸⁶ Delivery and logistics firms are also turning to national postal services, such as the U.S. Postal Service, which already have well-established last-mile networks.

Market Competition and Trends

E-commerce firms work closely with express delivery firms in key markets to overcome logistical hurdles. China has a very large express delivery market, which has grown by 30 percent annually in recent years. However, the system is under strain as package volumes grow.⁴⁸⁷ India's logistics industry is also growing rapidly, expanding by 12 percent annually in recent years. India and China are considered key growth markets for logistics investment.⁴⁸⁸ India's leading e-commerce companies, including Flipkart, Snapdeal, Amazon, and Paytm, are partnering with logistics firms to establish warehouses, e-fulfillment centers, and local pickup stations to speed delivery.⁴⁸⁹ In Russia, about 90 percent of e-commerce is concentrated in large urban areas, with 70 percent of the total taking place in Moscow and St. Petersburg.⁴⁹⁰

⁴⁸¹ Setlur, Rajendran, and Ravi, *Connected Shipping: Riding the Wave of E-Commerce*, 2016.

⁴⁸² Gilmore, "The New Era of Digital Logistics" (accessed May 18, 2017).

⁴⁸³ H. Lee et al., *Technological Disruption and Innovation in Last-Mile Delivery*, June 2016.

⁴⁸⁴ Banker, Cunnane, and Reiser, "Logistics and Supply Chain Trends to Monitor," January 11, 2016.

⁴⁸⁵ McKinsey, *Parcel Delivery: The Future of Last Mile*, September 2016, 6.

⁴⁸⁶ AT Kearney, "U.S. E-commerce Trends and the Impact on Logistics," April 2017; H. Lee et al., *Technological Disruption and Innovation in Last-Mile Delivery*, June 2016.

⁴⁸⁷ Lucas, "China's E-commerce Gold Rush," January 30, 2017; Lau and Su, "China's E-Commerce Soft Spot: Logistics," April 2016.

⁴⁸⁸ Nair, "Logistics to Be the Game Changer," January 6, 2016; Transport Intelligence, *Agility Emerging Markets Logistics Index 2017*, 2017, 23.

⁴⁸⁹ Nair, "Behind-the-Scenes of How E-commerce Delivers," September 1, 2016.

⁴⁹⁰ Ben-Shabat, Moriarty, and Nilforoushan, *E-Commerce Is the Next Frontier in Global Expansion*, 2012, 7.

Russian e-commerce firms such as KupiVIP, Lamoda, and Ozon are investing in their own logistics networks rather than using established firms such as DHL.⁴⁹¹

Geography can be a limiting factor for e-commerce in some countries. In Indonesia, e-commerce faces significant logistical challenges, primarily due to the population's geographic distribution over 17,500 islands.⁴⁹² Some Indonesian companies have been turning to alternative methods for e-commerce distribution, such as startup Go-Jek, which uses a network of motorcycles to distribute parcels.⁴⁹³ In Brazil, e-commerce transactions and deliveries are concentrated in São Paulo and other highly populated areas along the southeast coastal region. Firms such as Walmart, which are expanding operations in the country, are investing heavily in fulfillment and logistics as their operations grow.⁴⁹⁴

⁴⁹¹ Rogan, "Russian Cross-Border E-commerce Growing Exponentially," n.d. (accessed June 19, 2017).

⁴⁹² About 6,000 of which are inhabited. Dearth and Boynton, "Is Indonesia the Next China For E-Commerce?" January 5, 2017.

⁴⁹³ T. Lee, "DHL Is Set to Shake Up E-Commerce Logistics," October 5, 2016.

⁴⁹⁴ USDOC, ITA, Export.gov, "Brazil E-commerce," July 5, 2017; Brohan, "Wal-Mart Doubles Down on E-commerce in Brazil," July 2, 2014.

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Chapter 6

Industry Adoption of Digital Technologies

Introduction

The ability to move data over digital networks has fundamentally changed how industry works. Firms in industries across the economy have adopted digital technologies to improve their efficiency and productivity, to offer new or enhanced products and services, and to communicate better with their customers.⁴⁹⁵ Businesses have increasingly focused on three broad types of digital technologies: connected devices and data management technologies related to the Internet of Things (IoT); digital technologies for robotics and other kinds of automation; and cloud computing services for data processing and advanced analytics (table 6.1).

Table 6.1: Examples of firms' use of digital technologies across various industry sectors and business functions

Business processes	Internet of Things	Robotics and automation	Cloud computing and data analysis
R&D and product development	Measure people for customized clothing	3-D printing of prototypes	Modeling of chemical properties
Production	Sensors on the assembly line	Unmanned aerial vehicles (UAVs) in agriculture surveys	Analyze production data to improve efficiency
Management and internal coordination	Supply chain monitoring systems	Warehouse robots	Enterprise resource management
Marketing, sales, and customer relationship management	Power utility interactive pricing	Airline kiosks	Automated customer service
Distribution and post-sales services	Fleet management services	Package delivery UAVs	Remote monitoring, maintenance, and updates of products

Source: USITC.

⁴⁹⁵ Daugherty et al., *Driving Unconventional Growth through the Industrial Internet of Things*, 2015; 4. Manyika et al., *Digital America*, 3.

The next section briefly describes trends in use of digital technology by industry, as well as the benefits of adopting digital technologies. The remainder of the chapter is divided into three sections that focus primarily on trends in the use of digital technologies by different industries. The first section describes industry adoption of the Internet of Things, explaining how various sensors enable the IoT and how different industries use sensors and the IoT. IoT innovations used in fleet management and in usage-based insurance are also described. The second section outlines recent advances in industry's use of robotics and other instances of automation, particularly in manufacturing and agriculture, and highlights the potential for unmanned aerial vehicles (UAVs) and 3-D printing. The third section outlines the broad usefulness to industry of cloud computing and data analysis, describing how AI, ML, and other advanced data analytics are being applied in a wide range of sectors.

The digital technologies discussed in this chapter rely on data flows for a large share of their functions. For many of the multinational corporations using these technologies, the digital technologies and analytical tools are most useful when used with data from all of their global affiliates. Thus, any restriction on cross-border data flows could undermine these companies' ability to compete. Additionally, restrictions on the use of specific technologies (such as unmanned aerial vehicles), could also impede competition. For more on policies and regulatory measures, see chapter 8.

Trends in Adoption of Digital Technology

According to the MGI Industry Digitization Index, services sectors such as information and communications technology (ICT), media, professional services, and finance and insurance operate using high levels of digitization. Most business and financial services depend upon digital activities, as their operations are based on the transmission of data across the Internet. Information flows could be of many types, including transaction information, external communications with customers and suppliers, internal communications across the firm's operations, or the provision of software, video content, and other intellectual property to users inside and outside the firm. Previous chapters describe recent trends in digital services industries including digital communications, cloud computing, digital content and information search, e-commerce, and e-payments. However, so-called "traditional" services sectors like logistics, express delivery, banking, and insurance see themselves increasingly as technology providers. They are actively incorporating recent innovations in connected devices, automation, cloud computing, and data analytics into their operations, just as they had adopted earlier

digital technologies, such as email communications and online sales channels, in previous years.⁴⁹⁶

By contrast, advanced manufacturing, chemicals and pharmaceuticals, and basic goods manufacturing are relatively less digitized than the higher-tech services sectors listed above, ranking lower on various metrics such as digital spending, digital asset stock, and digital market making.⁴⁹⁷ However, they too have also begun to invest in digital technologies.⁴⁹⁸

Gains from a digitally connected factory include improved quality control (due to more sensors producing more data), lower energy costs, more efficient use of resources, and optimization and personalization of products.⁴⁹⁹ One estimate shows that connected machinery achieved a 47 percent decrease in downtime and a 48 percent decrease in defective products, attaining greater efficiency and a better use of resources.⁵⁰⁰ Simply by reducing unplanned downtime, industries reliant on manufacturing could save \$50 billion a year.⁵⁰¹ Not only will a fully integrated factory increase productivity and make production more efficient, but it will also integrate communications and connections along all phases in a product's lifecycle, from design, procurement, and prototyping to production, quality control, shipping, maintenance, and repair. This integration allows quicker resolutions to bottlenecks and other issues.⁵⁰²

According to the McKinsey Global Institute (MGI), the least digitized sector is agriculture and hunting.⁵⁰³ However, precision agriculture techniques and unmanned aerial systems are increasingly used in that sector as well to measure growing conditions and improve yields.⁵⁰⁴ A lack of farmer confidence in farm data security and management may be slowing the adoption of some precision agriculture applications. The industry is working hard to address these issues

⁴⁹⁶ Manyika et al., *Digital America*, December 2015, 31.

⁴⁹⁷ Ibid.

⁴⁹⁸ Ibid.

⁴⁹⁹ Cheung et al., *Planning for Innovation: Understanding China's Plans*, July 28, 2016, 46; PwC, *Industry 4.0: Building the Digital Enterprise*, 2016, 14.

⁵⁰⁰ IBM, "Watson Internet of Things" (accessed July 10, 2017).

⁵⁰¹ Deloitte, *Predictive Maintenance and the Smart Factory*, 2017, 2.

⁵⁰² Dreher, "The Smart Factory of the Future 1," January 28, 2015; Manyika et al., "Digital America," December 2015, 61.

⁵⁰³ Manyika et al., *Digital America*, December 2015, 31.

⁵⁰⁴ Holland, Erickson, and Widmar, *2013 Precision Agricultural Services Dealership Survey Results*, November 2013, 23; Erickson and Widmar, *2015 Precision Agricultural Services Dealership Survey Results*, August 2015, 11.

by developing better data management and technical standards for sensors and other equipment.⁵⁰⁵

Industry's Use of the Internet of Things

The IoT is the ever-growing network of connected objects—such as robotic devices, sensors, 3-D printers, cars, appliances (like thermostats, lights, and refrigerators), and more—that are able to collect and exchange data via sensors.⁵⁰⁶ While the wired or wireless transmission of digital information is not new, the number of devices connected to Internet Protocol (IP) networks has almost doubled, from 8.7 billion in 2012 to 16.3 billion in 2015.⁵⁰⁷ Of those 16.3 billion devices, the networking firm Cisco estimates that 3.9 billion are business devices; of the latter, 2.3 billion, or roughly 60 percent, are machine-to-machine devices.⁵⁰⁸ According to the technology research firm Gartner, 43 percent of organizations were expected to use IoT-related digital technologies by 2016.⁵⁰⁹

As these connections grow, technological solutions will be needed to handle the increased data load between the connected devices. Much of the data storage, processing, and analysis related to IoT systems occurs in the cloud. As firms replace older legacy machines with newer models that can gather and report data in addition to performing their primary function, they take advantage of wider network connectivity (as discussed in chapter 2). This allows them to conduct more extensive data collection and analytics, which can then spur productivity gains.⁵¹⁰

IoT applications are enabling firms in many different fields to bundle goods and services so they can offer a higher-quality, more differentiated product. While this approach certainly existed before the digital era—an early version of bundling were maintenance contracts, with manufacturers being paid by consumers to maintain their product during its useful life—firms are seeing many new opportunities with new technologies. With more devices connected to

⁵⁰⁵ For example, the Agricultural Industry Electronics Foundation developed the ISOBUS standard (ISOBUS is a universal protocol for electronic communication between agricultural equipment) which allows interoperability between equipment from different manufacturers, and AgGateway has developed a standard for sharing data with other actors in the agriculture supply chain, from input suppliers to farm management systems. Agricultural Industry Electronics Foundation, <http://www.aef-online.org/en/about-isobus/what-is-isobus.html>; American Farm Bureau Federation, “Farm Bureau Survey: Farmers Want to Control Their Own Data,” May 10, 2016; American Farm Bureau Federation, “Privacy and Security Principles for Farm Data,” April 1, 2016; U.S. industry representative, telephone interview with USITC staff, March 27, 2017.

⁵⁰⁶ Meola, “Internet of Things Devices, Applications and Examples,” December 19, 2016. For more information on IoT see U.S. House of Representatives, “Disrupter Series: Update on IOT Opportunities,” June 13, 2017.

⁵⁰⁷ Cisco, Visual Networking Index, “VNI SA Highlights: Devices” (accessed May 8, 2017).

⁵⁰⁸ Ibid.

⁵⁰⁹ The survey covered organizations on each major continent. Gartner, “Gartner Survey Shows,” 2016.

⁵¹⁰ *Industry Week*, “The Internet of Things: Finding the Path to Value” (accessed May 12, 2017).

the Internet, and the growing importance of software, companies are able, for example, to extend and improve those early maintenance contracts to include real-time monitoring of a product, and sometimes its remote update and repair.⁵¹¹ Firms are also able to offer consumers additional services, including data collection and analysis.

Sensors

Internet-connected sensors and similar devices are the primary means through which firms are able to gather and analyze big data⁵¹² and apply it to their business models and daily operations. Sensors make firms' operations more visible from start to finish. They also provide data for predictive modeling that can be used to increase performance, reduce risk, and deliver products faster and at lower costs for end consumers.⁵¹³ For example, adding Internet-enabled sensors to lighting and to heating, ventilation, and air conditioning (HVAC) systems allows firms to monitor and change a production plant's temperature from a remote location in order to lower utility costs for business processes. This improvement does not need to incorporate other technologies such as cloud services, big data, and data analytics to reduce costs.

Sensors can be split into two categories: those that measure processes and those that measure products.⁵¹⁴ Process measurements include measures of pH, temperature, flow, vibration, pressure, displacement, acoustics, electronics, ultrasound, and electrochemicals.⁵¹⁵ Product measurements include measurement of dimensions, composition, purity, viscosity, stiffness, moisture, and content.⁵¹⁶

Machine-to-machine (M2M) communication is the automated transferring of information between mechanical and electronic equipment over a wired or wireless system. It is very important for the function of sensors in the IoT.⁵¹⁷ With M2M, companies can set up systems that monitor devices, not only collecting data on the devices but also alerting firms when to reallocate resources or perform maintenance.

⁵¹¹ Brisbane, "Tesla's Over-The-Air Fix" February 2014; Taub, "Your Car's New Software is Ready," September 8, 2016; OnStar, "OnStar Services" (accessed on April 10, 2017).

⁵¹² "Big data" is the industry term for very large, high-volume datasets composed of structured and unstructured data from a wide variety of sources, often collected at high velocity in "real time." Examples include click streams from search engines, transaction data from electronic markets, or environmental or location data from machine sensors. USITC, *Digital Trade in the U.S. and Global Economies, Part 2*, August 2014, 151.

⁵¹³ MHI, *The 2017 MHI Annual Industry Report*, MHI & Deloitte, 2017.

⁵¹⁴ Strong, presentation at "Going Digital," March 14, 2017.

⁵¹⁵ Ibid.

⁵¹⁶ Ibid.

⁵¹⁷ Verma et al., "Machine-to-Machine (M2M) Communications," May 2016; Gartner, "Machine-to-Machine (M2M) Communications" (accessed April 10, 2017).

Sensors in Manufacturing and Chemicals

Manufacturers use sensors for research and development (R&D), production, internal coordination, and “post-sales”—the phase after delivery of goods to the customer. The leading uses of sensors in the manufacturing sector are production and internal coordination (supply chain).⁵¹⁸ Firms also use sensors for R&D. For example, the apparel industry can use cameras and sensors to design and create customized clothing specific to a certain body type or even to a unique individual with a degree of precision that was previously unattainable.⁵¹⁹

The chemicals industry uses networks of connected sensors in production to ensure quality control, reduce costs, and facilitate logistics and compliance with regulations. In comparison to analog equipment or to unlinked digital sensors and controls that require time-consuming manual checks, IoT allows continuous monitoring of production variables that affect the product, such as temperature, flow rate, pressure, system fouling, and catalyst aging.⁵²⁰ This continuous flow of data allows operators to control product quality and consistency and to manage energy costs.⁵²¹

IoT and connected sensors also allow the continuous analytic monitoring of maintenance data, including vibration analysis, infrared thermography, and leak inspection.⁵²² Problems with plant equipment affect production quality and can also require downtime for maintenance, safety, and environmental issues, which could result in missed deadlines and loss of profits.⁵²³ The importance of maintenance is illustrated by one study, which estimated that maintenance costs at poorly performing plants could be more than triple those at top-performing plants.⁵²⁴

Sensors also play an increasing role in internal coordination—specifically, in logistics and supply chains. Improvements in remote monitoring technology have advanced the business case for digital technology and logistics. Identification technology such as bar codes and radio frequency identification combine with global positioning system (GPS) tools to enable physical tracking. More sophisticated tools allow satellite monitoring of conditions, relying on sensors to measure

⁵¹⁸ MHI, *The 2017 MHI Annual Industry Report*,” MHI & Deloitte, 2017; U.S. representatives, interviews by USITC staff, Chicago, Illinois, April 3–7, 2017.

⁵¹⁹ U.S. industry representative, interview by USITC staff,” March 10, 2017.

⁵²⁰ DiStefano and Hawkins, *Achieving Top-Quartile Reliability Returns*, 2015, 3–5; Van Thienen et al., “Industry 4.0 and the Chemicals Industry,” 2016, 5.

⁵²¹ Swafford, “Continuous Monitoring,” March 2016; Van Thienen et al., “Industry 4.0 and the Chemicals Industry,” 2016, 6. Strict production consistency requirements are of particular concern in the more exacting pharmaceutical industry, where it is estimated that more than 50 percent of injectable drugs produced in 2010 had to be discarded for quality concerns. DiStefano and Hawkins, *Achieving Top-Quartile Reliability Returns*, 2015, 3–5.

⁵²² DiStefano and Hawkins, *Achieving Top-Quartile Reliability Returns*, 2015, 3–5.

⁵²³ Swafford, “Continuous Monitoring,” March 2016.

⁵²⁴ DiStefano and Hawkins, *Achieving Top-Quartile Reliability Returns*, 2015, 3–5.

and transmit data about parameters such as temperature and pressure.⁵²⁵ Tracking and monitoring helps to assure product quality from production plant to delivery point. In addition to tracking shipments individually, monitoring data can also be aggregated to assess supply chains and distribution channels to increase efficiency.⁵²⁶

Sensors also have an important post-sales use, in that they enable “predictive maintenance.” Manufacturers can monitor equipment remotely after it has been sold to customers. In this way they can verify whether their products are working as intended, thus reducing maintenance calls and customer complaints. By increasing a firm's productivity, remote monitoring benefits both consumers and producers. Finally, as discussed below, sensors are an integral part of the trend towards “collaborative robots.”

U.S. and International Markets

Sensors are becoming more common within the U.S. manufacturing sector. The 2017 MHI survey finds that 49 percent of U.S. manufacturing firms surveyed currently have “sensors and automatic identification” in place today (up from 43 percent in 2015).⁵²⁷ Sales of IoT-enabled sensors in the United States have increased by 26.8 percent from \$970 million in 2014 to \$1.23 billion in 2016.⁵²⁸

Market Competition and Trends

Top U.S. manufacturers of sensors used in the manufacturing sector and other inspection equipment include Cognex, Datalogic USA (subsidiary of Italian firm Datalogic), Microscan (subsidiary of Spectris), and ProPhotonix.⁵²⁹ Table 6.2 reports total and regional revenues for these four companies in 2016. Among these firms, Datalogic and Cognex report the highest total revenue, but Spectris reports the highest percentage of revenue coming from North America.

⁵²⁵ Blanchard, “The Logistics Landscape Is Wide Open,” April 15, 2016.

⁵²⁶ Van Thienen et al., *Industry 4.0 and the Chemicals Industry*, 2016, 21; Kumbhar, “Globalstar Enables Ovinto and SABIC to Monitor Petrochemicals,” November 5, 2015.

⁵²⁷ MHI, *The 2017 MHI Annual Industry Report*, MHI & Deloitte, 2017

⁵²⁸ Statista, “IOT in the Retail Market in the U.S.” (accessed July 7, 2017).

⁵²⁹ *Manufacturing Tech Insights* included in their rankings some solutions/integrations firms in addition to producers of sensors and other inspection equipment. Listed here are only the producers of the primary devices. For the complete list see Carroll, “Top 10 Machine Vision Technology Solution Providers,” July 5, 2016.

Table 6.2: Revenues of top manufacturers of sensors and other inspection equipment, 2016 (thousand \$)

Region	Datalogic	Cognex	Spectris ^a	ProPhotonix	Total by region
North America	174,293	135,396 ^b	211,735	6,782	528,206
Europe	313,203	234,339	39,322	7,777	594,641
Asia/RoW ^c	112,968	151,018	51,421	1,686	317,093
Company total	600,464	520,753	302,478	16,245	1,439,940

Source: Cognex, "Cognex Form 10-K," January 29, 2017; Datalogic, *Datalogic 2016 Financial Report*, December 31, 2016; Spectris, *Spectris Annual Report and Accounts 2016*, March 2017; and ProPhotonix, *ProPhotonix Annual Report 2016*, March 15, 2017.

^a Spectris data are from their "Internal Controls" company segment, which includes Microscan, the company that makes its sensors and similar technology.

^b Data are for only the United States. Canada and Mexico are not separately broken out and are included in rest of world (RoW).

^c ROW stands for rest of world.

Sensors in Agriculture

Dairy Cow Monitors

For dairy operators, collecting data on individual cows and compiling these into big data has many benefits for milk production and internal coordination of cows in the herd. Perhaps the most important is the ability to determine the fertility cycle of an individual cow and when she should be bred, because dairy cows must give birth to a calf in order to produce milk. The volume of milk produced daily is partly a function of the period of time that the cow has been producing milk, referred to in the industry as days in milk (DIM). The volume of milk produced is highest from about 30 to 150 DIM. Thus, this is the ideal period for the cow to be bred. Each day past 110 DIM that a dairy cow has not been successfully bred is believed to lower the profitability of the dairy, but a high-producing dairy cow might only be receptive to breeding for six hours every 21 days.⁵³⁰ Thus it is important to quickly identify when a cow is in estrus (heat). One measure of reproductive efficiency is the pregnancy rate of the overall herd (the number of cows that become pregnant over a 21-day period divided by the number of cows eligible to be bred). An increase in the pregnancy rate of 1 percent is worth an estimated \$25 per year per cow in the herd.⁵³¹ A variety of dairy cow monitors are designed to more accurately identify when a cow is approaching estrus by measuring her activity level. This reduces the amount of time a dairy operator spends observing the cows in order to identify their estrous cycles. One industry representative estimated that the increase in milk production would pay for the cost of a monitoring system in less than a year.⁵³²

⁵³⁰ Missouri Dairy Growth Council, *Dairy Cattle Reproductive Manual*, February 2009, 3, 7.

⁵³¹ Dairy researcher, telephone interview by USITC staff, March 28, 2017.

⁵³² Dairy monitoring firm representative, telephone interview by USITC staff, March 27, 2017.

The top cattle sensor models used in the United States today are produced by Israeli and European firms. Those two dairy-producing regions have labor costs higher than the United States. Many different systems are available to U.S. dairy producers (table 6.3). Some of them also measure other characteristics, such as the rumination activity of each animal.⁵³³ This is a guide to the animal's health. Rumination varies among individual cows, but a marked change in rumination can signal a health issue and that a cow should be more closely examined.

Table 6.3: Characteristics of top cattle sensor models

System	Company	Country	Location	Activity	Rumination	Cloud/Web
AccuBreed	Estroprotect	United States	Rump	√		
AfiAct II	Afimilk	Israel	Ankle	√		√
Alta Alert	Alta Genetics	Canada	Ankle, neck	√	Eating bouts	
CowManager	Select Sires	United States	Ear	√	√	√
CowScout 1 S	GEA	Germany	Ankle, neck	√	Eating bouts	
DeLaval	DeLaval	Sweden	Ankle	√		
HeatPhone	Medria	France	Ankle	√	√	√
RealTime+	Boumatic	United States	Ankle, neck	√	Eating bouts	
Heatime/ai24 eSensor	SCR	Israel	Neck, ear	√	√	√
MooMonitor+	Dairymaster	Ireland	Neck	√	√	√
Silent Herdsman AFI	Afimilk	Israel	Neck	√	√	√
SmartBOW	Precision Animal Monitoring	Austria	Ear	√	√	√
Track a Cow	Animark	United States	Ankle	√	Eating bouts	

Source: Nebel, "2015 Proceedings of the Dairy Cattle Reproduction Council Annual Meeting," November 12–13, 2015.

Note: An "eating bout" is the interval during which a cow is consuming food. Rumination is the process by which a cow regurgitates previously consumed food and chews it again.

Other Animal Identification

One common method used to collect data that identify and trace animals is the radio frequency identification (RFID) ear tag, which is primarily used for internal coordination. Use of RFID ear tags simplifies the record-keeping process. Tags can be scanned when animals are moved or sold, for instance, and other measurements such as weight can be matched with each individual animal. Automating and digitizing record-keeping processes allows more precise management of individual animals. For instance, the amount of feed consumed by each animal can be measured or controlled. Providing the optimal volume of feed maximizes the return for individual animals and lessens waste. Many devices and software packages are available from

⁵³³ Rumination is the process where a cow regurgitates feed and chews it again, or "chews her cud."

different vendors, but some problems have been reported with merging data from different mobile devices or with sharing data between individuals who use different software.⁵³⁴

One new application of particular interest to cattle ranchers uses GPS tracking to locate cattle. By examining GPS data using advanced data analytics, cattle ranchers can gain insights into pasture use, which can improve their management of a herd.⁵³⁵ Researchers are also attempting to use GPS tracking data to detect cattle behavior that may signal that an animal needs some assistance. In the future, location data may help guide genetic selection to improve grazing distribution of cattle.⁵³⁶

Other IoT Innovations

This section covers three other innovations that are more specialized and include more than just one new type of digital product: precision agriculture, fleet management systems, and usage-based insurance. They use sensors integrated into the larger IoT to improve the efficiency of older legacy processes.

Precision Agriculture

Precision agriculture involves measuring the relevant conditions within each part of a field, determining the most effective treatments for that specific segment, and then applying the treatments as precisely as possible.⁵³⁷ Digital technologies are important at each phase of the process, from measuring and collecting data on soil and plant characteristics, to analysis, to application of the prescribed management practices as precisely as possible. Precision agriculture practices commonly include tracking and auto-steering of vehicles; sensing and analyzing field conditions, diseases, and pest infestations; variable rate application of inputs such as fertilizer and pesticides; and determining optimum varieties, seeding rates, cultivation, and harvest schedule.

Typically, precision agriculture is associated with large-scale field crops like corn and soybeans or more permanent plantings like vineyards and orchards. Elements of this approach vary, but for field crops and vineyards, they will typically include GPS, tied to geographic information systems (GIS); variable-yield monitors; variable-rate application hardware with programmable

⁵³⁴ USDA, APHIS, *Ultra-High Radio Frequency Identification*, August 2016, 8.

⁵³⁵ EU Directorate-General for Internal Policies, Agriculture and Rural Development, *Precision Agriculture: An Opportunity for EU Farmers*, June 2014, 18.

⁵³⁶ New Mexico State University, "Researchers from New Mexico and Australia Collaborate on GPS Tracking," January 24, 2017.

⁵³⁷ EU Directorate-General for Internal Policies, Agriculture and Rural Development, *Precision Agriculture: An Opportunity for EU Farmers*, June 2014, 9.

control; active sensors, such as electrical conductivity sensors; remote sensors; and automatic steering of equipment. Development of these tools, plus widespread adoption of personal electronic devices and the Internet, have made precision agriculture possible.⁵³⁸

Without detailed data on intra-field variability, farmers make decisions for each field based on a single data point. For instance, without precise data on productivity, a farmer may apply fertilizer at a rate sufficient for the most productive area of the field. This would maximize yield, but waste fertilizer on less productive segment of the fields, leading to possible environmental problems from fertilizer runoff.⁵³⁹ With precision agriculture, a farmer collects specific data—for example, growing conditions and yield—for every portion of a field. The farmer then uses variable-rate applicators to apply treatments tailored to each area. In addition to saving on inputs such as fertilizer and herbicide and boosting yields, this process also lessens environmental impact.⁵⁴⁰

One of the first steps for many farmers of field crops moving to more automation is to use a GPS, which allows the farmer to track each piece of farm equipment. With more precise tracking, an entire field can be plowed, planted, sprayed for pests, or harvested with complete coverage and minimal overlap. The farmer saves on seed or fertilizer, fuel, and time. Figure 6.1 is a photograph of corn planted in an irregularly shaped field in Indiana. The rows on the right side of the picture were planted first. When planting the rows on the left, each row of the multirow planter stopped planting at the right point to eliminate overlap.

Figure 6.1: Illustration of swath control in planting



Photo courtesy of Carnahan & Sons, Inc., from company blog, “What Is Swath Control?” <https://casifarm.wordpress.com/2014/04/05/what-is-swath-control/>, April 5, 2014.

⁵³⁸ Hopkins, “17 Innovations That Shaped the Precision Ag Revolution,” June 17, 2015.

⁵³⁹ Industry representative, telephone interview by USITC staff, April 3, 2017.

⁵⁴⁰ EU Directorate-General for Internal Policies, Agriculture and Rural Development, *Precision Agriculture: An Opportunity for EU Farmers*, June 2014, 12.

A GPS system can be stand-alone or tied to other systems. The most basic GPS systems used in agriculture are typically called “lightbar” systems. A lightbar GPS system requires a driver to follow an indicator (a rectangular device showing a bar of light), just as a driver not using a GPS system would follow rows or a system of markers. Auto-steer or auto-guidance systems do not require a driver to steer the equipment. Auto-steering with GPS provides immediate benefits for the farmer in saving time, fuel, and input costs, and in maximizing the useful production area.⁵⁴¹ For some farmers, GPS and auto-steering are the most profitable investments offered by precision agriculture.⁵⁴²

The great majority of expenditures on precision agriculture are for equipment, rather than services. GIS and guidance systems reportedly accounted for the largest share of revenue in the U.S. precision agriculture market at over 40 percent of the total, followed by yield monitors and variable-rate application control systems. Support services (7.6 percent) and data management services (7.5 percent) account for a small share of the market.⁵⁴³

Combined, the use of GPS lightbar and auto-steer systems are the most widely adopted precision agriculture technologies. The use of auto-steer systems, however, has increased, while the use of lightbar systems has declined. In a 2015 survey of agricultural input suppliers, auto-steer systems were used on 51.7 percent of farm land, and lightbar steering on 30.1 percent. A similar survey in 2013 estimated auto-steering use at 33.7 percent, and lightbar steering at 34.2 percent.⁵⁴⁴ Additionally, in 2015, many dealers reported using some type of GPS correction to improve the accuracy of the system.⁵⁴⁵ The adoption rates for other applications have also increased, as shown in table 6.4.

Table 6.4: Reported Share of Market Area Using Precision Agriculture Technology

Technology	2013 (percent)	2015 (percent)
Yield monitor with GPS	32.7	43.0
Soil sampling	37.2	40.8
Satellite/aerial imagery	15.4	18.0
Variable seeding rate	9.8	13.9

Source: Holland, Erickson, and Widmar, *2013 Precision Agricultural Services Dealership Survey Results*, November 2013, 47; Erickson and Widmar, *2015 Precision Agricultural Services Dealership Survey Results*, August 2015, 22.

⁵⁴¹ Industry representative, telephone interview by USITC staff, April 3, 2017.

⁵⁴² *Farm Industry News*, “Measuring Tech ROI on the Farm,” March 21, 2014.

⁵⁴³ IBISWorld, *Industry Report OD4422, Precision Agriculture Systems*, February 2016, 14.

⁵⁴⁴ Holland, Erickson, and Widmar, *2013 Precision Agricultural Services Dealership Survey Results*, November 2013, 46; Erickson and Widmar, *2015 Precision Agricultural Services Dealership Survey Results*, August 2015, 21.

⁵⁴⁵ Erickson and Widmar, *2015 Precision Agricultural Services Dealership Survey Results*, August 2015, 10.

The rapid adoption of many precision farming practices is evidence of the positive return on investment from these technologies. Auto-steer and programmable controllers may be particularly cost-effective on irregularly shaped fields.⁵⁴⁶ An analysis by the U.S. Department of Agriculture (USDA) of a broad sample of corn and soybean farming operations found that operating profits for farms that had adopted precision agriculture practices was on average \$66 per acre higher than for non-adopters. Larger operations are adopting precision agriculture practices at a higher rate than smaller operations because they can take better advantage of economies of scale.⁵⁴⁷

In a survey by the University of Nebraska, Lincoln, 70 percent of respondents indicated that the adoption of precision agriculture programs had increased the farm's profit, and nearly 95 percent said that the investment was worth the cost.⁵⁴⁸ Nationally, for the average-size farm, GPS guidance systems had a net return on investment of 1.5 percent, soil characteristics and yield mapping 1.8 percent, and variable-rate application of inputs 1.1 percent.⁵⁴⁹ The savings are additive. GPS and auto-steer technology, combined with field sensors, accurate analysis, and variable-rate applicators, help the farmer provide the 4Rs: the right nutrients at the right rate, at the right time, and the right place. U.S. Corn Belt farms that adopted GPS and auto-steer technologies increased productivity of both labor and equipment, and were able to profitably farm more land, with the same resources.⁵⁵⁰

In the European Union (EU), precision agriculture is also likely to be more profitable for large farms. The economic benefits from guidance technology for a 500-hectare (ha) farm in the United Kingdom (UK) were estimated to be at least \$3.07/ha, and adoption of additional precision agriculture technologies was estimated to increase the returns to over \$24.64/ha. Other studies in Europe have had mixed results. Variable-rate application of fertilizer in Germany was found to save between \$13.69/ha and \$34.23/ha, but appeared to yield no savings in Denmark.⁵⁵¹ In the EU, market penetration for satellite-assisted precision agriculture technologies in tractors, such as auto-steering, was 7.5 percent in 2010.⁵⁵²

⁵⁴⁶ Swath control is a system for controlling planting, application, or harvesting equipment in order to minimize overlap. *Farm Industry News*, "Measuring Tech ROI on the Farm," March 21, 2014.

⁵⁴⁷ USDA, ERS, *Farm Profits and Adoption of Precision Agriculture*, October 2016, 17.

⁵⁴⁸ University of Nebraska, *Precision Agriculture Usage and Big Agriculture Data*, May 27, 2015, 2–3.

⁵⁴⁹ USDA, ERS, *Farm Profits and Adoption of Precision Agriculture*, October 2016, 17–18, 28.

⁵⁵⁰ Griffin, Lambert, and Lowenberg-DeBoer, "Economics of Lightbar and Auto-Guidance GPS," 2005.

⁵⁵¹ EU Directorate-General for Internal Policies, Agriculture and Rural Development, *Precision Agriculture: An Opportunity for EU Farmers*, June 2014, 21. Note that units converted from Euros to U.S. dollars are based on June 30, 2014, conversation rate. Federal Reserve, <https://www.federalreserve.gov/releases/h10/Hist/>.

⁵⁵² EU Directorate-General for Internal Policies, Agriculture and Rural Development, *Precision Agriculture: An Opportunity for EU Farmers*, June 2014, 28.

U.S.-based company Climate Corporation currently offers a technology called “FieldView,” which uses aerial footage to identify problem areas, such as areas of low growth. The technology is used by U.S. farmers covering a combined total of “more than 92 million crop acres” and is expected to launch in Brazil in the near future.⁵⁵³ One Brazilian firm, PromonLogicalis, is using weather balloons to expand Internet connectivity to rural areas in the country, enabling IoT devices in precision agriculture to interface with one another and the cloud.⁵⁵⁴ Russian farmers are also beginning to adopt precision agriculture technologies, including automated vehicles and equipment, drones, and advanced imaging.⁵⁵⁵ In Indonesia, several universities and government agencies have begun researching the application of precision agriculture technologies, including soil testing sensors and drones.⁵⁵⁶

U.S. and International Markets

In 2014, the market for precision agriculture was estimated to be \$1.2 billion in North America, \$400 million in Europe, and \$200 million each in South America, Asia, and the rest of the world.⁵⁵⁷ Data from the USDA indicates that precision agriculture practices such as GPS guidance, yield mapping, and variable-rate application were used on 30 percent to 50 percent of U.S. corn and soybean acres over 2010–12.⁵⁵⁸

China may have the greatest potential to benefit from precision agriculture, potentially offering significant savings on fertilizer and irrigation.⁵⁵⁹ Nitrogen fertilizer efficiency in China has declined over time and is well below that seen in the United States.⁵⁶⁰

In Brazil, precision agriculture practices are most often employed in soybean and corn production on larger farms. A recent survey of farmers, technical support providers, and consultants indicated that 67 percent of soybean farms and 56 percent of corn farms over 1,000 ha used precision agriculture practices. The most widely used technologies were GPS

⁵⁵³ Pepitone, “Hacking the Farm: How Farmers Use ‘Digital Agriculture’ to Grow More Crops,” August 3, 2016.

⁵⁵⁴ Prescott, “IoT Projects Focused on Agriculture Take Root in Brazil,” October 25, 2016.

⁵⁵⁵ Dokin, Aletdinova, and Kravchenko, “Prospects and Features of Robotics In Russian Crop Farming,” 2017, 3.

⁵⁵⁶ Virgawati, “The Prospects of Precision Agricultural Development in Indonesia,” n.d., 5.

⁵⁵⁷ Roland Berger, *Business Opportunities in Precision Farming*, July 2015, 4, figure 2.

⁵⁵⁸ USDA, ERS, *Farm Profits and Adoption of Precision Agriculture*, October 2016.

⁵⁵⁹ Dahl, “China Is the Greatest Opportunity for Precision Agriculture,” January 2016.

⁵⁶⁰ Zhang et al., “Managing Nitrogen for Sustainable Development,” December 2015. “Nitrogen efficiency is the increase in crop yield from an additional unit of nitrogen fertilizer”.

guidance and yield mapping. Additionally, over 40 percent reported using GPS technology to manage the logistics of farm equipment.⁵⁶¹

Several factors limit the adoption of precision agriculture. In China, adoption is hampered by the small size of most farms, a lack of young and well-educated farmers, and a low level of mechanization.⁵⁶² In Brazil, the barriers to expansion of precision agriculture reportedly include uncertainty of economic return, difficulty in using the software, and a lack of training.⁵⁶³ In India, as in China, most farms are small: Over two-thirds of agricultural households own less than 1 ha (2.47 acres).⁵⁶⁴ The expense of the investment and lack of access to finance and credit have been identified as key barriers to the adoption of precision agriculture practices in India.⁵⁶⁵ Further, smaller farms may not be able to achieve the economies of scale necessary to take advantage of many precision agriculture practices.

Market Competition and Trends

There are many providers of precision agriculture products in the United States. They include broad-line manufacturers of tractors and agricultural equipment; manufacturers of specialized equipment, such as sprayers and other variable-rate application equipment; makers of remote sensors and guidance systems; suppliers of inputs such as seed and fertilizer; and suppliers of software that enables communication with these pieces of equipment. The three largest market participants in the U.S. precision agriculture industry account for only about 34 percent of the market (table 6.5).

Table 6.5: Major precision agriculture companies in the United States

Firm	Products	Estimated precision agriculture revenue, 2016
Trimble Inc.	Field solutions and software	\$304.1 million
Deere & Co.	Field solutions and software	\$169.1 million ^a
Raven Industries	Field solutions	\$115.1 million ^b

Source: IBISWorld, *Precision Agriculture Systems and Services in the U.S.*, February 2016, 24–26.

^a Revenue in 2015–16.

^b Revenue in 2016–17.

⁵⁶¹ Lightbar and auto-steer systems were used by 89 percent and 56 percent of respondents, respectively, yield maps by 56 percent of respondents, and 44 percent of respondents used GPS to manage farm equipment. Borghi et al., “Adoption and Use of Precision Agriculture in Brazil,” 2016, 92, 94.

⁵⁶² Miao, “Precision Agriculture for Food Security and Sustainable Development in China,” August 2–4, 2016.

⁵⁶³ Borghi et al. “Adoption and Use of Precision Agriculture in Brazil,” 2016, 89.

⁵⁶⁴ Government of India, Ministry of Agriculture and Farmers Welfare, *Pocket Book of Agricultural Statistics 2016*, table 11.2, “Indebtedness of Agricultural Households (all-India) in Different Size Classes of Land Possessed.”

⁵⁶⁵ Tech Mahindra, “Precision Agriculture and Potential Market in India,” n.d., 4–5 (accessed July 7, 2017).

Fleet Management Systems

Fleet management (FM) services use sensor devices, radio frequency identification (RFID) tags, and GPS technologies to collect data on vehicles (typically trucks) within a commercial fleet.⁵⁶⁶ These services commonly collect a wide variety of data, such as vehicle speed, location, mileage, fuel consumption, and the number of hours that drivers work, including time spent driving the vehicle. The collection and processing of real-time data in the cloud allows manufacturers and trucking companies to improve the efficiency of their fleet operations. Benefits include a comprehensive, fleet-level view of vehicle locations (often displayed on an electronic map), improved compliance with environmental, labor, and safety regulations, and real-time delivery confirmation. Monitoring delivery routes and vehicle speed also allows fleet operators to reduce fuel consumption, vehicle downtime, and labor costs.⁵⁶⁷ Depending on the purpose of the trucking fleet, fleet management systems could be considered a key technology in production (for trucking operators or logistics companies), internal coordination (for manufacturers or retailers), or post sales (for manufacturers or e-commerce companies).

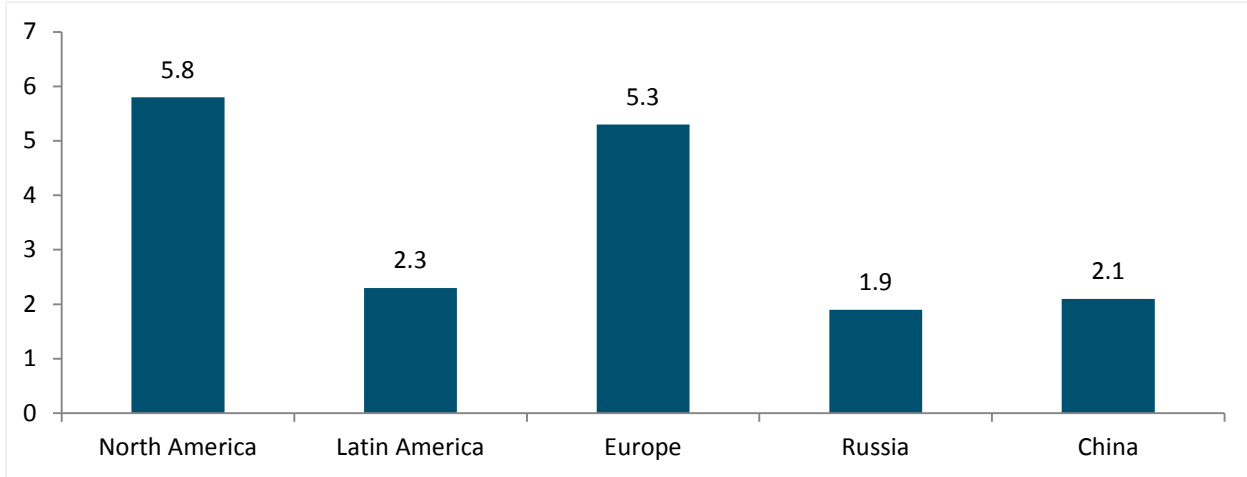
U.S. and International Markets

By the end of 2015, the number of actively used FM systems in North America totaled 5.8 million units (19.8 percent of non-privately owned commercial vehicles) (figure 6.2). In the United States, demand for FM services is expected to be driven not only by a growing awareness of cost and logistical efficiencies, but also by the electronic logging rule mandated in December 2015 by the Federal Motor Carrier Safety Administration.⁵⁶⁸

⁵⁶⁶ Fleet management is also prevalent in the use of agricultural equipment.

⁵⁶⁷ GMI, *Vehicle Tracking Market Size, Industry Analysis Report*, 2017.

⁵⁶⁸ The Federal Motor Carrier Safety Administration press release regarding the use of electronic logging devices, can be found here: <https://www.fmcsa.dot.gov/newsroom/electronic-logging-devices-be-required-across-commercial-truck-and-bus-industries>.

Figure 6.2: Actively used fleet-management (FM) systems, 2015 (million units)

Source: Berg Insight, *Fleet Management in the Americas*, July 2016, 2; Berg Insight, *Fleet Management in Europe*, August 2016, 2; Berg Insight, *Fleet Management in Russia/CIS and Eastern Europe*, March 2016, 2; Berg Insight, *Fleet Management in China* (Executive Summary), January 2015, 1.

Note: Corresponds to [appendix table G.14](#).

Market Competition and Trends

In North and South America, there are more than two dozen providers of fleet management services, with many focusing on specific country markets or industry market segments such as heavy trucks or service fleets. Verizon Telematics, owned by U.S.-based Verizon Communications, Inc., is the largest provider of FM services on the two continents, largely due to its acquisition of both Fleetmatics and Telogis in 2016. At the end of 2015, Fleetmatics was the market leader in North and South America, with more than 600,000 installed systems, whereas Telogis (450,000 installed systems) had a third-place market share behind Omnitrac (500,000 installed systems). At least a dozen other market participants had more than 100,000 systems installed.⁵⁶⁹ In Brazil, important FM service vendors include AutoTrac, Positron, OMNILINK, and OnixSat. In addition, nearly a dozen vehicle manufacturers offer factory-installed fleet telematics.⁵⁷⁰

In Europe, the installed base of active FM systems totaled roughly 5.3 million units (18.1 percent penetration) in 2015.⁵⁷¹ The European FM market is dominated by several pan-European aftermarket (not provided by the original equipment manufacturer) FM providers, including market-share leader TomTom Telematics (529,000 systems) and second-place

⁵⁶⁹ Those companies include Trimble, Geotab, Zonar Systems, Verizon Networkfleet, Teletrac Navman, Sascar, Position Logic, Spireon, BSM Technologies, NexTraQ, and Fleet Complete.

⁵⁷⁰ These include Daimler, Volvo, Paccar, Navistar, Ford, GM, Hino, Isuzu, MAN, Scania, and Iveco. Berg Insight, *Fleet Management in the Americas* (Executive Summary), July 2016, 2.

⁵⁷¹ Berg Insight, *Fleet Management in Europe*, (Executive Summary), August 2016, 2.

Masternaut. Other leading market participants, all of which are European, include Transics, the leader in the heavy truck segment with an estimated 100,000 installed systems, as well as Trakm8, Microlise, ABAX, Quartix, Tantalum, OCEAN, and Vehco. In addition, the leading truck manufacturers in Europe offer factory-installed fleet telematics, including Scania (133,000 installed systems), Daimler (86,000 installed systems), and Volvo (81,000 installed systems). U.S. firms operating in the European FM service market include Fleetmatics, Trimble, and TeletracNavman.⁵⁷²

In Russia, the installed base of active FM systems totaled 1.9 million units in 2015. Leading Russian providers of FM services are TechnoKom, which is also active throughout Eastern Europe, as well as Navigator Group, NIS, Scout, and Omnicomm.⁵⁷³

While currently small (2.1 million units in 2014), the FM services market in China is expected to grow dramatically over the next few years. Factors driving the Chinese market include government regulations enacted to reduce pollution and to track certain trucks and buses. In addition, rapidly growing e-commerce is forcing logistics companies to improve customer service and fleet management efficiency.⁵⁷⁴ Overall, so-called “track and trace” systems dominate the market, with a large portion of those comprising low-end, limited-function systems. In China, the leading providers of FM systems (companies with an installed base exceeding 100,000 units) are E6GPS and Etrans; companies with installed bases of 50,000 to 100,000 units include Beijing Zhongdou Technology, Shenzhen Huabao Electronics Technology, Shenzhen Weitongda Electronics, and 666GPS. Although a few international aftermarket providers have entered the Chinese market, their installed bases remain limited. International FM providers operating in China with an installed base of at least 1,000 units include Trimble, MiX Telematics, Microlise, and Navman Wireless.⁵⁷⁵

Usage-Based Insurance

Usage-based insurance (UBI) is a type of auto insurance with its price based upon the current behavior of the individual driver. A relatively recent innovation in the insurance industry, a key aspect of UBI is the use of a GPS-enabled telematics device.⁵⁷⁶ Such devices, which are either integrated into the vehicle or plugged into a special vehicle port, record a variety of factors that are of interest to insurance underwriters, including distance driven, vehicle location, time of

⁵⁷² Ibid.

⁵⁷³ Berg Insight, *Fleet Management in Russia/CIS and Eastern Europe* (Executive Summary), March 2016, 2.

⁵⁷⁴ Berg Insight, *Fleet Management in China* (Executive Summary), January 2015, 1.

⁵⁷⁵ Ibid.

⁵⁷⁶ Telematics refers to the collection of information related to remote objects via telecommunications networks. Berg Insight, *Insurance Telematics in Europe and North America* (Executive Summary), June 2016, 1.

day, and driver behavior (e.g., rapid acceleration, hard braking, hard cornering, air bag deployment, etc.).⁵⁷⁷

Under traditional auto plans, insurance premiums are based upon actuarial studies of aggregated historical data. Companies attempt to differentiate drivers based upon the perceived riskiness of similar drivers, with drivers in lower risk groups qualifying for lower premiums.⁵⁷⁸ One weakness of the traditional model, however, is that information on an individual's driving pattern is not incorporated into the calculation of their insurance premium, unless an event such as an accident claim shifts them into a different risk group. UBI addresses this problem by collecting real-time information on driver behavior and pricing premiums accordingly. A driver who consistently drives at a speed higher than the posted limit, for example, will pay a higher insurance premium than one who drives within the speed limit. Depending upon the UBI scheme, premium payments are collected via a variety of methods, including debit accounts, smart-card systems, and gas-pump billing.⁵⁷⁹

The first UBI schemes emerged about a decade ago, when Progressive Insurance Company (Progressive) and General Motors Assurance Company (GMAC) began to offer mileage-based discounts, with mileage information recorded by GPS or cellular-based devices. Technological advancements over the past 10 years have greatly increased the amount of data that can be obtained by such devices, resulting in the emergence of a variety of UBI programs, including so-called pay-as-you-drive, pay-how-you-drive, pay-as-you-go, and distance-based programs.⁵⁸⁰

Currently, the UBI market is in the early stages of development, with the vast majority of active UBI programs and policies located in the United States, the UK, and Italy. At the end of 2015, active UBI policies in the United States and Europe totaled 6.3 million and 5.3 million, respectively; in Canada, there were roughly 450,000 active UBI policies.

Globally, insurance companies with a notable position in the UBI market include Allstate, Allianz, Generali, Intact, Insure the Box, Progressive, UnipolSai, and State Farm. Allstate's UBI program, for example, was launched in 2010 and is now available in more than 45 U.S. states. Called "Drivewise," this program uses either a smartphone app or onboard telematics device to analyze speed, braking, and time of day, with the collected data being used to calculate cash

⁵⁷⁷ NAIC, "Usage-Based Insurance and Telematics," March 1, 2017.

⁵⁷⁸ To calculate the appropriate premium to charge, auto insurance companies assign individual policyholders to different risk groups based upon a wide range of data, including personal characteristics (age, gender, marital status), credit-based insurance score, vehicle type and use, driving record, liability limits, deductibles, and previous claims. NAIC, "Usage-Based Insurance and Telematics," March 1, 2017.

⁵⁷⁹ NAIC, "Usage-Based Insurance and Telematics," March 1, 2017.

⁵⁸⁰ Ibid.

rewards and/or premium discounts.⁵⁸¹ Similarly, Liberty Mutual's "RightTrack" program uses an onboard telematics device to record and analyze mileage, time of day, and accelerating/braking behavior, with participants eligible for premium discounts of up to 30 percent.⁵⁸²

Insurance companies have the option of either developing their own programs or partnering with UBI suppliers. Prominent suppliers of UBI services and equipment include Octo Telematics, LexisNexis Risk Solutions, Cambridge Mobile Telematics, and DriveFactor. Telecommunications companies, many of which work with UBI suppliers, are also active in the market, with market leaders including Sprint, Telefonica, Verizon, and Vodafone.⁵⁸³

Robotics and Other Automated Processes

With Internet connectivity enabling the flow of information within a firm and around the globe, firms in many different industry sectors are automating tasks that were previously done by a combination of humans and machinery. In 2011, McKinsey Global Institute (MGI) surveyed U.S. companies about automation and its effects on their hiring and human resource plans; two-thirds of respondents said they had restructured their operations in recent years to reduce headcount and increase output per worker, and 44 percent reported that they had automated at least some tasks.⁵⁸⁴ In manufacturing, robots have been used to perform a number of heavy tasks on the assembly line for decades. Now, modern robots are working more closely with workers and performing more complex tasks. The prevalence of robotics in agriculture has increased in recent years, as has that of other types of automation.

This section also describes unmanned aerial vehicles (UAVs or "drones") and their many uses, and 3-D printing, which is expanding beyond the creation of prototypes to the creation of molds and even 3-D-printed parts. Although not discussed in detail in this section, automation can also include the use of kiosks or ATMs by airlines and banks.

An important way of quantifying a business case for these technologies is to calculate the return on investment (ROI) of purchasing and implementing new technologies. There is, however, a very wide range of opinions on how fast such an investment pays for itself. Some

⁵⁸¹ Allstate, <https://www.allstate.com/drive-wise.aspx> (accessed March 14, 2017).

⁵⁸² Liberty Mutual Insurance, <https://www.libertymutual.com/righttrack/righttrack-works> (accessed March 14, 2016).

⁵⁸³ Berg Insight, *Insurance Telematics in Europe and North America* (Executive Summary), June 2016, 2.

⁵⁸⁴ Manyika et al., *An Economy That Works*, June 2011, 12.

robotics firms advertise an average as low as approximately 195 days, while other firms suggest that the industry average is closer to two years.⁵⁸⁵

Robotics in Manufacturing

The use of robots in the manufacturing sector began as far back as 1954, but included only the largest of firms until recent years.⁵⁸⁶ Since then, advancements in technology have driven down the cost of robots, making more firms able to afford them. Technological progress has also made them more reliable, safe, and adaptive, as well as more easily integrated with other facets of automation such as AI, big data, and the cloud.⁵⁸⁷

The primary use of robots in the manufacturing sector is to automate tasks that were traditionally manual, including some quite complicated ones, such as picking, sorting, painting, palletizing, inspecting, storing, and handling products.⁵⁸⁸ Manufacturers use robots in R&D, production, and in warehouses for internal coordination and supply chain purposes. Overall, robots also offer more precision, consistency, and repeatability than humans.⁵⁸⁹

Developments in robotics have increased the ability of robots to operate safely around workers. In the past, robots often worked in fenced-in areas to ensure the safety of workers on the factory floor, which added cost and slowed down the production process. Safer robots (called “collaborative robots”) have more complicated sensors, and are able to sense their human counterparts; they slow down or pause an operation when humans are in range to prevent workplace accidents and minimize risk.⁵⁹⁰ Another major development is so-called “cloud robotics,” where Internet-connected robots can “learn” through trial and error how to improve the speed with which they complete a task. The robots also share the information with other robots performing the same task through databases stored in the cloud.⁵⁹¹

⁵⁸⁵ Universal Robots, “The Future is Collaborative,” September 2016; industry representatives, interviews by USITC staff, Chicago, Illinois, April 3–7, 2017.

⁵⁸⁶ *Robotics Online*, “Unimate: The First Industrial Robot” (accessed April 19, 2017); industry representative, interview by USITC staff, Washington, DC, March 15, 2017.

⁵⁸⁷ Jackson, “Intelligent Robots Offer a Competitive Edge,” Q3 2016; industry representative, interview by USITC staff, Washington, DC, March 15, 2017.

⁵⁸⁸ MHI, *The 2017 MHI Annual Industry Report*, MHI & Deloitte, 2017; industry representatives, interviews by USITC staff, Chicago, Illinois, April 3–7, 2017.

⁵⁸⁹ Industry representative, interview by USITC staff, Washington, DC, March 15, 2017; industry representatives, interviews by USITC staff, Chicago, Illinois, April 3–7, 2017.

⁵⁹⁰ Industry representatives, interviews by USITC staff, Chicago, Illinois, April 3–7, 2017.

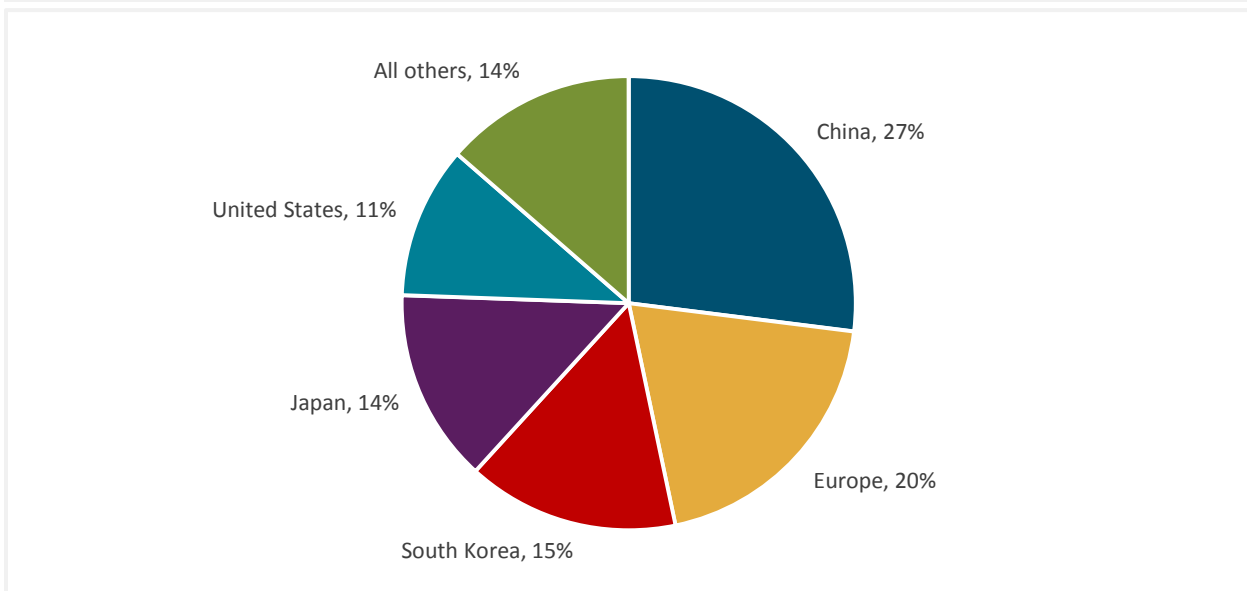
⁵⁹¹ Goldberg, “Cloud Robotics” (accessed May 12, 2017); FANUC, “Reducing Cycle Time in Industrial Robot Applications” (accessed May 12, 2017).

The majority of digital technologies' contribution to U.S. value added in manufacturing comes from increasing product complexity or providing solutions to manufacturing processes and problems, instead of from a specific product. In many cases integration firms design custom solutions from the ground up to fit firm-specific problems. Some of the larger systems integration firms include Automated Cells and Equipment (ACE), Genesis Systems Group, Wolf Robotics, JR Automation Technologies, Acme Manufacturing Company, Dynamic Robotic Solutions, Intelligrated, Lincoln Electric, Schneider Packaging, and Bastian Solutions.

Market Competition and Trends

Worldwide sales of industrial robots have increased 53.9 percent since 2011, from 165,000 to 254,000 in 2015.⁵⁹² As many as 1.75 million industrial robots were in operation as of 2017.⁵⁹³ Of the 254,000 sold in 2015, 27 percent were sold in China (68,556); 20 percent in Europe (50,073), of which 40 percent were in Germany; 15 percent in South Korea (38,285), 14 percent in Japan (35,023), and 11 percent in the United States (27,504) (figure 6.3). Sales in India totaled 2,065 units in 2015 (down slightly from previous years), and sales in Brazil were 1,407 units (up slightly from previous years).⁵⁹⁴

Figure 6.3: Worldwide robotics sales, by destination market, 2015



Source: International Federation of Robotics, (IFR), "World Robotics 2016," September 29, 2016.

Note: Corresponds to [appendix table G.15](#).

⁵⁹² Statista, "Worldwide Sales of Industrial Robots from 2004 to 2015" (accessed May 1, 2017); IFR, "World Robotics 2016," September 29, 2016, 11–18.

⁵⁹³ Acemoglu and Restrepo, "Robots and Jobs: Evidence from U.S. Labor Markets," March 2017.

⁵⁹⁴ Indonesian data are not broken out separately. IFR, "World Robotics 2016," September 29, 2016, 11–18.

According to the MHI Annual Industry Report, adoption of robotic technologies among the U.S. manufacturing and supply-chain firms surveyed is currently 37 percent.⁵⁹⁵ By 2015 revenues, the largest producers of industrial robotics were Mitsubishi Electric (\$11.24 billion), ABB Robotics (\$9.07 billion), FANUC (\$1.62 billion), Yaskawa (\$1.3 billion), Kawasaki (\$1.19 billion), and KUKA Robotics (\$983 million).⁵⁹⁶

Robotics in Agriculture

Agricultural robotics, especially those that milk cows, are attracting increasing interest in the United States as a cost-cutting measure, since they reduce the need to depend on workers during a time of rising agricultural wages.⁵⁹⁷ However, relatively few robotic milking systems have been installed in the United States—about 500 out of a global total of 25,000 to 30,000.⁵⁹⁸

Growth has been faster in Europe. Robotic milking systems account for half of new dairy equipment installed in Germany and about 90 percent of that in Sweden and Finland.⁵⁹⁹ According to one report, Lely (Netherlands) is the global market leader in robotic milking units, followed by Sweden's DeLaval.⁶⁰⁰ Among key markets considered for this report, DeLaval sold its first robotic milking units in Brazil in October 2012.⁶⁰¹ Less than 5 percent of cows in Russia and China were milked robotically in 2015.⁶⁰² In Indonesia and India the herd sizes tend to be fewer than 10 cows, making robotic milking less useful.⁶⁰³

A robotic milking system may save labor costs for even a fairly small dairy (less than 150 cows).⁶⁰⁴ In addition to the labor saved in milking, once the initial equipment is installed, cows are identified individually by a chip on a harness or ear tag, providing the operator access to data on individual cows, which can be stored in the cloud and accessed from anywhere. These data may allow greater precision in the operation. For instance, it is possible to collect individual data on the volume and type of feed a cow consumes, how often she is milked, and

⁵⁹⁵ MHI, *The 2017 MHI Annual Industry Report*, MHI & Deloitte, 2017.

⁵⁹⁶ Statista, "Major Companies in the Global Industrial Robot Market in 2015" (accessed July 7, 2017). Note that units are converted from euros to U.S. dollars based on the January 4, 2016, conversion rate. Federal Reserve, <https://www.federalreserve.gov/releases/h10/Hist/>.

⁵⁹⁷ Daniels, "Future of Farming: Driverless Tractors, Ag Robots," September 16, 2016.

⁵⁹⁸ Merlo, "Robotic Milking Picks Up Speed in the U.S.," March 2017.

⁵⁹⁹ EU, European Parliamentary Research Service, *Precision Agriculture and the Future of Farming in Europe*, December 2016, 30.

⁶⁰⁰ Grant, *Challenges of Appraising Robotic Dairy Facilities*, November 5, 2016, 3.

⁶⁰¹ DeLaval, "A Year with the First Milking Robotic in South America," 2014.

⁶⁰² Beekman and Bodde, "Milking Automation is Gaining Popularity," January 15, 2015.

⁶⁰³ Morey, "Indonesia Dairy Industry Development," May 2011, 2; Narula, *India's 75 Million Dairy Farms Now Produce More Milk*, July 15, 2014.

⁶⁰⁴ Noyes, "Robotic Milkers Benefit Small Family Dairies," June 17, 2016.

the volume and quality characteristics of the milk. These data also allow the farmer to control the amount of feed given to each cow and to determine if there is a health problem with an individual animal before she shows outward signs of ill health. Additionally, there are reports of lower cull rates of cows and lower rates of injury to employees with robotics than with traditional milking systems.⁶⁰⁵

Unmanned Aerial Vehicles⁶⁰⁶

Unmanned aerial vehicles (UAVs) can capture high-resolution imagery from an aerial view at a comparatively low cost.⁶⁰⁷ They are typically equipped with high-resolution cameras that record in visible light or other spectra. These collect data, which can be uploaded to the cloud for later processing and analysis. Companies in infrastructure, entertainment, mining, agriculture, transportation, and security industries use UAVs in a wide variety of ways, such as in R&D, for internal coordination (e.g., monitoring a herd of cattle), and post-sales (e.g., monitoring a pipeline for maintenance purposes). UAVs also offer a safer way to collect data by transmitting pictures of construction sites that allow project managers to oversee work without sending workers into potentially dangerous areas.⁶⁰⁸ In 2014, one study estimated the global value of commercial UAVs at \$552 million.⁶⁰⁹

Agricultural uses of UAVs include locating cattle and surveying fields. A thermal camera can be used to find cattle even in thick brush or tree cover. Applications now being developed include algorithms that can distinguish a calf from another type of animal, and that identify injured or diseased cattle by analyzing behavior or body temperature.⁶¹⁰ UAVs also give farmers a less costly way to gather data on field and plant conditions. One commercial UAV supplier reported in March 2017 that 84 percent of mapping by UAVs was performed by models costing \$1,500 or less, and that more than 60 percent of its users created maps on a weekly basis.⁶¹¹ Firms that analyze these data combine individual images to create a detailed image of a field illustrating a

⁶⁰⁵ Grant, *Challenges of Appraising Robotic Dairy Facilities*, November 5, 2016, 7–8, 17, 23, 54.

⁶⁰⁶ This section uses the term UAV to describe things commonly referred to as UAVs, UASs (unmanned aerial systems), or “drones.” For more information, see FAA C.F.R. Title 14, (2016) §107.3: https://www.ecfr.gov/cgi-bin/text-idx?SID=e331c2fe611df1717386d29eee38b000&mc=true&node=pt14.2.107&rgn=div5#se14.2.107_13

⁶⁰⁷ McCormick, “From Drone to the Field,” December 17, 2015.

⁶⁰⁸ PwC, *Clarity from Above*, May 2016, 5.

⁶⁰⁹ Grand View Research, “Commercial Drone Market Analysis by Product,” January 2016.

⁶¹⁰ Black, “Thermal Cameras Arm Drones for Cattle Scouting,” February 26, 2017.

⁶¹¹ DroneDeploy, “Commercial Drone Industry Trends,” March 2017, 3.

wide variety of attributes.⁶¹² These data may be used alone or combined with other data to create a detailed prescription map or map of management zones.⁶¹³

In the United States, the Federal Aviation Administration (FAA) regulates commercial use of UAVs. Before new regulations appeared in mid-2016, commercial UAV operations were restricted to licensed pilots. As a result, in 2015, the civilian commercial segment accounted for only 3.8 percent of U.S. revenue in the UAV market, and almost all UAV sales were to government agencies.⁶¹⁴ The three largest U.S. firms in the UAV industry in 2015 were Northrup Grumman, General Atomics Aeronautical Systems, and Textron.⁶¹⁵

Issuance of part 107 of the Federal Aviation Regulations, which came into effect August 29, 2016, changed the picture dramatically. These regulations cover commercial operations of small UAVs (under 55 pounds). Issuance of these regulations has helped to increase the use of commercial UAVs in the United States: individuals can now get a remote pilot certificate (following testing) to pilot drones for commercial use.

The FAA estimated that there were 42,000 commercial UAVs operating in the United States in 2016, with about 1,000 more being licensed each week.⁶¹⁶ As of December 2016, about 29,000 commercial UAV pilots had been licensed by the FAA.⁶¹⁷ As of March 2017, the leading drone suppliers in the commercial UAV industry were reportedly Da-Jiang Innovations (DJI), SenseFly, and 3DR, and the leading camera suppliers were DJI, Canon, and Sony.⁶¹⁸

Global shipments of consumer and commercial UAVs are expected to reach 3 million units in 2017. These units accounted for \$6 billion in sales, an increase of 35 percent from 2016 when sales were \$4.5 billion, with 2.2 million units shipped.⁶¹⁹

⁶¹² Two common measurements are the Normalized Difference Vegetation Index, which measures the density of vegetation, and the Photochemical Reflectance Index, which measures the efficiency of photosynthesis. NASA, "Measuring Vegetation (NDVI & EVI)," August 30, 2000.

⁶¹³ Images from most cameras used by UAV are already tagged with geographic location data. Industry representative, telephone interview by USITC staff, April 3, 2017; in China, where most fields are small, UAVs are reportedly used to apply pesticides. Jiang, "Drones for Agricultural Use Taking Off in China," July 25, 2016. The volume of data collected by UAVs is large. Uploading the data to be analyzed in the cloud may take several hours. Many users upload data overnight and download the resulting analysis the following day. Industry representative, telephone interview by USITC staff, April 3, 2017.

⁶¹⁴ IBIS, *Unmanned Aerial Vehicle (UAV) Manufacturing in the U.S.*, December 2015, 16.

⁶¹⁵ *Ibid.*, 25.

⁶¹⁶ FAA, *FAA Aerospace Forecast: Fiscal Years 2017–2037*, March 21, 2017, 31–32.

⁶¹⁷ DroneDeploy, "Commercial Drone Industry Trends," March 2017, 6. Many operators have more than one UAV.

⁶¹⁸ DroneDeploy, "Commercial Drone Industry Trends," March 2017, 4.

⁶¹⁹ Forni and van der Meulen, "Gartner Says Almost 3 Million Personal and Commercial Drones," February 9, 2017.

UAVs are becoming increasingly common in key markets discussed in this report, with numerous military and civilian applications. In certain EU member states, unlike in the United States, UAV operators can fly a UAV beyond the operator's visual line of sight, increasing the usefulness of UAVs for agricultural use.⁶²⁰ In Brazil, Qualcomm has launched a pilot program that uses drones to survey crops and send data back to farmers, with an emphasis on making the technology affordable for smaller, non-corporate farms.⁶²¹

3-D Printers

3-D printing is a relatively limited digital process that is mainly used in R&D and production applications such as prototyping, customized medical devices, customized consumer goods, and limited aerospace applications.⁶²² The process can also be used to produce equipment with properties that were not attainable before. For example, footwear companies such as Nike, Adidas, and New Balance are in different stages of testing 3-D printing with hopes of offering higher-quality shoes with better flexibility, strength, and cushioning, as well as more customizable options for their various product lines.⁶²³ As of 2017, Adidas and U.S. apparel brand Under Armour have successfully released limited production runs of 3-D-printed running shoes to the general public.⁶²⁴ One general manager noted that, whereas it historically takes between one and two years for a shoe design to go from concept to retail, the use of 3-D printed prototypes has the potential to reduce that to a matter of weeks.⁶²⁵

3-D printing can also be used to more rapidly create new molds for production in many manufacturing fields.⁶²⁶ According to one technical expert at Ford, for traditional prototypes, production time was 8–16 weeks and cost as much as \$100,000. But 3-D printing allows the production, assembly, and prepping the prototype for testing to all be done in as little as one week and for a few thousand dollars.⁶²⁷

⁶²⁰ McNabb, "5 Drone Applications Legal in Europe—But Not in the U.S.," May 4, 2017.

⁶²¹ Prescott, "IoT Projects Focused on Agriculture Take Root in Brazil," October 25, 2016.

⁶²² Wohlers Associates, *Wohlers Report 2016*, 2016.

⁶²³ Zaleski, "Who's Winning the 3D-Printed Shoe Race?" December 15, 2015.

⁶²⁴ Thomasson, "Adidas Will Mass-Produce 3D-Printed Sneakers," April 7, 2017; Lawler, "Under Armour's Latest \$300 3D-Printed Sneaker Arrives March 30th," March 24, 2017.

⁶²⁵ Zaleski, "Who's Winning the 3D-Printed Shoe Race?" December 15, 2015.

⁶²⁶ Industry representative, interview with USITC staff, April 2017.

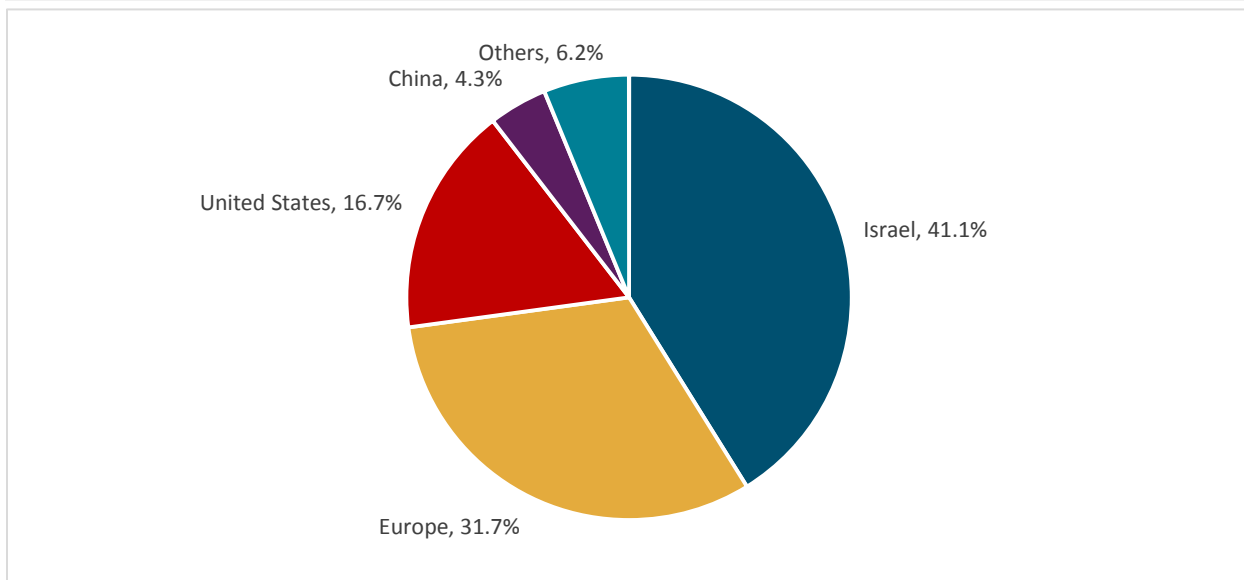
⁶²⁷ Kylau, Goerlich, and Mitchell, "How 3D Printing Will Disrupt Manufacturing," July 28, 2015.

U.S. and International Markets

Of the 1,100 U.S. manufacturing and supply chain firms interviewed in a recent industry survey, 15 percent had adopted 3-D printing technology by 2016.⁶²⁸ Worldwide, the top uses for 3-D printing in 2016 were automotive design (29.6 percent), aerospace and defense parts printing (17.8 percent), and tools/component printing (7.5 percent).⁶²⁹

The total market for 3-D printers increased 107 percent from 2013 (\$2.5 billion) to 2015 (\$5.2 billion).⁶³⁰ Of the 12,558 3-D printers sold in 2015, 41 percent were sold by Israeli companies (5,166), 32 percent by European companies (3,981), 17 percent by U.S. companies (2,097), and 4 percent by Chinese companies (534) (figure 6.4).⁶³¹ These sales make up over 93 percent of the total supply worldwide. By contrast, Brazilian companies sold only three 3-D printers in 2015, and neither Indonesian nor Russian companies sold any.⁶³²

Figure 6.4: Worldwide sales of 3-D printers, by exporter, 2015



Source: Wohlers Associates, *Wohlers Report 2016: 3-D Printing*, 2016.

Note: Corresponds to [appendix table G.16](#).

India's 3-D printing market is still quite small, but several startups are using the technology for automotive, electronic, healthcare, and aerospace applications. Several mechanical engineering programs at major Indian universities are training students in the use of 3-D printing and

⁶²⁸ MHI, *The 2017 MHI Annual Industry Report*, MHI & Deloitte, 2017.

⁶²⁹ Statista, "3D Printing Market by Use Case" (accessed July 7, 2017).

⁶³⁰ Statista, "Global Market for 3D Printers" (accessed July 7, 2017).

⁶³¹ Wohlers Associates, *Wohlers Report 2016: 3-D Printing*, 2016.

⁶³² Ibid.

computer-aided design (CAD) software.⁶³³ Russian companies and citizens currently own 2 percent of the world's 3-D printers; some Russian companies have used the technology to make prosthetics and dentures.⁶³⁴

Market Competition and Trends

Top U.S. producers of 3-D printers include HP, 3D Systems, Inc., Proto Labs, Stratasys, and ExOne. Another large producer of 3-D printers is Materialise NV, a Belgian company, which has facilities in the United States as well as in China, Brazil, and other European countries. 3-D printers vary significantly in price and capability. Those commonly used by hobbyists, universities, and small businesses typically range from several hundred dollars to more than ten thousand dollars. Generic 3-D printers marketed by Monoprice cost less than \$1,000,⁶³⁵ while higher-end models from MakerBot, a subsidiary of Stratasys, cost between \$1,300 and \$6,500.⁶³⁶ Printers in the lower price ranges typically use plastic filaments and are unable to build the more advanced shapes or metallic objects that powder-based printers can produce. Prices of advanced industrial 3-D printers such as those offered by 3D Systems range from \$70,000⁶³⁷ to more than \$300,000,⁶³⁸ the top-end units manufactured by German firm EOS cost as much as \$250,000.⁶³⁹

Industry's Use of Cloud Computing and Data Analysis

Like digital technologies related to the IoT, automation and robotics, cloud computing and advanced data analysis are becoming standard tools for firms in all functional areas of their business: research and product development; production; management and internal coordination; marketing, sales, and customer relationship management; and distribution and post-sales services (see table 6.1 earlier in this chapter). As firms of all kinds increasingly collect data from an ever wider range of sources and devices, they benefit from efficiency-enhancing and profit-generating uses for big data analysis and other types of advanced data analytics. To reap productivity gains, most firms are outsourcing the storage and processing of their data to cloud services providers, reducing their up-front costs and gaining access to almost unlimited

⁶³³ IANS, "Dassault Systems Set to Skill, Nurture Indian 3D Printing Market," February 8, 2017.

⁶³⁴ Smile Expo, "The Development of 3D Printing in Russia," November 2, 2016.

⁶³⁵ Monoprice, "Maker Ultimate 3D Printer" (accessed June 16, 2017).

⁶³⁶ Makerbot, "Compare Makerbot 3D Printers" (accessed June 16, 2017).

⁶³⁷ 3D Hubs, "3D Printer Index" (accessed June 16, 2017).

⁶³⁸ 3D Shop, "3D Systems ProJet 7000 MP 3D Printer" <http://www.the3dshop.com/product-view.aspx?i=63011> (accessed June 19, 2017).

⁶³⁹ 3D Hubs, "3D Printer Index" (accessed June 16, 2017).

data storage and processing power. Data analysis is also moving increasingly to the cloud, because it often requires large amounts of data that would be difficult to store or process otherwise (see chapter 3 for more on major cloud providers and global usage). Some firms outsource the analysis of their data to data analytics services providers (usually operating in a cloud environment), while others use ML and other AI techniques themselves to glean insights from their datasets.⁶⁴⁰

Cloud Computing Applications in Industry

Firms in almost every industry sector use cloud computing services in their business, from centralized data storage and processing, to communication and collaboration across locations. As mentioned earlier, cloud computing services enable firms to combine and manipulate data from multiple locations. Data from connected devices, for example, would be less useful if firms could not do this.⁶⁴¹

In an EIU survey of 360 senior executives, half believed cloud computing was either a significant or pervasive presence in their industry. Many services sectors, for example, perceive important benefits to cloud computing because data flows are central to their operations. In the banking and retail sectors, nearly 60 percent of respondents reported a significant or pervasive presence of cloud computing in their industry, while in manufacturing the number was just below 50 percent. In education and healthcare the number was slightly lower, at 44 percent and 39 percent, respectively.⁶⁴² In banking, cloud computing is streamlining back-office functions and linking new, innovative financial technology (fintech) services providers to larger financial institutions and their customers. In retail services, cloud computing enables firms to reach customers more easily and to react more quickly to shifts in customer demand. In education services, cloud computing enables expansion of enrollment in online courses, while in healthcare, it is expected to lead to a sharp widening of access to health services with remote monitoring, diagnostics, and treatment.⁶⁴³

Cloud computing is also used by firms in sectors across the economy for management and internal coordination, as well as supply chain management. Especially in large firms with many locations, networked and scalable ICT capability is very advantageous for administrative

⁶⁴⁰ Weldon, “The 14 Leading Products for Predictive Analytics,” March 23, 2017, 1. Major cloud-services providers that have strength in analytics, such as IBM, Google, Microsoft, and SAP, are active in this market, as are specialist analytics software firms such as Alpine Data, RapidMiner, SAS, and Statistica.

⁶⁴¹ Specialist cloud services providers such as Box, a company that offers a secure method for storing and accessing sensitive files in the cloud, often run their services on cloud infrastructure offered by one of the major cloud-services firms such as AWS, Microsoft, or Google. Darrow, “Box Says Its Latest Cloud Feature,” June 14, 2017.

⁶⁴² EIU, *Ascending Cloud*, 2016, 3.

⁶⁴³ *Ibid.*, 4–8.

functions such as human resources, budget and control, management accounting, or regulatory compliance. For example, when Four Seasons (a Canadian luxury hotel chain) moved to a globally scaled cloud-based human resources system in 2015, it was able to achieve a relatively uniform organizational structure across sites while still permitting local customization where necessary for its 85 hotels located in 41 different countries.⁶⁴⁴ Additionally, when companies switch from using in-house servers to renting cloud infrastructure they can save money on maintenance, even if they do not integrate across multiple locations.⁶⁴⁵

With its scalable connectivity, a cloud-based supply chain management system helps firms to control their procurement and parts inventory. Companies can share data internally across sites (horizontal integration) or across firms (vertical integration), enabling different firms within the supply chain to better collaborate.⁶⁴⁶ This type of information sharing reduces lead times and operational risk and increases productive efficiency. (See box 6.1 below for more on cloud computing in chemicals manufacturing.) For example, when Boeing developed the airframes for its 777 and 787 jets using cloud-based virtual design, it was able to reduce the time spent from production to market by more than 50 percent.⁶⁴⁷

Box 6.1: Cloud Computing in Chemicals Manufacturing

The chemicals industry increasingly uses cloud computing to handle increased computational requirements and a shift to more collaborative business models for both R&D and production. For example, in the pharmaceutical sector, the cost and complexity of data storage has increased along with the amount of data generated. As a result, companies are facing challenges in managing their own data storage needs and performing their research in-house. One publicly available dataset, the International Cancer Genome Consortium's database, is over two petabytes in size; it could take a research group more than 15 months to download and a million dollars of computer hardware simply to store.^a Storing and sharing such large amounts of data on cloud services reduces data analytics costs and the IT management burden for companies. Sharing services helps to both increase return on investment for large, established companies and allows new, smaller companies to enter the pharmaceutical industry and be productive.

Other costs and technical challenges have also increased in the sector.^b Collaborative work between traditional pharmaceutical companies and more specialized entities, such as biotechnology firms and clinical research organizations, has become more common in both drug development and clinical research. Faced with a high level of regulation, some pharmaceutical partnerships depend on cloud computing to manage not only product development, but also the significant documentation and compliance burden across multiple production sites.^c In fact, 20 percent of pharmaceutical companies deploy manufacturing software in the cloud, often to “collaborate more easily with upstream partners,

⁶⁴⁴ Finnegan, “Four Seasons Chooses Workday Hcm Cloud,” October 20, 2015.

⁶⁴⁵ Ripton, “8 Ways Cloud Computing Can Increase Productivity and Profits,” February 22, 2017.

⁶⁴⁶ OECD, *The Next Production Revolution: Implications for Governments and Business*, 2017, 82.

⁶⁴⁷ Richman, “Microsoft Azure Wins Big Piece of Boeing’s Cloud Computing Business,” July 18, 2016.

facilitate quicker FDA approvals, and more efficiently extend quality and compliance functionality to professionals in distributed locations.”^d

Other sectors of the chemical industry may be adopting cloud technology more widely, but mostly for purposes of internal coordination. A 2014 survey suggests that more than 80 percent of chemical companies were planning to use the technology for enterprise processes such as human resources, while 42 percent said they were planning to use it for new product development. The main perceived benefits of the cloud were IT cost reduction and the ability to better deploy IT resources. The main obstacles to adopting the cloud were complexities due to privacy, data information management, and security.

Sources: Mullin, “Cloud Computing,” October 24, 2016; industry representative, telephone interview by USITC staff, May 5, 2017; Stein et al., “Data Analysis: Creating a Cloud Commons,” July 8, 2015; Markarian, “The Internet of Things for Pharmaceutical Manufacturing,” September 2, 2016; Littlefield et al., *A Road Map for Addressing Quality and Manufacturing Challenges in Life Sciences* (accessed May 10, 2017), 36; ChemITC, *Chemical Companies’ Cloud Strategy: Current Adoption and Future Plans*, 2014, 3–4.

^a A petabyte is 10,000,000,000,000,000 bytes. Stein et al., “Data Analysis: Creating a Cloud Commons,” July 8, 2015.

^b Developing a new cancer drug can cost up to \$2.6 billion over 12–14 years. Medeiros, “The Startup Fighting Cancer with AI,” March 22, 2016.

^c “The key distinguishing feature of the pharma industry is the requirement to document and record everything that happens during production for compliance reasons.” Markarian, “The Internet of Things for Pharmaceutical Manufacturing,” September 2, 2016.

^d Littlefield, “Addressing Quality and Manufacturing Challenges in Life Sciences” (accessed May 10, 2017), 36.

Cloud computing also plays an important role in sales and marketing. Customer relationship management firms assist companies with practices, technologies, and strategies aimed at better managing and analyzing customer interactions in order to improve the business-customer relationship, improve customer retention, and drive sales growth. For example, the U.S. software provider Salesforce has a “Sales Cloud” designed to “help salespeople sell smarter and faster by centralizing customer information, logging their interactions with your company, and automating many of the tasks salespeople do every day.”⁶⁴⁸ In addition, Salesforce has created platforms for specific industries. For example, in partnership with the Dutch technology company Philips, Salesforce introduced a cloud-based health-care platform. The platform can remotely monitor patients with chronic diseases, aiming to improve management of complex chronic diseases for health-care providers.⁶⁴⁹

One way that manufacturers also use the cloud is in the provision of post-sales services. For example, many automotive manufacturers, including GM, Ford, and Tesla, have cloud-based systems that provide different services to vehicle owners. Tesla transmits safety updates and software downloads directly to its vehicles via the cloud.⁶⁵⁰ The company has even begun

⁶⁴⁸ Salesforce, “Frequently Asked Questions (FAQ)” (accessed May 19, 2017), <https://www.salesforce.com/products/sales-cloud/faq/>.

⁶⁴⁹ Lohr, “Salesforce Takes Its Cloud Model to Health Care,” June 26, 2014.

⁶⁵⁰ Taub, “Your Car’s Software Is Ready,” September 8, 2016; Brisbane, “Tesla’s Over-the-Air Fix” (accessed May 19, 2017).

offering additional options for purchase via download, including its “autopilot” system, which enables some hands-free driving.⁶⁵¹ GM’s OnStar increases the usefulness of its vehicles by providing navigation, security, emergency, and diagnostic services, as well as providing other services like phone, Internet search, and digital wallets that rely on Internet connectivity.⁶⁵² Boeing, a manufacturer of large civil aircraft, already uses cloud computing for various post-sales services. Through the increased use of cloud software, Boeing offers analytic services during the life of their aircraft, helping airlines to optimize fuel consumption and reduce maintenance costs.⁶⁵³

Data Analytics Applications in Industry

Data analytics is the ability to extract and analyze information from existing datasets or other technologies to better examine trends in processes and to predict future outcomes. According to one recent industry survey, firms in a wide range of industry sectors view cloud-based data analysis services as central to the success of their business for R&D, marketing and sales, executive management, finance, and IT functions.⁶⁵⁴ This is particularly true in financial services, where over 80 percent of firms said that these services were critical, very important, or important to their industry. In the education sector, 60 percent of firms ranked cloud business intelligence services highly, while in healthcare the number was 40 percent. About half of firms surveyed in the retail and wholesale services sector rated these services as critical, very important, or important, similar to the response rate for the telecommunications sector. In business services the response was slightly higher, at around 55 percent, while in manufacturing the number was lower, at around 25 percent.⁶⁵⁵ Worldwide revenues for big data and business analytics are expected to reach \$151 billion in 2017, up 12 percent from 2016, according to International Data Corporation.⁶⁵⁶

Data analytics helps businesses to achieve cost savings, accelerate decision making, and create new products and services through careful analysis of their data.⁶⁵⁷ Although successful firms have always sought to adapt their business strategies based on available information, the huge amount of data now being collected requires new analytical approaches and scalable data-

⁶⁵¹ Boyle, “Tesla Releases Autopilot Features Available via Download,” October 26, 2015.

⁶⁵² OnStar, “The Evolution of OnStar,” September 19, 2016, “Redefining Manufacturing,” June 19, 2017.

⁶⁵³ Kawamoto, “Microsoft Azure Wins Boeing’s Cloud Business,” July 19, 2016.

⁶⁵⁴ Dresner Advisory Services, *2017 Cloud Computing and Business Intelligence Market Study*, as quoted in Columbus, “2017 State of Cloud Business Intelligence,” April 9, 2017.

⁶⁵⁵ Dresner Advisory Services, *2017 Cloud Computing and Business Intelligence Market Study*, as quoted in Columbus, “2017 State of Cloud Business Intelligence,” April 9, 2017.

⁶⁵⁶ Violino, “Big Data and Analytics See Double Digit Growth,” March 27, 2017.

⁶⁵⁷ SAS Institute, “Big Data Analytics: What It Is and Why it Matters” (accessed April 20, 2017); IBM, “What Is Big Data Analytics?” (accessed April 20, 2017).

handling capability in order to extract additional, useful information. Data analytics has evolved beyond performing simple statistical analysis of the data into using AI and ML to spot patterns and opportunities previously undiscovered.⁶⁵⁸

Artificial Intelligence and Machine Learning

AI is a generic term for computational programs or applications that can react and exhibit foresight rather than just follow a strict set of programmed rules. ML is an application of AI where the machine learns through examples and precedents.⁶⁵⁹ The theory underpinning AI has been around since the 1950s, but has become more useful as cloud computing has significantly increased data processing and storage capabilities at a significantly lower cost.⁶⁶⁰

AI and ML create productivity improvements through the automation of typically human-tasks processes. ML, and AI more generally, can handle voice recognition and other complex data analysis tasks. AI is used for natural language processing for voice assistants or chatbots as developed by companies like Google, Amazon, Microsoft, and Apple. These resources are found in standalone devices, automobiles, and smartphones.⁶⁶¹ By organizing the huge flow of unstructured data generated in normal business operations into structured datasets that can be analyzed, AI and ML enable firms to glean valuable insights. For example, IBM's Watson is able to quickly and efficiently review previous clinical trials, textbooks, and journal articles to aid doctors in oncology diagnoses and treatments. This results in more accurate diagnoses and better quality of care.⁶⁶²

Advanced data analytics have long been used in the retail sector to analyze customer preferences and shopping patterns. Market research is a large segment in the data analytics sector, now that many transactions take place via connected devices and generate large amounts of transaction history data.⁶⁶³ Travel firms have started to use ML to offer tailored suggestions based on user preferences in matters like specific seasons, hotel styles, and price.⁶⁶⁴ Moreover, firms like Boxever and John Paul provide customer relationship

⁶⁵⁸ IBM, "What Is Big Data Analytics?" (accessed on April 20, 2017).

⁶⁵⁹ Reese, "Understanding the Differences Between AI, Machine Learning, and Deep Learning," February 23, 2017; Software & Information Industry Alliance, *Artificial Intelligence and the Future of Work*, September 22, 2016, 6.

⁶⁶⁰ Copeland, "What's the Difference Between Artificial Intelligence, Machine Learning, and Deep Learning?" July 29, 2016.

⁶⁶¹ USITC, hearing transcript, April 4, 2017, 337 (testimony of Christine Bliss, Coalition of Services Industries).

⁶⁶² SIIA, *Artificial Intelligence and the Future of Work*, September 22, 2016, 8.

⁶⁶³ Bressand et al., "How Leading Retailers Turn Insights into Profits," December 2014.

⁶⁶⁴ Yao, "Balancing Machine Learning and Human Intuition in the Travel Industry," April 13, 2017.

management services for the travel industry, aimed at improving a firm's customer experience using the cloud and AI to personalize responses and results provided to a given customer.⁶⁶⁵

ML has become an important part of various digital business ventures. For example, at Amazon, ML is heavily involved in drone delivery services, the popular Amazon Echo voice-activated speaker, and the new cashierless Amazon Go convenience stores unveiled in Seattle in 2016.⁶⁶⁶ Chatbots, already commonly used by digital services firms such as MasterCard and Kik, are becoming more widely adopted in a variety of customer-facing industries such as customized banking and retail services.⁶⁶⁷ eBay is currently beta testing its “ShopBot,” which uses AI to provide customers with a smart personal shopping assistant via Facebook Messenger. ShopBot allows customers to type a word or take a picture of an item and immediately receive URLs to purchase the item in question at the cheapest available price across eBay’s one billion listings.⁶⁶⁸ AI has also become common place in the post-sales and support phases of company-customer interaction, with telecommunications companies like Verizon and Comcast offering online automated support that reduces company costs while also reducing the need for human support staff to respond to high volumes of customer calls.

Data Analytics and Predictive Analysis in Manufacturing

Predictive analysis is using data, statistical algorithms, and ML techniques to identify the likelihood of future outcomes based on historical data.⁶⁶⁹ Predictive analysis is becoming more common, particularly in the manufacturing sector. While only 17 percent of companies surveyed by MHI stated that they were using predictive analysis in their business operations currently, 79 percent of respondents say they will within the next five years.⁶⁷⁰ This new resource offers more sophisticated statistical and quantitative analysis, data mining, and predictive simulations that enable firms to predict, forecast, optimize, and determine the best business plan for a given situation. It replaces the more traditional business practice of examining data post hoc to understand what has already happened.⁶⁷¹

Many companies that lack internal data analytics expertise turn to cloud-based services. This lack of knowledge and skill in data analytics has led to growth in the number of consultancies

⁶⁶⁵ Boxever Company, <http://www.boxever.com/solution-overview/>; John Paul Company, <https://www.johnpaul.com/en/home/>.

⁶⁶⁶ Soper, “Bezos Says Artificial Intelligence to Fuel Amazon’s Success,” April 12, 2017.

⁶⁶⁷ Mishra, “Winning Over Customers and Employees with Chatbots,” June 20, 2017.

⁶⁶⁸ Pittman, “Say Hello to eBay ShopBot Beta,” October 17, 2016.

⁶⁶⁹ SAS, “Predictive Analytics: What It Is and Why It Matters” (accessed June 19, 2017).

⁶⁷⁰ MHI, *The 2017 MHI Annual Industry Report*, 2017.

⁶⁷¹ SAS, *The Internet of Things: Finding the Path to Value*, January 27, 2016.

and solutions firms that offer services including the analysis of a firm's data and the creation of a predictive analytics plan that fits a specific company.

Even so, two-thirds of manufacturers surveyed in one study report that they still rely more on management experience and expertise than advanced data analytics when addressing business issues.⁶⁷² *Harvard Business Review* reports that only 18 percent of 306 interviewed business leaders indicated that their companies have a big data strategy approach in place, and only 35 percent are currently developing big data strategies and approaches.⁶⁷³ Firms indicate that lack of skills, changes to existing business processes that would be needed, challenges related to correlating different data formats, and uncertainty about the usefulness of big data are all factors preventing them from using (or using more of) the big data already being collected.⁶⁷⁴

Data Analytics in Chemical Manufacturing

For pharmaceutical firms, digitization has increased the amount of data collected at production facilities, often by one or two orders of magnitude, which can lead to new analysis techniques that provide novel insights.⁶⁷⁵ In one example of the benefits of large data, Merck used advanced data analysis and modeling techniques that combined equipment data with maintenance and production environment data, carrying out 15 billion calculations to improve performance at a production facility.⁶⁷⁶

Data analytics may offer new approaches to product development. Traditional drug and chemical compound development relies on the often costly and time-consuming method of identifying possible candidate products and physically screening them for effect in a simulation of the target physical environment. In contrast, “de novo” design techniques use complex datasets to first model the physical setting and desired effect of a compound, then design a chemical that will match those requirements.⁶⁷⁷ A variation of de novo development is demonstrated in the development of an anticancer drug at the company Berg, a biopharma company where studies of a single sample environment of tissue cells generated 14 trillion data points. Studying such a large amount of data required AI methods to analyze the data and inform product development.⁶⁷⁸

⁶⁷² SAS, *The Internet of Things: Finding the Path to Value*, January 27, 2016.

⁶⁷³ *HBR, The Enterprise Lacks a Big Data Strategy*, 2017.

⁶⁷⁴ *Ibid.*

⁶⁷⁵ Porter et al., “Digital Opportunities for Chemical Producers,” August 10, 2016.

⁶⁷⁶ Henschen, “Merck Optimizes Manufacturing with Big Data Analytics,” April 2, 2014.

⁶⁷⁷ Tetko et al., “BIGCHEM: Challenges and Opportunities for Big Data Analysis in Chemistry,” December 2016.

⁶⁷⁸ Medeiros, “The Startup Fighting Cancer with AI,” March 22, 2016.

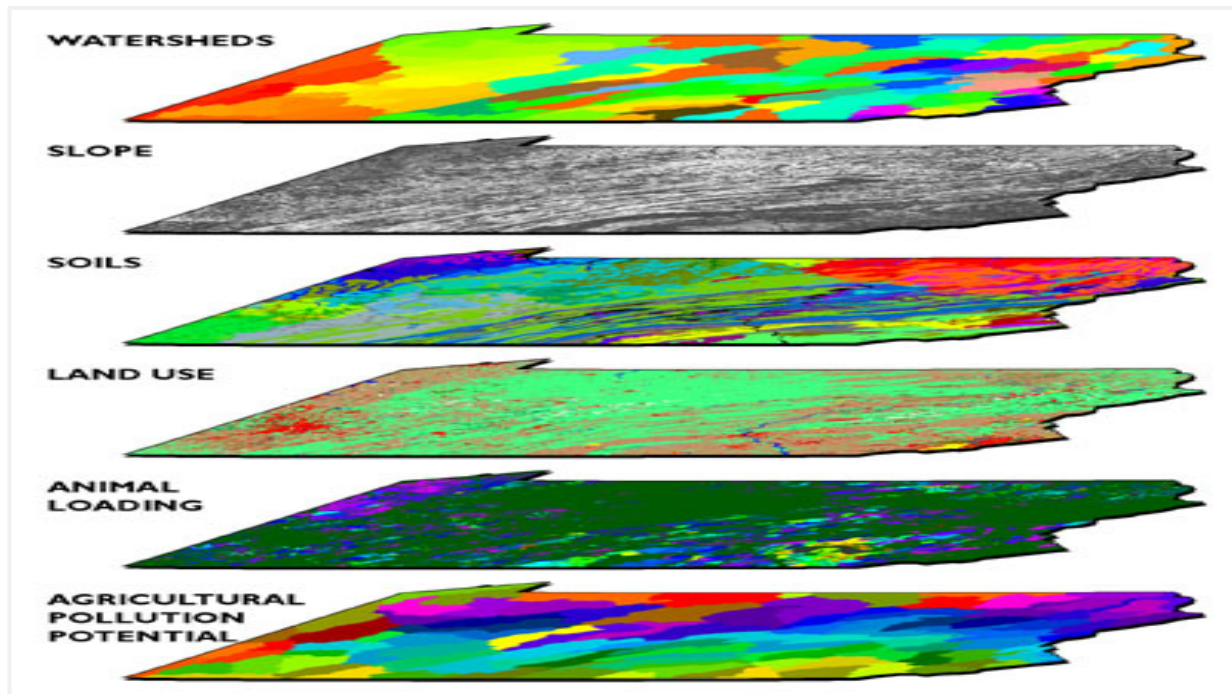
Data Analytics in Agriculture

Data on soil or on production characteristics such as yield can be paired with location data to produce a detailed map of characteristics of interest. This detailed information is available to farm managers making decisions on which crops to plant or how much fertilizer or pesticide to apply next year. Often, farm-specific data are combined with data on weather patterns, pest or disease infestations, global market conditions, exchange rates, and the costs and expected response of possible interventions, such as applying more or a different fertilizer.⁶⁷⁹ Data are used to determine management zones, also called a prescription map. This allows farmers to make better decisions and to make them on a more disaggregated basis, reportedly using farm field grids as small as 10 meters square.⁶⁸⁰ It can be thought of visually as creating a map overlay. Data on each characteristic becomes one layer of the map. Different layers are then combined to create a map showing different management zones.

The map overlay shown in figure 6.5 illustrates the agricultural pollution potential of major watersheds in the state of Pennsylvania. The different map layers include the state's watersheds, land slopes, soil types, land uses, and animal loading. Similarly, map layers for a farm field showing last year's yield, slope of the land, soil type, and amount of vegetation could be used to create a map of application rates for fertilizer. The recommended application rate would be different for each zone, illustrated visually by a different color on the map.

⁶⁷⁹ Often, these data are combined with information gathered by the farmer or consultant “ground proofing.” That is, walking into the field and adding additional observations on-site. Multiple types of measurement can be performed with a GPS-enabled device like a smartphone and added to an analysis.

⁶⁸⁰ Industry representative, telephone interview by USITC staff, April 3, 2017.

Figure 6.5: Illustration of map overlay layers

Source: DiBiase et al., “Map Overlay Concept,” chap. 9, “Integrating Geographic Data” in *The Nature of Geographic Information*, Pennsylvania State University, Penn State College of Earth and Mineral Sciences, Department of Geography (accessed July 20, 2017).

Data Analytics in Insurance and Banking

In the financial sector, both insurance companies and banks have taken advantage of data analytics. Using this tool, they have improved their assessments of risk, creditworthiness, and fraud, as well as facilitated regulatory compliance.

Insurance providers use data analytics primarily to price their insurance products more effectively, based on a detailed and sometimes individualized evaluation of risk. (See the section on usage-based insurance earlier in this chapter for a description of how insurers are beginning to use individualized risk assessments when pricing auto insurance.) Underwriters offering all types of insurance are increasingly turning to AI and other advanced analytical methods to improve their actuarial assessments with better insights about their customers and about the likelihood of negative events affecting their customers.⁶⁸¹ Social media, location, web browsing, and loyalty cards are new sources of third-party data that can be used to assess insurance risk at the customer level.⁶⁸² With larger datasets and better data analytics, insurance companies can make more accurate predictions about the probability of negative events and

⁶⁸¹ Golia, “Machine Learning: the Next Step for Insurance Analytics,” March 30, 2017.

⁶⁸² *Economist*, “Big Data, Financial Services and Privacy,” February 9, 2017.

future claims, and thus are able to price their insurance products more keenly.⁶⁸³ However, since risk-pricing algorithms tend to be proprietary, both consumers and regulators face a lack of transparency when determining how premium rates are assigned to customers.⁶⁸⁴

Banks, too, now rely on data analytics to inform a variety of core business functions. With better analytical engines they are able to achieve more accurate pricing for loans and other credit products, better risk management for trading operations, more effective marketing and customer support, better identification of illegal and fraudulent transactions, and prudential regulatory compliance.⁶⁸⁵ Advanced data analysis for risk management is an especially important tool for banks because it allows a large number of financial risk variables (including new regulatory measures and market scenarios) to be monitored in real time across the bank, rather than having position and risk monitoring compartmentalized within individual departments.⁶⁸⁶

Data analytics also help banks to vet new customers and comply with know-your-customer and anti-money-laundering regulations, and to offer a wider range of services to both new and existing clients. According to one industry survey, in the next few years banks will increasingly interact with their customers via AI tools.⁶⁸⁷ In markets with less developed credit reporting systems, or in cases where customers lack credit history due to their age or socioeconomic status, banks can use data analytics to estimate a potential customer's creditworthiness.⁶⁸⁸ Factors such as the structure of a customer's social media network, the time of day that they submit a credit application, and the length of time that they take to fill out the application can all be used to supplement credit history.⁶⁸⁹ With an established customer, a bank gains insights from monitoring account transaction patterns. These can be used, for example, to predict consumer behavior such as travel and foreign transactions, thereby allowing a bank to offer customized services to such customers.⁶⁹⁰ In another example, banks use analytics to identify customers who may be considering a major purchase such as an automobile or a home,

⁶⁸³ Ralph, "Insurance: Robots Learn the Business of Covering Risk," May 16, 2017; Simchak, written testimony to the USITC, April 4, 2017, 3; USITC, *Digital Trade in the U.S. and Global Economies: Part 2*, 2014, 157.

⁶⁸⁴ *Economist*, "Big Data, Financial Services and Privacy," February 9, 2017.

⁶⁸⁵ *BizTech*, "7 Ways Banks Benefit from Using Data Analytics," May 9, 2016; EY, *The Digital Bank: Tech Innovations Driving Change at US Banks*, 2016.

⁶⁸⁶ Toraskar, "Fast Data Is the Key to Next-Gen Capital," December 9, 2015.

⁶⁸⁷ Kelly, "AI to Become the Main Way Banks Interact with Customers," March 28, 2017.

⁶⁸⁸ Li, "How Technology Is Changing Online Credit Checks," March 28, 2017.

⁶⁸⁹ Chintamaneni, "How Banks Are Capitalizing on a New Wave of Big Data," November 22, 2016.

⁶⁹⁰ PwC, "The Extra Mile: Risk, Regulatory, and Compliance Data," April 2015.

allowing them to preemptively offer customers loans or other services that are tailored to their financial needs.⁶⁹¹

Banks can also use data analytics to verify that transactions are legal and to detect fraud, such as misuse of a customer's data or unauthorized activity among the bank's own employees.⁶⁹² For example, if regulators suspect that a bank's clients may be engaged in money laundering or other illicit activities, the bank can use data analytics to monitor transaction patterns in the suspected accounts. If all is well, the bank can “demonstrate to the regulators that the accounts were compliant with [anti-money laundering] regulations.”⁶⁹³

Finally, banks use data analytics to ensure compliance with prudential risk requirements set by their financial regulator. Under Basel III, a set of international reform measures agreed to in 2010 in the wake of the global financial crisis, the G20 countries and others have established regulatory requirements for reserving capital and maintaining liquidity to ensure the stability of the banking system. As part of this process, banks work with regulators to agree on approaches for modeling all types of risk.⁶⁹⁴

⁶⁹¹ Chintamaneni, “How Banks Are Capitalizing on a New Wave of Big Data and Analytics,” November 22, 2016.

⁶⁹² EY, *The Digital Bank: Tech Innovations Driving Change at US Banks*, 2016.

⁶⁹³ PwC “The Extra Mile: Risk, Regulatory, and Compliance Data,” April 2015.

⁶⁹⁴ USITC, *Recent Trends in U.S. Services Trade*, 2016, 76.

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Chapter 7

Consumer Communications Services and Connected Devices

Introduction

In recent years, communications services offered to end-users have become more sophisticated, often integrating images and streamed video into phone calls, messaging, and social media communications. The number of devices through which users access these sophisticated Internet-based services continues to grow exponentially. Such devices now include a wide array of products beyond smartphones, tablets, and personal computers. Recent innovations in machine-to-machine (M2M) technologies, particularly sensor and data-logging technologies, combined with the widespread availability of wireless technologies, have enabled the rollout of an ever-increasing variety of innovative, Internet-connected communications devices.

This chapter spotlights emerging trends in the digital communications industry, with a focus on products and services that facilitate digital trade, particularly the mass adoption of new over-the-top communications and messaging services, and recent innovations in connected devices. The products and services discussed here include both business-to-business (B2B) and business-to-consumer (B2C) applications.

The chapter is divided into two sections. The first section looks at devices and networks of devices that are used to communicate data in new places and ways. The second section examines new communications services that have evolved as a result of digital technologies. Policies that restrict data flows, such as data localization, as well as tariffs on imports of tech products, can particularly impede U.S. firms' ability to sell the products and services described in this chapter in foreign markets. For more discussion on policies and regulatory measures see chapter 8.

Internet-Connected Devices

This section focuses on devices and networks of devices that allow Internet access and enable individuals and firms to use digital technologies for a growing array of purposes. The first section lays out recent developments in smartphone adoption in various national and regional markets, highlighting the fact that mobile access is becoming the most common means of

accessing the Internet for consumers in many countries. The following two sections look at devices attached to people (wearables and remote healthcare monitoring), which collect large amounts of individual data that can be used in a variety of ways (to analyze health, athletic activity, etc.). These devices tend to have relatively limited technology inputs (a few sensors, limited memory, and a wireless connection), but, are increasingly able to transmit data through cloud-based applications to be stored and analyzed. The final section examines networks of devices and sensors that enable city and home improvements, data collection, analysis, and remote access.

Smartphones

A smartphone is a handheld electronic device that performs not only the basic operations of a mobile telephone but also functions as a specialized computer. Most smartphones feature a touchscreen interface, a camera, Internet connectivity (mobile broadband and/or Wi-Fi), a QWERTY keyboard (either physical keys or touchscreen symbols), and a computer operating system capable of running a variety of mobile applications (apps)⁶⁹⁵ and tools. Examples of popular smartphones include Apple iPhones⁶⁹⁶ and the Samsung Galaxy S series.⁶⁹⁷

After more than 10 years of strong growth, smartphone sales are likely to start slowing as markets in the United States, Western Europe, and even China approach saturation. In addition, the level of technological and design sophistication of the average smartphone is increasingly difficult for a new model to surpass, eroding the ability of vendors to convince consumers to replace their old handsets.⁶⁹⁸

U.S. and International Markets

In 2016, the global smartphone market grew by 7.7 percent to \$428.9 billion. China accounted for 31 percent (\$133.6 billion) of global sales, making it the single largest regional market, followed by North America (\$71.8 billion; 16.7 percent), Western Europe (\$53.6 billion; 12.5 percent) and the developed countries of the Asia-Pacific region⁶⁹⁹ (\$45.3 billion; 11

⁶⁹⁵ Mobile apps are software programs designed to run on mobile devices, mainly smartphones and tablet computers.

⁶⁹⁶ Apple Inc., "iPhone," <https://www.apple.com/iphone/> (accessed May 11, 2017).

⁶⁹⁷ Samsung Electronics Company Limited, "All Galaxy Phones,"

http://www.samsung.com/us/mobile/phones/galaxy-s/s/_/n-10+11+hv1rp+zq1xa/ (accessed May 11, 2017).

⁶⁹⁸ EIU, *World Industry Outlook: Telecommunications*, November 2016, 3; EIU, *Telecoms: Treading the Line*, 2016, 48.

⁶⁹⁹ Developed markets in the Asia-Pacific are: Australia, Hong Kong (China), Japan, New Zealand, Singapore, South Korea, and Chinese Taipei. Statista, "Smartphones," 2017, 65.

percent).⁷⁰⁰ Global smartphone shipments totaled 1.47 billion units in 2016, up 2.3 percent over the previous year.⁷⁰¹ In 2015, the latest year for which data are available, China was the largest single-country market for smartphones, accounting for 29.7 percent of global shipments, followed by the United States (11.8 percent), India (7.6 percent), Brazil (4.4 percent), and the United Kingdom (2.4 percent).⁷⁰²

Market Competition

Globally, Samsung and Apple are the leading makers of smartphones. Samsung has been the clear market leader in recent years, as it shipped 306 million units in 2016,⁷⁰³ accounting for 21.2 percent of the global smartphone market. Its 2016 share, however, represented a slight decline (from 22.3 percent in 2015), due to heavy industry competition and a recall of its popular Galaxy Note 7.⁷⁰⁴ Apple, which shipped 207 million units in 2016, was the second-largest vendor of smartphones globally, accounting for 14.6 percent of the world market.⁷⁰⁵ Apple's market share has also been affected by strong industry competition. Other prominent vendors of smartphones include LG, Lenovo, ZTE, Huawei, OPPO, Vivo, and Xiaomi.⁷⁰⁶ Google's Android, which was installed on more than 80 percent of the smartphones sold in 2016, was the dominant operating system. Apple's operating system (iOS), which was installed on approximately 15 percent of smartphones sold during that same year, is Android's main competitor.⁷⁰⁷

While Apple's iOS operating system is proprietary, the open-source Android system has encouraged a group of smaller, second-tier companies to release a wide array of budget smartphones designed to compete with the market leader's core product offerings. These budget devices sell alongside high-end, premium phones, varying in external design, screen size, build quality, and processing power. Overall, budget smartphones put significant downward pressure on industry pricing.⁷⁰⁸ As lower-end smartphones have improved, the initial differentiation offered by premium phones has significantly diminished, a factor that has

⁷⁰⁰ Smartphone sales in other regions include the Middle East and Africa (\$41.8 billion; 9.7 percent), emerging Asia-Pacific (\$34.1 billion; 7.9 percent), Latin America (\$31.7 billion; 7.4 percent); and Central and Eastern Europe (\$17.1 billion; 4 percent). Statista, "Smartphones," 2017, 20.

⁷⁰¹ Statista, "Smartphones," 2017, 20; IDC, "Apple Tops Samsung in the Fourth Quarter," February 1, 2017.

⁷⁰² Statista, "Smartphones," 2017, 40.

⁷⁰³ Ibid., 56.

⁷⁰⁴ In autumn 2016, Samsung suspended the sale of one of its flagship products, the Galaxy Note 7, due to a manufacturing defect that caused the batteries in some phones to catch fire; a recall of the Galaxy Note 7 was subsequently issued. Dolcourt, "Samsung Galaxy Note 7 Recall," April 16, 2017; Statista, "Smartphones," 2017, 59.

⁷⁰⁵ Statista, "Smartphones," 2017, 53, 59.

⁷⁰⁶ Ibid., 60.

⁷⁰⁷ Statista, "Statistics and Facts about Smartphones" (accessed May 22, 2017).

⁷⁰⁸ MarketLine, *Global Mobile Phones*, July 2016, 23; EIU, *World Industry Outlook: Telecommunications*, 2016, 17.

led a growing number of customers to gravitate towards less expensive handsets.⁷⁰⁹ In response, the leading vendors have taken steps to improve the functionality of existing smartphone features, including better image and sound quality.⁷¹⁰

The key barrier to entry in the smartphone market is competition from the large incumbent players—Samsung and Apple—with deep financial resources for research, development, production, and marketing.⁷¹¹ Chinese manufacturer Xiaomi competes with these incumbent rivals by offering smartphones at significantly lower prices; Xiaomi keeps costs down by using a direct-to-consumer distribution model. Although its profit margin on phones is reportedly only 1.3 percent, Xiaomi’s low-margin, high-volume strategy relies on its ability to build a substantial customer base to which it ultimately aims to sell apps and software. Apple and Samsung also earn revenues from selling apps through their respective app stores (box 7.1), although the majority of apps sold in their stores are developed by third parties, as opposed to in-house.⁷¹²

Box 7.1: App Stores

An app store is a digital platform designed to distribute smartphone and tablet apps. Since the main mobile operating systems are Android (Google) and iOS (Apple), the two largest app distribution platforms are, not surprisingly, Google Play and Apple’s App Store. Google Play is the largest app store, offering 2.8 million apps in March 2017. Although, nearly 69 percent of the apps in Google Play were free, the platform still reached sales of \$6 billion in 2015. Apple’s App Store contained about 2.2 million apps in 2017, slightly below Google Play, but contributed more directly to Apple’s bottom line, with sales totaling roughly \$29 billion in 2016.

In 2016, smartphone users downloaded more than 75 billion apps from both App Store and Google Play. Overall, the most popular apps in both App Store and Google Play, measured by the number of downloads, are games. In App Store, 25 percent of active apps in March 2017 were games. Other popular app categories include entertainment, photography/video, utilities, and social networking. Other app stores in 2017, include Windows Store (670,000 apps), Amazon App Store (600,000 apps), and BlackBerry World (234,500 apps).

Source: Statista, “App Stores,” 2017, 6, 10, 14, 16, 21–22, 27–29.

Some second-tier players are also able to compete with industry leaders by focusing on niche markets and/or specific geographic regions. In India, Karbonn Mobiles and Micromax have developed significant market share by focusing on rapid turnover of low-cost smartphones.⁷¹³

⁷⁰⁹ MarketLine, *Global Mobile Phones*, July 2016, 23.

⁷¹⁰ EIU, *Telecoms: Treading the Line*, 2016, 48.

⁷¹¹ MarketLine, *Global Mobile Phones*, July 2016, 19.

⁷¹² MarketLine, *Global Mobile Phones*, July 2016, 20. Samsung’s app store is quite small compared to the market leaders, Apple App Store and Google Play.

⁷¹³ EIU, *World Industry Outlook: Telecommunications*, November 2016, 17.

Companies like Telpa in Turkey and Mundo Reader in Spain have also been able to challenge the dominance of the global players by adopting a low-cost strategy.⁷¹⁴

Wearables

Wearable devices, or simply “wearables,” are devices worn on a user’s body that incorporate sensors and data-logging electronics. Currently, most wearables use Bluetooth technologies to connect to (and sync with) an app on a smartphone, although some companies are starting to release products that connect directly to the Internet.⁷¹⁵ Enabled by the near-ubiquity of mobile broadband networks, by developments in miniaturized hardware and sensor technology, and by the emergence of cloud computing technologies, an entire industry has emerged over the past few years dedicated to developing wearable devices and related applications.

U.S. and International Markets

In 2016, the global wearables market grew by 20 percent to \$16.2 billion.⁷¹⁶ Wearable devices are increasingly popular in China: more than 9.5 million devices were sold in the country in the three months between April and June 2016, corresponding to roughly 9.4 percent of total global sales for all of 2016.⁷¹⁷ Wearables sold in China include the Apple Watch, Fitbit, and Motorola devices along with devices sold by numerous domestic brands, including market leader Xiaomi.⁷¹⁸

In early 2017, 3.1 percent of Russians were using wearable devices.⁷¹⁹ Revenue for the sector was \$59 million in 2017.⁷²⁰ While Chinese devices and top U.S. brands Apple and Fitbit predominate in most other emerging markets, U.S.-based Jawbone was the most popular brand in Russia in 2015, with more than 85 percent of sales.⁷²¹

⁷¹⁴ MarketLine, *Global Mobile Phones*, July 2016, 19.

⁷¹⁵ Berg Insight, *Connected Wearables*, December 2015, 1–2.

⁷¹⁶ IDC, “Table 4: Worldwide Wearables ASP and Value of Shipments, July 2017.

⁷¹⁷ Charara, “China Loves Wearable Tech,” September 15, 2016.

⁷¹⁸ Sophie Charara, “China Loves Wearable Tech,” September 15, 2016.

⁷¹⁹ Statista, “Wearables: Russia” (accessed May 5, 2017).

⁷²⁰ Ibid.

⁷²¹ Jawbone is now entering liquidation. Reuters, “Jawbone’s demise a case of ‘death by overfunding’ in Silicon Valley,” July 10, 2017; Tyan, “Russian Market for Fitness Wearables Growing,” August 5, 2015.

Brazil's wearables market is relatively small. In early 2017, 2.4 percent of Brazilians were using wearable devices.⁷²² Revenue for the sector was expected to be \$69 million in 2017.⁷²³

Wearable devices have come under criticism in the European Union and Norway due to privacy concerns about the amount and type of data collected, the length of time the data are stored, and how the data are used or distributed to third parties.⁷²⁴ User penetration for wearables varied across European countries in 2017, at 4.6 percent in Germany⁷²⁵ and 2.2 percent in Bulgaria.⁷²⁶

Indian wearable sales totaled 2.5 million units in 2016, with low-cost producers taking the top two spots in most sales.⁷²⁷ GOQii, a U.S.-based start-up, made up 15.5 percent of Indian wearable sales in the last quarter of 2016, followed by China's Xiaomi (13.2 percent), and U.S.-based Fitbit (7.9 percent).⁷²⁸

Market Competition and Trends

Although there are several dozen companies operating in the wearables industry, many are not selling enough devices to break even, and some have not progressed beyond the research, development, and testing stages. By the end of 2016, the main commercially viable devices were "smartwatches" and fitness trackers, with only a handful of companies selling the bulk of these devices.⁷²⁹ In the smartwatch segment, the market leader is Apple, which captured an estimated 55 percent of the market with its line of Apple Watches, followed by Samsung, which holds about 11 percent of the market.⁷³⁰ The remainder of the market is divided among several traditional watch companies, including U.S.-based Fossil (which makes watches under its own name and for fashion companies like Burberry, Michael Kors, and Diesel) and a few well-known electronics companies, including Sony, LG, Huawei, and Asus.⁷³¹ In the fitness tracker segment, Fitbit, headquartered in California, is the clear market leader, although more than 15 companies are reportedly selling such devices, including Jawbone, Garmin, and Samsung.⁷³²

⁷²² Statista, "Wearables: Brazil" (accessed May 5, 2017).

⁷²³ Ibid.

⁷²⁴ Lomas, "Fitbit, Jawbone, Garmin and Mio," November 3, 2016.

⁷²⁵ Statista, "Wearables: Germany" (accessed May 5, 2017).

⁷²⁶ Statista, "Wearables: Bulgaria" (accessed May 5, 2017).

⁷²⁷ IDC, "Indian Wearable Market Clocks 2.5 Million Units," March 28, 2017.

⁷²⁸ Ibid.

⁷²⁹ Kovach, "Wearables Are Dead," December 11, 2016.

⁷³⁰ Bradshaw, "Wearable Tech Groups Press On," February 9, 2017.

⁷³¹ McCann and Faulkner, "Best Smartwatch," May 3, 2017; McClean, "Fossil to Flood the Smartwatch Market," June 1, 2016; Badkar, "Fossil Shares Tumble," November 3, 2016.

⁷³² Peckham, "Best Fitness Trackers for 2017," February 6, 2017.

The wearables market reportedly grew much more slowly in 2016 than in 2015 (table 7.1). Total shipments of wearable devices grew by 25 percent in 2016, compared to 171.6 percent in 2015. Shipments of Apple Watches, which represented 10 percent of the wearables market, were particularly hard hit, falling by 8 percent in 2016.⁷³³ Among non-U.S.-based competitors, Xiaomi shipped the most wearable devices, offering primarily lower-end and children’s units with prices ranging from \$50 to \$160.⁷³⁴

Table 7.1: Shipments of wearable devices by the top five global vendors 2014–16 (million units)

Vendor (HQ country)	2014	2015	2016
Fitbit (United States)	10.9	22.0	22.5
Xiaomi (China)	1.1	12.0	15.7
Apple (United States)	0.0	11.6	10.7
Garmin (United States)	2.0	5.8	6.1
Samsung (South Korea)	2.7	3.2	4.4
Others	12.0	27.4	43.0
Total	28.8	81.9	102.4

Sources: IDC, “The Worldwide Wearables Market Leaps 16.9% in the Fourth Quarter,” February 23, 2016; IDC, “Wearables Aren’t Dead,” March 2, 2017.

Remote Healthcare Monitoring

Remote healthcare monitoring systems, sometimes referred to as machine-to-machine (M2M) healthcare, use a remote sensing device worn on a patient’s body to capture certain real-time medical data (e.g., current heart rate or blood pressure). The data are then transmitted through a telecommunications network⁷³⁵ to a software application, generating usable information (e.g., whether a patient needs attention).⁷³⁶ The patient’s healthcare provider can then analyze the data to make a diagnosis or a decision about treatment.⁷³⁷ In 2016, about 7.1 million patients were being remotely monitored worldwide.⁷³⁸

The remote healthcare monitoring market is highly fragmented and largely structured around patient medical conditions. In 2016, sleep therapy surged by 70 percent to become the largest

⁷³³ IDC, “The Worldwide Wearables Market Leaps 126.9% in the Fourth Quarter,” February 23, 2016; IDC, “Wearables Aren’t Dead” March 2, 2017.

⁷³⁴ Wiggers, “Huami’s Amazfit PACE Fitness Tracker Will Launch,” November 21, 2016.

⁷³⁵ Currently, most remote healthcare monitoring systems use wireless cellular technologies to connect to data processing applications.

⁷³⁶ Atlantic-ACM, “M2M within the Healthcare Sector,” April 10, 2015.

⁷³⁷ U.S. GAO, “Internet of Things,” May 15, 2017, 22.

⁷³⁸ Berg Insight, “MHealth and Home Monitoring,” February 2017, 1. This estimate includes patients enrolled in healthcare programs in which connected medical devices are used as part of a care regime; it does not include connected medical devices used for various types of personal health tracking.

single segment. Implantable devices for managing cardiac rhythms, the previous leader, represented the second-largest segment. Other important segments included devices for monitoring electrocardiograms, blood pressure, blood oxygen, coagulation, airflow, and glucose.⁷³⁹

Market leaders in the remote healthcare monitoring industry vary by segment. In the cardiac rhythm monitoring segment, for example, the leading providers are large, well-established medical device companies like Medtronic, Boston Scientific, Biotronik, and St. Jude Medical.⁷⁴⁰ In the sleep therapy segment, the market leaders are ResMed, SRETT, SomnoMed, Löwenstein Medical Technology, and Drive DeVilbiss Healthcare.⁷⁴¹ Overall, competitive pressures are intense, requiring companies to continually develop new products and services. To this end, several vendors are working with wearable device manufacturers to develop new or hybrid devices and/or services.⁷⁴²

Global Market

In 2016, the market for remote healthcare monitoring systems totaled about \$8.4 billion worldwide.⁷⁴³ Rapid growth will likely be driven by a number of factors, including aging populations, the growing incidence of chronic disease, and hospitals' ongoing efforts to reduce costs, particularly via a shift from inpatient to outpatient care. Other factors driving the adoption of these systems over the next few years will likely be the growing penetration of high-speed wireless networks, particularly in developing countries, and increased awareness of the benefits and convenience of such technologies on the part of both patients and doctors.⁷⁴⁴

⁷³⁹ Berg Insight, "MHealth and Home Monitoring," February 2017, 1.

⁷⁴⁰ St. Jude Medical was acquired by Abbott in January 2017.

⁷⁴¹ Berg Insight, "MHealth and Home Monitoring," February 2017, ii – iv.

⁷⁴² Technavio, *Global M2M Healthcare Market 2016–2020*, December 2016.

⁷⁴³ Berg Insight, "MHealth and Home Monitoring," February 2017, 1.

⁷⁴⁴ Technavio, *Global M2M Healthcare Market 2016–2020*, December 2016; Atlantic-ACM, "M2M within the Healthcare Sector," April 10, 2015.

Smart Homes

A “smart home”—also increasingly referred to as a “connected home”—is a house that incorporates a variety of devices for controlling, automating, and optimizing standard housing systems and functions. These may include heating, cooling, and ventilation systems; lighting; security; and energy management systems. A defining characteristic of the smart home is that “smart” devices within the home are connected to the Internet and can be controlled remotely using dedicated applications installed on a smartphone, tablet, or personal computer, or a separate system within the home itself.⁷⁴⁵

Although smart home devices are becoming increasingly prevalent in the United States, the industry is struggling to move from the “early adopter” phase to the “mass market” phase of the technology adoption life cycle. Such stagnation is driven by a number of factors, including high prices, long replacement cycles, and concerns over device obsolescence.⁷⁴⁶ Poor customer education and/or unclear product benefits also reportedly limit demand for smart home products.⁷⁴⁷ Perhaps the greatest barrier to the broader adoption of smart home devices, however, is technological fragmentation within the so-called smart home “ecosystem.” The large number of devices, technological standards, and networks required to connect and operate a smart home has created interoperability problems which, in turn, have made it difficult to set up and control multiple devices, ultimately confusing consumers.⁷⁴⁸ Consumer concerns over security and privacy, including how their personal data will be used, are also a factor limiting the adoption of smart home technologies.⁷⁴⁹

Most purchases of smart home devices are still driven by basic concerns, including price, reliability, ease of use and installation, and the ability of the device to solve basic problems. Perhaps for these reasons, many of the most popular smart home devices are easy to use and perform fairly standard home tasks, including devices related to lighting, climate control, and security. In the lighting segment, for example, the most popular products are Internet-connected lightbulbs that screw into existing fixtures and use smartphone or tablet apps to turn lights on and off and to adjust brightness throughout the day. In the security segment, smart locks allow not only instant access to homeowners via a smartphone app but also temporary,

⁷⁴⁵ The desire to increase energy efficiency and security has also led to the use of smart devices in commercial buildings. Market data for this sector are difficult to isolate, however, from the broader category of building management expenses. Olick, “Just What Is a Smart Home Anyway?” May 10, 2016.

⁷⁴⁶ Olick, “Why 2017 Will Finally Be the Year of the Smart Home,” January 4, 2017; Greenough, “The U.S. Smart Home Market Has Been Struggling,” October 18, 2016; Keys, “Who Will Win?” September 1, 2016.

⁷⁴⁷ McKinsey, “There’s No Place Like a Connected Home,” 2017.

⁷⁴⁸ Greenough, “The U.S. Smart Home Market Has Been Struggling,” October 18, 2016.

⁷⁴⁹ Keys, “Who Will Win?” September 1, 2016.

time-delineated access to tradesmen and guests without the need for a physical key. Some affordable smart security systems, many of which include self-install motion sensors, video cameras, and door alarms, not only notify homeowners via text message, email, or phone call when a disturbance is detected but also allow them to see what is happening in their home via a smartphone or tablet app.⁷⁵⁰

Originating as a niche market catering to wealthy homeowners, the smart home market has begun to develop products and services that are more accessible to the mainstream market over the past several years.⁷⁵¹ There are currently hundreds of smart home devices on the market, ranging from relatively conventional devices like Internet-connected thermostats and security cameras to more esoteric products like connected toasters, juicers, and pet dishes.⁷⁵²

U.S. and International Markets

In 2016, the smart home market in the United States was valued at \$10.4 billion. According to industry forecasts, the United States (\$14.6 billion) will account for roughly 70 percent of global smart home revenues in 2017, well ahead of other leading markets such as the European Union (EU) (\$4.9 billion) and China (\$2.1 billion).⁷⁵³ At present, key markets for many of the products studied in this report (Brazil, India, Indonesia, and Russia) are not major markets for smart home products.

Market Competition and Trends

Google and Samsung acquired U.S.-based smart home firms Nest and SmartThings in 2014 for \$3.2 billion and \$200 million, respectively.⁷⁵⁴ However, Chinese firms in the smart home market could potentially leverage their manufacturing ability, large scale, and deep talent pool to rapidly develop new products and compete in the U.S. market.⁷⁵⁵ China has several domestic companies specializing in the smart home industry, including manufacturers and installers of smart home products such as climate control, energy monitoring, motion sensors, locks and security systems, lighting and automation systems, and other related systems.⁷⁵⁶ Alibaba is also considering making acquisitions in the U.S. market.⁷⁵⁷

⁷⁵⁰ Savoy, "Think You Missed the Boat on Smart Home Technology?" February 27, 2017.

⁷⁵¹ Keys, "Who Will Win?" September 1, 2016.

⁷⁵² Ibid.

⁷⁵³ Statista, "Smart Home" (accessed May 9, 2017).

⁷⁵⁴ Whitney, "Google Closes \$3.2 Billion Purchase of Nest," February 12, 2014; Wroclawski, "Samsung Buys SmartThings for \$200 Million," August 14, 2014.

⁷⁵⁵ Kim, "In the U.S. Smart Home Market," June 11, 2015.

⁷⁵⁶ Nakono, "Smart Homes: China" (accessed May 5, 2017).

⁷⁵⁷ Ibid.

Smart Cities

The term “smart city” describes a variety of initiatives launched by select cities to enable citizens to use their infrastructure better and more efficiently and, to a lesser degree, improve services offered in cities (box 7.2). Important factors enabling the deployment of smart city technologies include the near ubiquity of smartphones, smartphone apps, and broadband wireless networks, as well as the rapidly falling cost of sensors, the growth of low-cost data storage platforms, and new developments in ML and data analytics.⁷⁵⁸

Box 7.2 : Barcelona’s Smart City Initiative

Perhaps the best example of an advanced “smart city” initiative is that of Barcelona, Spain. Starting in 2012, the city began to incorporate sensors and other smart city technologies into a wide variety of infrastructure in order to improve the delivery of city services. For example:

- The city began installing connected bus shelters (powered by solar panels) with USB charging ports, free Wi-Fi, and digital screens showing information on bus location, wait times, and nearby sites.
- Barcelona’s bicycle-sharing program also released an app that allows users to monitor, in real time, the availability of bicycles at sharing stations.^a
- Barcelona has embedded sensors in some parking spaces that detect the presence or absence of a vehicle. Equipped with this information, it launched an app called ApparkB, which directs drivers to empty parking spots, reportedly reducing both traffic congestion and vehicle emissions. The app also allowed drivers to pay for parking online. Within one year of implementation, Barcelona was reportedly issuing 4,000 parking permits per day via the ApparkB app.
- The city has installed trash bins equipped with sensors that monitor trash levels and notify the sanitation department when bins are full, allowing it to develop more efficient collection routes.
- More than a thousand lampposts have been fitted with energy-saving light-emitting diode (LED) lightbulbs and sensors that automatically dim when the streets are empty.
- Sensors installed in park irrigation systems and fountains monitor rain, humidity, and water levels. Such systems allow park workers to focus their watering efforts on critical areas.^b

For Barcelona, implementing smart city projects has yielded measurable benefits in the form of both increased revenues and lower costs stemming from reduced use of water and electricity. The ApparkB app, for example, reportedly raised parking revenues by \$50 million by the end of 2015, while the smart lamppost initiative cut spending on electricity by \$37 million. Moreover, the park water initiative—installed in 68 percent of public parks by the end of 2015—cut water use by 25 percent, saving the city roughly \$555,000 per year.^c

^a U.S. GAO, *Internet of Things*, May 15, 2017, 24.

⁷⁵⁸ Totty, “The Rise of the Smart City,” April 16, 2017.

^b Walt, “Barcelona: The Most Wired City,” July 29, 2015; Ancheta, “Ten Reasons Why Barcelona Is a Smart City,” February 23, 2014; Adler, “How Smart City Barcelona Brought the Internet of Things to Life,” February 18, 2016.

^c Adler, “How Smart City Barcelona Brought the Internet of Things to Life,” February 18, 2016.

Although “smart cities” have received a growing amount of media attention over the past few years, there are few, if any, examples of large-scale, fully funded smart cities anywhere in the world. Instead, most smart city initiatives are characterized by pilot projects and vendor demonstrations,⁷⁵⁹ with estimates of the number of such projects running from several dozen to several hundred.⁷⁶⁰ Overall, the biggest obstacles to the development of smart cities over the near term are the existence of legacy infrastructure in many cities and the lack of funding for the new infrastructure and software needed for smart cities.⁷⁶¹

Market Competition and Trends

In 2016, the global market for smart city technologies was valued at \$36.8 billion. The key industry participants are largely well-known multinational companies, including Alcatel-Lucent, AT&T, Cisco, Ericsson, General Electric, Honeywell, IBM, Intel, Oracle, and Siemens. However, a number of smaller companies are also active in the market, including Engle, Itron, Telensa, and Urbiotica.⁷⁶²

While there are very little data on key markets, experiments are taking place in many countries. China has over 200 cities that are trying out smart-city technologies, notably the city of Yinchuan, which links people’s facial features and their bank accounts so they can easily pay their fares on public transit.⁷⁶³ The most prominent example in the EU is Barcelona, whose multiple initiatives are described in box 7.2. Launched in 2015, India’s “Smart Cities Mission” has chosen 90 of a planned 100 cities that will use a variety of technologies for retrofitting, redevelopment, and greenfield development of focus areas, using “smart solutions” to improve city infrastructure and planning.⁷⁶⁴

⁷⁵⁹ Navigant, “Smart Cities,” second quarter 2016; Walt, “Barcelona: The Most Wired City,” July 29, 2015.

⁷⁶⁰ Hamblen, “Just What IS a Smart City?” October 1, 2015; Singh, “Smart Cities: A \$1.5 Trillion Market Opportunity,” June 19, 2014.

⁷⁶¹ Saiidi, “How Smart Cities Are Building the Future,” February 9, 2017; Grand View Research, “Smart Cities Market Analysis,” November 2014.

⁷⁶² Navigant Research, “Smart City Technologies and Infrastructure,” second quarter 2016.

⁷⁶³ Carrington, “Yinchuan: The Smart City,” October 10, 2016.

⁷⁶⁴ Government of India, Ministry of Urban Development, “Smart Cities Mission: Strategy,” April 12, 2017.

Communications Services

Over the last five years, a significant share of businesses and individuals has transitioned from traditional communications services to Internet-based services. This section provides an overview of over-the-top (OTT) services, which are supplied via nontraditional channels to both consumers and businesses, and unified communications, which are services used by businesses to allow workers to access voice and text communications remotely in a variety of forms.

Over-the-Top Services

Between 1983 and 2007, international voice traffic, measured in minutes, grew by 15 percent annually.⁷⁶⁵ Starting in 2007, however, growth in voice traffic started to slow, with average annual growth of only 7 percent during 2007–14. This was followed by declines of 1 percent in both 2015 and 2016, the first such declines since the Great Depression.⁷⁶⁶ Slowing or negative growth in the carrier-voice market over the past seven years is in large part structural, resulting from the mass adoption of OTT communications services. In the telecommunications industry, OTT refers to services that are delivered over a device’s Internet connection, thereby bypassing traditional carrier-based services. Accessed via apps on smartphones, tablets, and laptops, OTT services typically focus on free (or very cheap) voice calls or messaging services, effectively replacing carriers’ traditional voice and messaging services.⁷⁶⁷

Demand for international communication services is high; billions of people worldwide use OTT communications apps. In June 2016, the six most popular OTT communications apps—WhatsApp, Facebook Messenger, WeChat (Weixin), Viber, Line, and Kakao Talk—had a combined total of 4.4 billion monthly users globally. That total was an increase of 800 million users since June 2015 and nearly three times the number of users in June 2014.⁷⁶⁸

Together, the users of OTT services are generating enough traffic to substantially cut into the international carrier voice market. TeleGeography, a telecom industry consulting firm,

⁷⁶⁵ Beckert, “Rise of the Apps,” February 1, 2017.

⁷⁶⁶ Christian, “Market Sees First Decline in International Voice,” January 26, 2017; Beckert, “Rise of the Apps,” February 1, 2017.

⁷⁶⁷ Techopedia, “Over-the-Top Application,” <https://www.techopedia.com/definition/29145/over-the-top-application-ott> (accessed July 3, 2017). Christian, “Market Sees First Decline in International Voice,” January 26, 2017. The term over-the-top is also used in the media and entertainment industry to describe Internet-based video-content services that substitute for traditional television services. Services like Netflix and Hulu, for example, offer an alternative to cable TV and over-the-air television distribution. OTT services effectively reduce the usage of traditional services and drive down their revenues, often making them unpopular with providers of traditional services.

⁷⁶⁸ Christian, “Market Sees First Decline in International Voice,” January 26, 2017.

estimates that cross-border OTT traffic (546 billion minutes) accounted for roughly half of total international voice traffic (1.1 trillion minutes) in 2016. By contrast, OTT communications represented a negligible share of the international voice market only a few years ago.⁷⁶⁹

Box 7.3: Chatbots

A chatbot is a software application designed to automate defined tasks and/or provide standardized replies. Typically integrated into messaging applications, most chatbots use a conversational interface that provides responses to verbal or typed queries.^a Just over the past couple of years, chatbots have emerged that accomplish simple tasks like checking news and weather, scheduling appointments, ordering food, or making travel reservations; most such bots interact with human users using short, text-message conversations. Voice-based interfaces are also increasingly common, including smartphone-based “virtual assistants” like Siri on Apple iPhones and tablets, or Alexa, available through the Amazon Echo “smart speaker” or Amazon Fire TV Stick. The stated rationale for chatbots is their convenience—that is, users do not have to leave their messaging platform and open another app to access desired services. Chatbots are typically powered by AI software that is located on a server, as opposed to on a user’s device, although some also incorporate an element of human interaction.^b

Chatbots were largely developed by the pioneering Chinese technology company Tencent. In 2011, Tencent released an OTT messaging app called WeChat for sending text, voice, and photos to friends and family. WeChat was specifically designed to incorporate chatbots. In 2013 WeChat also launched a platform, similar to an app store, for distributing a wide array of chatbots. Within three years, WeChat’s distribution platform contained over 10 million chatbots, known as “public accounts,” developed by banks, media outlets, fashion brands, hospitals, car manufacturers, pharmacies, and Internet start-ups, among myriad others. Most such chatbots were developed to sell services or subscriptions to users, with payments collected by another platform incorporated into the app, WeChat Wallet.^c

With more than a billion registered users, and roughly 900 million active users, the WeChat app is extremely popular in Asia, but relatively unknown in Europe and North America. In 2016, however, Facebook announced its Messenger Platform, a new service that allows businesses to develop customized chatbots for integration into the Messenger application.^d Other Messenger platforms including WhatsApp (also owned by Facebook), Slack, and Twitter, are also rolling out chatbot platforms and ecosystems. A few examples of commercial chatbots now active on Facebook Messenger are 1-800-Flowers, which allows users to buy flowers without having to leave Messenger; the *Wall Street Journal*, which allows users to get stock quotes and headline news within Messenger; and HP, which facilitates the printing of photos and documents from Facebook or Messenger to any connected HP printer. Facebook itself has also released Facebook M, a personal-assistant bot that helps users with queries ranging from trivia to restaurant recommendations to hotel rates.^e

Currently, Facebook has more than 100,000 bots on the Messenger Platform, although customer usage is off to a slow start—due, reportedly, to confusion on how to access or use chatbots. In response, Facebook upgraded its Messenger Platform by introducing new ways for users to interact with chatbots, including a simplified menu structure. Despite such early setbacks, Facebook’s large user base, numbering more than one billion at the end of 2016, is likely to provide a strong incentive for other enterprises to develop bots for the Messenger Platform.^f

⁷⁶⁹ Beckert, “Rise of the Apps,” February 1, 2017.

^a An, "What Is a Bot?" May 23, 2016.

^b *Economist*, "Bots, the Next Frontier," April 9, 2016.

^c Chan, "When One App Rules Them All," August 6, 2015.

^d Facebook, "Messenger," <https://www.facebook.com/messenger/> (accessed May 18, 2017); Anderson, "Facebook Bots 101," June 7, 2016.

^e Anderson, "Facebook Bots 101," June 7, 2016.

^f Perez, "As Messenger's Bots Lose Steam," March 2, 2017; Claburn, "Please Don't Call Them Facebook Chatbots," April 19, 2017.

U.S. and International Markets

According to a survey of 6,000 mobile media users by the Mobile Ecosystem Forum, regular use of messaging apps varies significantly by country (table 7.2). Worldwide, Facebook offers the two most popular messaging apps, with its Messenger and WhatsApp apps used by 56 percent and 50 percent of all Internet users, respectively. While Messenger and WhatsApp are the leading messaging apps in most of the countries featured in this report, Facebook and its various apps are largely blocked in China. WeChat—the messaging app developed by Chinese social media giant Tencent—is used by almost 80 percent of Chinese Internet users. However, WeChat has achieved limited market share in other markets, currently accounting for only 13 percent of the global market.⁷⁷⁰

Table 7.2: Messaging app usage by country (shares), 2016

Messaging app	Global	UK	U.S.	Brazil	France	Germany	China	India
Facebook								
Messenger	56	59	65	64	67	52	16	57
WhatsApp	50	47	9	76	20	72	4	63
SMS ^a	42	40	31	37	70	36	7	39
Snapchat	14	20	20	19	33	13	1	7
WeChat	13	2	2	3	2	4	79	6

Source: Mobile Ecosystem Forum, "Mobile Messaging Report 2016," 2016.

^a SMS stands for Short Message Service, and is the text messaging component of most mobile phone systems.

Unified Communications

Unified communications (UC) is a telecommunications service that manages and delivers communications messages (e.g., telephone calls, emails, and voice mails) across two or more devices (e.g., desktop computers, laptop computers, mobile telephones, and tablets). UC services can also incorporate Internet protocol (IP) telephony, short message service (SMS) text messages, instant messaging applications, data sharing, and audio- and videoconferencing,

⁷⁷⁰ Mobile Ecosystem Forum, "Mobile Messaging Report 2016," 2016.

among other services, into a single platform.⁷⁷¹ Using a UC platform, for example, a voice mail message can be converted to text file and emailed to the recipient. Similarly, UC platforms can convert text-based communications into sound files, allowing recipients to listen to emails and faxes. UC services help firms to manage communications across workforces that use a growing number of communications methods and devices. As a result, UC platforms are generally marketed as helpful for saving time and increasing workforce productivity.⁷⁷²

In 2015, the Telecommunications Industry Association estimated that the U.S. market for traditional, premises-based UC services grew by 5.9 percent to \$2.1 billion, slower than the average annual growth rate of 8.1 percent during 2010–14.⁷⁷³ Declining growth in premises-based UC services is largely attributable to the migration from premises-based equipment and software to cloud-based UC services. Movement to the latter platform, known as “unified communications as a service” (UCaaS), is a trend that is expected to continue over the next five years.⁷⁷⁴

The leading provider of UC is Cisco, although competing services are offered by Avaya, Microsoft, NEC, IBM, Siemens, and ShoreTel, among others. Overall, the UC market is highly competitive, with participants seeking to gain market share by product differentiation, quality enhancements, and mergers and acquisitions.⁷⁷⁵

⁷⁷¹ TIA, *TIA’s 2016–2020 ICT Market Review and Forecast, 2016*, 4–33; Grand View Research, “Unified Communications Market Analysis,” August 2016.

⁷⁷² TIA, *TIA’s 2016–2020 ICT Market Review and Forecast, 2016*, 4–33.

⁷⁷³ Grand View Research, a market research firm, estimated the global market for unified communications (UC) services to be \$36 billion in 2015. Grand View Research, “Unified Communications Market Analysis,” August 2016; TIA, *TIA’s 2016–2020 ICT Market Review and Forecast, 2016*, 4–33.

⁷⁷⁴ TIA, *TIA’s 2016–2020 ICT Market Review and Forecast, 2016*, 4–33.

⁷⁷⁵ GMI, “Unified Communications Market Size Worth \$96 Billion by 2023,” January 2, 2017; Grand View Research, “Unified Communications Market Analysis,” August 2016.

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Chapter 8

Regulatory and Policy Measures Affecting Digital Trade

Introduction

According to U.S. firms and the literature, many types of regulatory and policy measures act as impediments to global digital trade. These measures can be broadly categorized into two groups: (1) digital-specific measures, such as restrictions on cross-border data flows and forced data localization, and (2) traditional market access and investment measures that also affect providers of digital goods and services.⁷⁷⁶

This chapter is divided into six sections. The first section describes several digital-specific measures, including those that address data protection, privacy, and data localization. Data protection and privacy measures are generally used to protect the privacy of individuals. Data localization measures, which have been imposed by a number of countries, require companies to store and/or process data on servers physically located within a country's borders, in an effort to enforce data protection and privacy or cybersecurity laws. U.S. firms claim that such measures impose significant restrictions on how global firms do business, forcing them to modify their business models and introducing risks related to cybersecurity, among others.⁷⁷⁷

The second, third, and fourth sections of the chapter also describe digital-specific measures, based on information supplied by industry and the literature. The second section summarizes information relating to how cybersecurity measures can impede global digital trade by restricting e-commerce and digital content that is provided within a country's borders. Such measures include encryption restrictions and requirements to disclose a company's source code. The third section describes measures related to intellectual property rights (IPRs) that are viewed as inhibiting digital trade, including failure to enforce digital content IPRs (which leads to higher digital piracy rates), measures addressing intermediary liability, and "ancillary

⁷⁷⁶ Coalition of Services Industries, written submission to the USITC, March 28, 2017, 2.

⁷⁷⁷ Some industry experts suggest that while data protection laws are intended to protect individual privacy, data storage and retention requirements serve quite the opposite purpose, namely to secure access to personal data for law enforcement and intelligence agencies. Determann, "Residency Requirements for Data in Clouds," February 16, 2015.

copyright” laws for digital content.⁷⁷⁸ According to U.S. firms, these types of cross-border data restrictions often have the effect of significantly restricting cloud computing, the provision of digital content, e-commerce, and other activities that impact businesses of all sizes. The fourth section describes online censorship issues in key markets, and how these have been reported to impede U.S. content providers’ ability to compete in foreign markets.

The fifth and sixth sections describe traditional market access and investment measures that U.S. firms have identified as inhibiting global digital trade. U.S. firms, particularly small and medium-sized enterprises (SMEs), view meaningful customs service “de minimis” rules⁷⁷⁹ and the availability of electronic payment services as critical to enabling market access in e-commerce. They indicate that market access barriers such as discriminatory technical standards and government procurement regimes may limit firms’ ability to sell digital products across borders. Investment restrictions can prevent companies from establishing a presence in foreign markets, or make it more difficult for them to do so, limiting global sales. Examples of restrictions cited by U.S. firms include joint venture requirements, local content requirements, and discriminatory licensing, taxes, and fees. The measures discussed in this chapter affect different types of Internet technologies, as shown in table 8.1.

Table 8.1: Digital trade regulatory and policy measures related to Internet technologies

Type of regulatory and policy measures	Internet communications services	Cloud-based data processing	Digital content	E-commerce	Internet of Things
Data measures					
Data protection and privacy	▪	▪	▪	▪	▪
Data localization	▪	▪		▪	▪
Private and public cybersecurity measures					
Disclosing source code		▪	▪	▪	▪
Restrictions on cryptography	▪	▪	▪	▪	▪
Censorship					
Intellectual property rights measures					
Digital piracy			▪	▪	
Intermediary liability for copyright infringements	▪		▪	▪	
Ancillary copyright laws	▪		▪	▪	
Market access measures					
De minimis thresholds				▪	

⁷⁷⁸ “Ancillary” copyright laws impose a “snippet tax” on search engines and online platforms that provide short fragments of news text (including headlines and quotations) to the public, with the tax benefits meant to go to the publishers of the original news articles. Computer and Communications Industry Association, “Understanding Ancillary Copyright,” n.d. (accessed June 12, 2017).

⁷⁷⁹ Requirements that exporters who fulfill international orders face duties, taxes, and related paperwork if the value of a given shipment is above a certain threshold value. If the threshold is set too low, it inhibits the ability of SMEs in particular to sell low-value goods abroad.

Type of regulatory and policy measures	Internet communications services	Cloud-based data processing	Digital content	E-commerce	Internet of Things
Electronic payments				▪	▪
Government procurement	▪	▪	▪	▪	▪
Technical standards	▪	▪	▪	▪	▪
Investment-related measures					
Limits on foreign ownership & equity participation	▪	▪	▪	▪	▪
Local content requirements	▪	▪	▪	▪	▪
Discriminatory licensing, taxes and fees	▪	▪	▪	▪	▪

Source: Compiled by USITC.

Another concern cited by industry representatives is the differences among regulations that apply to digital trade in different jurisdictions. Even though particular policy measures might not act as impediments in themselves, industry representatives indicate that the need to comply with varying policies in several markets acts as an impediment to firms' overall global business.⁷⁸⁰

Data Protection and Privacy Measures

According to input from industry representatives, regulatory and policy measures focused on data protection and privacy affect all kinds of industries.⁷⁸¹ These measures can inhibit global digital trade by U.S. firms due to the increased administrative costs associated with complying with stricter privacy measures that differ from U.S. standards. Countries' data protection and privacy measures generally follow either a comprehensive approach, broadly regulating data flows across the economy, or a sectoral approach that applies to a particular industry, such as financial services.⁷⁸²

Currently, there are two main comprehensive international privacy approaches to address privacy laws covering private business activities: the European Union (EU) Data Protection Directive of 1995 and the Asian-Pacific Economic Cooperation (APEC) Privacy Framework.

⁷⁸⁰ USTR's National Trade Estimate Report identifies particular concerns about regulatory variance in the EU. However, it is expected that recent EU efforts to increase regulatory harmonization within the EU may reduce costs for U.S. vendors in Europe, and may particularly help SMEs. Beginning in June 2015, the European Commission began a process aimed at harmonizing contract rules for online purchases of both digital content and physical goods, and ensuring the availability of legal remedies for problems related to purchases of digital content. The EU has also initiated a similar effort to harmonize the enforcement of consumer protection rules among EU member states. USTR, *2016 National Trade Estimate Report*, 2016, 177–79.

⁷⁸¹ As discussed previously, these include cloud-based processing, the Internet of Things (IoT), Internet communication services, digital content, and e-commerce. Measures affecting these sectors often overlap with data localization laws, addressed in more detail below.

⁷⁸² For more information, see USITC, *Digital Trade in the U.S. and Global Economies*, July 2013, 5-8 to 5-12.

(Many non-EU members have modeled their privacy measures after the EU directive.⁷⁸³) One legal expert argues that the EU's data protection and privacy laws "substantially inhibit the ability of multinational companies from moving personal data" across borders efficiently.⁷⁸⁴ EU members may enact their own implementing laws, in line with the EU Data Protection Directive of 1995 and the forthcoming EU General Data Protection Regulation (GDPR), scheduled to be adopted in 2018.⁷⁸⁵ For a detailed discussion on the EU's data protection and privacy regulations, see appendix E.

The APEC Privacy Framework and its Cross-Border Privacy Rules offer another, nonbinding example of the comprehensive approach to privacy. The APEC Framework aims to promote electronic commerce by harmonizing members' data protection laws and facilitating cross-border data flows, thereby reducing costs and inefficiencies for businesses operating in countries that are signatories to the APEC Privacy Framework.⁷⁸⁶

Russia and Indonesia are examples of countries that have used the EU regulations and the APEC Privacy Framework, respectively, as models in writing their own comprehensive data protection and privacy laws. U.S. businesses and trade associations generally favor the APEC Framework because it sets a high standard of privacy across member countries without "interrupting or threatening the flow of data that fuel economic growth."⁷⁸⁷

In contrast, under the sectoral or "partial" approach, countries implement measures that provide data protection covering particular business sectors or activities.⁷⁸⁸ The United States, China, and India currently take a sectoral approach to data protection and privacy, although India is in the process of drafting more comprehensive regulations. Table 8.2 provides an overview of measures in selected markets, while table 8.3 provides more detail on a subset of these markets.

⁷⁸³ The comprehensive approach is sometimes referred to as an "omnibus" law. UNCTAD, *Data Protection Regulations and International Data Flows*, 2016.

⁷⁸⁴ Raul, "The Privacy, Data Protection and Cybersecurity Law Review," November 2014.

⁷⁸⁵ CRS, *U.S.-EU Data Privacy: From Safe Harbor to Privacy Shield*, May 19, 2016; EU Data Protection Supervisor, "The History of the General Data Protection Regulation" (accessed July 5, 2017).

⁷⁸⁶ Government of Australia, Australia Law Reform Commission, "Cross-Border Data Flows" (accessed July 5, 2017); IAPP, "The APEC Cross-Border Privacy Rules," September 4, 2014.

⁷⁸⁷ ITI, "Global Industry Group Calls for APEC Leadership," November 18, 2016; USDOC, ITA, "The APEC Cross-Border Privacy Rules," November 29, 2016.

⁷⁸⁸ UNCTAD, *Data Protection Regulations and International Data Flows*, 2016.

Table 8.2: Countries' rankings and domestic laws regarding data protection and privacy

Country	BSA's ranking on data privacy (out of 24) ^a	Scope and coverage of privacy law	Domestic laws/regulations governing use of personal data	Domestic laws compatible with EU Data Protection Directive	Domestic laws compatible with APEC Privacy Framework
Brazil	19	No specific law	Partial	No	No
China	21	Sectoral	Partial	No	No
India	18	Sectoral	Partial	No	No
Indonesia	15	Comprehensive	Partial	No	Yes
Russia	22	Comprehensive	Yes	Partial	Yes
EU					
France	13	Comprehensive	Yes	Yes	Yes
Germany	7	Comprehensive	Yes	Yes	Yes
Italy	9	Comprehensive	Yes	Yes	Yes
Spain	11	Comprehensive	Yes	Yes	Yes
United Kingdom	12	Comprehensive	Yes	Yes	Yes

Source: BSA, 2016 BSA Global Cloud Computing Scorecard.

^a BSA | The Software Alliance ("BSA") is a trade association that represents the global software industry. BSA's Global Cloud Computing Scorecard ranks 24 countries on their strengths and weaknesses in seven key policy areas, including data protection and privacy. Each country is ranked 1 through 24; lower numbers indicate that a country has stronger data protection and privacy measures than countries with a higher number. BSA did not rank Indonesia.

Table 8.3: Selected measures and policies related to data protection and privacy

Country	Measures and potential impacts
Brazil	<i>Current measures:</i> No specific data protection/privacy law. Data privacy is regulated by general principles, laws, and regulations contained in the Federal Constitution and Civil Code. U.S. and international companies tend to shy away from doing business in Brazil due to legal uncertainty and relatively high business risks that stem in part from the lack of clear guidelines on data protection and privacy. The management consulting firm McKinsey reported that it is unclear whether Brazil's data rules—data privacy provisions, restrictions on data collection, and requirements that Brazilians' data must be stored on servers within the country—could limit the use of large-scale data analytics. ^a
China	<i>Current measures:</i> Regulations addressing data protection and privacy are scattered throughout federal statutes. China has a sectoral approach to data protection and privacy. However, China passed a Cybersecurity Law in November 2016 (implemented in June 2017) that introduces enhanced data protection as a binding legal obligation for both Chinese companies and international companies doing business in China. China's new data protection and privacy laws require foreign firms to provide customers' sensitive personal information to government officials when requested on national security grounds. <i>Forthcoming measures:</i> China has been reviewing a comprehensive draft Personal Data Protection Law for many years, but there is no indication when the new law will be implemented. According to industry representatives, Chinese data protection and privacy measures could negatively affect U.S. businesses, adding significant costs and limiting their ability to sell information technology products in China—a \$465 billion market in 2017. ^b

Country	Measures and potential impacts
EU	<p><i>Current measure:</i> EU Data Protection Directive, 1995.</p> <p><i>Forthcoming measure:</i> The GDPR entered into force on May 24, 2016; it must be transposed into national law by all EU members by May 6, 2018; it will apply beginning May 25, 2018.^c The GDPR is a comprehensive update of the EU Data Protection Directive. The main objective of the GDPR is to give EU citizens control over their personal data, and to simplify the regulatory environment for businesses.^d GDPR incorporates several changes from the existing EU Data Protection Directive 1995, including a more explicit provision for obtaining the customers' consent and an extension of EU's jurisdiction (i.e., increased territorial scope^e) over companies processing the personal data of EU citizens, regardless of the physical location of the company.^f Other specific changes to the EU Data Protection Directive are discussed in detail in appendix E.</p> <p>According to U.S. industry representatives, implementation of the GDPR represents an "immense regulatory burden" that will negatively affect U.S. businesses operating in the EU, as well as EU competitiveness in the digital economy.^g Some businesses, mainly SMEs, have expressed particular concern about the high administrative costs associated with GDPR compliance.^h</p>
India	<p><i>Current measures:</i> Data protection and privacy is addressed through a series of measures. Electronic data are covered by the Information Technology Act of 2000. Data privacy is covered by the Information Technology Rules (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information Rules), also known as the "Privacy Rules."ⁱ Adopted in 2011, the Privacy Rules require corporate entities that collect, process, and store personal data, including sensitive personal information, to comply with certain procedures.^j</p>
Indonesia	<p><i>Current measures:</i> Two measures govern data protection and privacy: Law No. 11 of 2008 regarding Information and Electronic Transactions and Government Regulation No. 82 of 2012 (Regulation 82).^k Both measures state that providers must ensure that personal data are protected and are used only for the purpose that was communicated to their data subjects. Regulation 82 does not clarify the scope of the data covered by the provision, a question which is instead addressed through measures applying to domestic sectors. Indonesia takes a sectoral approach to data privacy and protection, with specific measures covering telecommunications, financial services, and public information.^l</p>
Russia	<p><i>Current measures:</i> Data Protection Act No. 152, implemented in July 2006 (DPA). In addition, chapter 14 of the Russian Labor Code regulates the protection of employees' personal data. Other Russian measures contain data protection provisions that apply to specific areas of state services or industries.^m The September 2015 amendment to the DPA requires that all personal data operators store and process the personal data of Russian individuals on databases located in Russia, subject to few exceptions. The new amendment clarifies that all personal information provided by Russian citizens when registering on websites, making online purchases, or sending electronic messages must be stored inside Russia. The penalty for violating this requirement is, ultimately, the blocking of websites that have unlawfully handled Russians' personal data.ⁿ</p>

Sources: Compiled by USITC.

^a Pereira, "Privacy and Data Protection," January 19, 2016; industry representatives, interview by USITC staff, Washington, DC, March 7, 2017; McKinsey, "New Era of Global Flows," March 2016.

^b DLA Piper, "Data Protection Laws of the World" (accessed April 22, 2017); industry representatives, interview by USITC staff, Washington, DC, March 7, 2017; CRS, *Digital Trade and U.S. Trade Policy*, January 13, 2017.

^c UNCTAD, *Data Protection Regulations and International Data Flows*, 2016; European Commission, "Protection of Personal Data," November 24, 2016.

^d European Union General Data Protection Regulation, "Key Changes" (accessed February 7, 2017).

^e The GDPR increases territorial scope (jurisdiction) from the current EU Data Protection Directive to include businesses that are not established within the EU, but that process personal data relating to goods and services offered to EU citizens. DLA Piper, "EU General Data Protection Regulation" (accessed April 22, 2017).

^f Furthermore, in instances where the data controller or processor is not established as a business in the EU, the GDPR will also apply to processing of personal data if the activity relates to offering goods or services to EU citizens (even if no payment is

required for these goods or services) and if there is monitoring of behavior within the EU. European Union General Data Protection Regulation, “Key Changes” (accessed February 7, 2017).

^g USITC, hearing transcript, April 4, 2017, 257–58 (testimony of Sean Heather, U.S. Chamber of Commerce).

^h IAPP European Data Protection Intensive Conference, London, UK, March 15–16, 2017; industry representatives, telephone interview by USITC staff, March 29, 2017.

ⁱ DLA Piper, “Data Protection Laws of the World” (accessed April 22, 2017).

^j DLA Piper, “Data Protection Laws of the World” (accessed April 22, 2017).

^k Wulansari and Socarana, “Data Protection in Indonesia,” September 1, 2016.

^l Wulansari and Socarana, “Data Protection in Indonesia,” September 1, 2016; BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016; Herbert Smith Freehills, “Indonesia Readies for First Omnibus Data Protection Law,” February 2016.

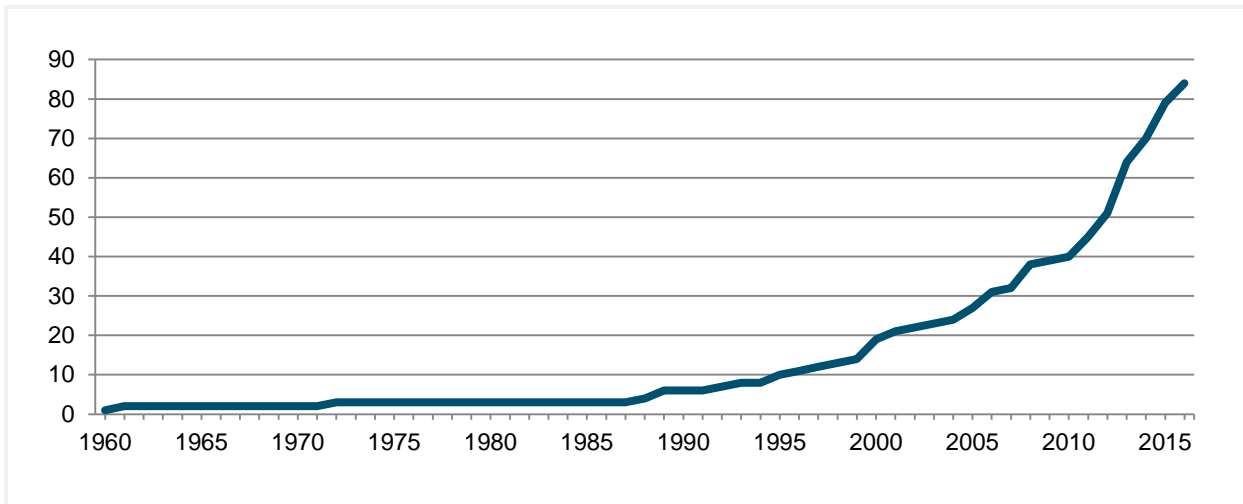
^m Baker McKenzie, “Global Privacy Handbook” (accessed February 6, 2017).

ⁿ Reportedly, however, the storing and processing of Russian individuals’ personal data outside of Russia can still be compliant with the law as long as initial storage and processing of the data is done in Russia. DLA Piper, “Data Protection Laws of the World” (accessed April 22, 2017); Kozlov, “Russian Personal Data Law Set to Come in Force,” August 2015.

Data Localization Measures

All businesses increasingly rely on data flows, with fully half of all global trade in services now depending on access to cross-border data flows. In response, the number of data localization measures has grown considerably in recent years (figure 8.1). Data localization measures specifically limit or prohibit the transfer of data across country borders.⁷⁸⁹

Figure 8.1: Number of data localization measures globally (1960–2015)



Source: ECIPE Digital Trade Estimates database.

Note: The database includes data localization measures of 65 countries worldwide. Corresponds to [appendix table G.17](#).

⁷⁸⁹ The United Nations defines transborder data flows as “movement across national boundaries of machine readable data for processing, storage or retrieval.” United National Center on Transnational Corporations, *Transnational Corporations and Transborder Data Flows: A Technical Paper*, 1982, 8.

At the Commission’s public hearing on April 4, many industry representatives voiced their concerns about data localization measures.⁷⁹⁰ In some cases, such measures have led some companies to withdraw from certain markets. In 2016, for example, the online payment company PayPal suspended its Turkish operations in response to a requirement that PayPal fully localize its information systems within Turkey.⁷⁹¹ One industry expert contended that such localization requirements could “threaten the major new advances in information technology—not only cloud computing, but also the promise of data analytics and the Internet of Things (IoT)” (table 8.4).⁷⁹² In the absence of data localization measures, Internet data are routed across companies’ networks through decisions made autonomously and automatically at local routers, which choose paths based largely on efficiency and not on country boundaries. Data localization dramatically alters this fundamental architecture of the Internet.⁷⁹³

Table 8.4: Internet technologies and the impact of data localization

Internet technology	Impact of data localization measures
Internet communication services	Data localization affects all Internet communication service providers. However, these measures place small firms at a particular disadvantage, as large companies that operate online often benefit from economies of scale, and thus are better able to craft data policies for individual countries.
Cloud-based data processing	Companies subject to data localization measures need to rely on country-specific cloud centers and servers, increasing the locations where a company stores data and fragmenting global data into country-specific datasets. Additionally, localizing data to individual countries can amplify the risk of losing data if servers are compromised by events such as natural disasters or mechanical failures. For larger multinational firms that conduct substantial cross-border data flows, data localization can also effectively prevent entry into certain markets.
E-commerce	Like Internet communication service providers, e-commerce companies may find it hard to maintain operations in countries that make data localization a condition of market access. When governments require processing or storing data in-country, or restrict cross-border data flows, the complexities and costs effectively exclude some firms from commerce.
Internet of Things (IoT)	Applying data localization measures to the IoT can reduce data security by forcing providers to create new and previously unnecessary data centers, thus exposing data flows to additional potential breach areas. Further compliance with data localization policies may require detours and inefficient routes for data, creating delay (“latency”) that reduces IoT functionality.

Source: Compiled by USITC.

⁷⁹⁰ USITC, hearing transcript, April 4, 2017, 240 (testimony of Nigel Cory, Information Technology Industry Foundation); USITC, hearing transcript, April 4, 2017, 160 (testimony of Carl Schonander, Software and Information Industry Association); USITC, hearing transcript, April 4, 2017, 176 (testimony of K.C. Swanson, Telecommunications Industry Association); USITC, hearing transcript, April 4, 2017, 162 (testimony of Brian Scarpelli, The App Association); USITC, hearing transcript, April 4, 2017, 169 (testimony of Daniel O’Connor, Computer and Communications Industry Association).

⁷⁹¹ *Business Insider*, “PayPal Is Shutting Down in Turkey,” June 1, 2016.

⁷⁹² Chander, “Breaking the Web: Data Localization,” July 5, 2015, abstract.

⁷⁹³ Goldenstein, “The End of the Internet?” July/August 2014.

Data localization measures differ from country to country in terms of industry coverage, geography, types of data covered, complexity, data intensity, and economic impact, among other factors. Accordingly, the measures can be categorized in multiple ways. One observer groups them into four main categories, from most to least stringent: (1) geographical restrictions on data export; (2) geographical restrictions on data location; (3) permission-based regulations; and (4) standards-based regulations.⁷⁹⁴ Another observer places them into two categories: (1) strict data localization measures, and (2) conditional flow regimes. Strict data localization measures may require local storage (collecting data on local servers); local storage and processing (collecting and manipulating data to produce meaningful information on local servers); or local storage, processing, and access (thus banning data transfers). Under conditional flow regimes, certain conditions need to be fulfilled for data to leave the implementing jurisdiction, effectively banning the transfer of data. These regimes can be so restrictive as to cause a de facto ban on the transfer of specific data, as is the case in China.⁷⁹⁵ The following discussion focuses on conditional flow regimes.

Brazil

Brazil's Law No 12.965, *Marco Civil da Internet* or "Marco Civil" (Civil Rights Framework for the Internet), "establishes rules on net neutrality, privacy, data retention, and intermediary liability, among other issues." During 2013–14, Brazil's national legislature debated a local data storage requirement that would have required all data relating to Brazilian citizens and the Brazilian operations of both domestic and international companies to be stored in the country. While the requirement was stripped from the Marco Civil, there are some reports that such legislation may be reintroduced.⁷⁹⁶

Although the Marco Civil does not contain an explicit data localization requirement, it states that data collected, stored, retained, or treated in Brazil shall respect Brazilian law, implying that certain data stored overseas by foreign companies might be subject to the law. Companies that do not comply could face fines of up to 10 percent of gross Brazil revenues and/or a temporary or permanent suspension of operations in Brazil.⁷⁹⁷

Brazil has also issued a Draft Bill for the Protection of Personal Data, intended to protect "the fundamental rights of freedom and privacy" as they relate to the processing of personal data.⁷⁹⁸

⁷⁹⁴ Kaplan and Rowshankish, "Addressing the Impact of Data Location Regulation," May 2015, 1.

⁷⁹⁵ Bauer, Ferracane, and van der Marel, "Tracing the Economic Impact of Regulations," May 2016, 7.

⁷⁹⁶ Dempsey, written testimony to the USITC, April 4, 2017, 5.

⁷⁹⁷ Spinola, "Brazil Leads the Efforts in Internet Governance," April 30, 2014; USDOS, *2015 Investment Climate Statement: Brazil*, May 2015, 8.

⁷⁹⁸ Ethisphere, "Draft Privacy Law," Chapter I, Art. 1, 1.

The draft bill would allow the international transfer of personal data only in certain circumstances, such as “to countries that afford a level of personal data protection at least equivalent” to that of Marco Civil.⁷⁹⁹ The draft bill also includes notice and consent requirements; access, correction, cancellation, and objection rights; security, integrity, and retention requirements; and cross-border transfer restrictions.⁸⁰⁰

U.S. firms are concerned that the draft bill may require customers’ express consent for processing personal data. They also express fear that the bill could impose requirements on data transfer that would restrict the ability of companies to move data in and out of the country for processing.⁸⁰¹

China

China’s Cybersecurity Law contains requirements for the local processing and storage of “important data” related to Chinese citizens and critical information infrastructure. However, this law’s reference to data export limitations or specific requirements is unclear to industry representatives.⁸⁰² The law, which took effect in June 2017, authorizes Chinese agencies to restrict market access for cloud computing and other Internet-enabled services through requirements for localizing both data and facilities that the government deems critical.⁸⁰³

China also maintains data localization measures pertaining to financial institutions and telecommunications. In 2011, the People’s Bank of China issued a “Notice to Urge Banking Financial Institutions to Protect Personal Financial Information.” The notice explicitly prohibits offshore storing, processing, or analysis of any personal financial information of Chinese citizens.⁸⁰⁴ The “PRC Telecommunications Regulation of 2000” requires all data collected inside China to be stored on Chinese servers. As a result of this regulation, Hewlett Packard, Qualcomm, and Uber were required to divest more than 50 percent of their businesses in China to Chinese companies, to avoid fines of more than \$1 billion each.⁸⁰⁵

Overall, China has released drafts for comment or enacted legislation requiring local data storage for a wide host of industries, including civil aviation, health information management,

⁷⁹⁹ Ethisphere, “Draft Privacy Law,” Chapter V, Art. 33, 13.

⁸⁰⁰ Zwiebach, “Brazil’s Internet Governance and Data Protection Legislation,” June 17, 2015.

⁸⁰¹ American Insurance Association, written submission to the USITC, March 28, 2017, 8.

⁸⁰² Information Technology Industry Council, “Data Localization Snapshot” (accessed April 17, 2017).

⁸⁰³ USTR, “Key Barriers to Digital Trade,” March 2016; Abkowitz and Dou, “Apple to Build China Data Center,” July 12, 2017.

⁸⁰⁴ ITI, “Data Localization Snapshot” (accessed April 17, 2017).

⁸⁰⁵ Software & Information Industry Association, written submission to the USITC, March 28, 2017, 10.

online publishing, insurance, and connected vehicles, among others.⁸⁰⁶ In some cases, companies are not only required to store and process data within China, but they are also not allowed to send a copy of the data abroad. Other proposed or widely discussed measures appear to build on these data localization requirements. Examples include proposed rules related to Internet-based mapping applications, and draft cybersecurity standards released by China’s National Information Security Standardization Technical Committee (TC 260).⁸⁰⁷

European Union

The EU imposes many restrictions on cross-border data flows. The GDPR (as noted above) will apply not only to organizations located within the EU, but also to outside organizations that offer goods or services to, or monitor the behavior of, EU data subjects. Streamlining international data transfer rules may benefit some companies, but the process for transferring personal data out of the EU will remain costly for U.S. firms.⁸⁰⁸

EU member states can implement measures under the broader guidelines imposed by the GDPR. In Germany, for example, the Commercial Code requires companies to store accounting data and documents locally.⁸⁰⁹ The Brandenburg Data Protection Act requires that data on residents of the state of Brandenburg be stored on cloud computing servers located in the state.⁸¹⁰ Examples of other EU data localization measures are highlighted in table 8.5.

Table 8.5: Examples of EU data localization measures

Country	Measure
Denmark	The Danish Bookkeeping Act requires firms to store their financial records in Denmark, or in one of the other Nordic countries, for five years. In cases where records are stored on a server physically located outside of Denmark or in the cloud, a complete copy must be kept inside Denmark. The Danish Commerce and Companies Agency may, under special circumstances, grant companies permission to preserve accounting records abroad, but permission is rarely granted.
Germany	In December 2016, Germany introduced local data storage requirements for the telecommunications industry, which aims to retain telecommunications data for law enforcement and security purposes. The law went into effect on July 1, 2017.
Greece	In 2001, Greece introduced data localization requirements, stating that data generated and stored on physical media located within the Greek territory must be retained within Greek territory.
Luxembourg	In 2012, Luxembourg’s financial services regulator issued a circular stating that financial institutions operating in the country are required to process their data in-country, unless the overseas entity processing the data is part of the same Luxembourg-based company and the data is transferred with the explicit consent of the client.”

⁸⁰⁶ Telecommunications Industry Association, written submission to the USITC, March 28, 2017, 2.

⁸⁰⁷ EY Law, “China Is Strengthening Its Legal Framework,” February 7, 2017.

⁸⁰⁸ Webster, “Navigating the Roadways of Cross Border Transfer,” September 2016, 10.

⁸⁰⁹ Information Technology & Innovation Foundation, written submission to the USITC, April 21, 2017, 23.

⁸¹⁰ Ibid.

Country	Measure
Netherlands	The Netherlands Public Records Act requires records to be stored in archives in specific locations in the country.
Poland	The Polish Gambling Act requires online gambling firms to store all data relating to customer betting in the EU.
Romania	In 2015, Romania enacted new online gambling regulations that require all data on players and their gambling activities to be stored in Romania.
Sweden	Sweden’s Financial Services Authority requires “immediate” access to data in the markets it supervises. Industry representatives interpret this rule as a requirement to give the supervisory body physical access to their servers. This amounts to a de facto localization requirement, as companies must store data in Sweden to provide such access. Sweden also has accounting requirements that require companies to store current company records and account data for seven years.
United Kingdom	According to the UK’s Companies Act 2006, “if accounting records are kept at a place outside the United Kingdom, accounts and returns . . . must be sent to, and kept at, a place in the United Kingdom, and must at all times be open to such inspection.”

Sources: Compiled by the USITC from Information Technology Industry Council, “Data Localization Snapshot,” January 2017; Information Technology & Innovation Foundation, “Cross-Border Data Flows: What are the Barriers?” May 2017, 23; Information Technology & Innovation Foundation, written submission to the USITC, April 21, 2017, 25.

Despite previous and current agreements that allow the legal flow of data from EU member states to the United States (e.g., the U.S.-EU Privacy Shield, model contracts), U.S. firms have been building domestic cloud data centers in the EU. This is due, in part, to the challenge of conducting business in a region that is increasingly reluctant to allow the storage of personal data outside the EU. Further, Deutsche Telecom has advocated for stricter rules at the EU Commission. The rules would mandate data storage on local cloud servers and block access to local data by foreign authorities, making it more difficult for U.S. cloud services providers to operate in the EU because of the added cost of storing data on local servers.⁸¹¹

India

In February 2014, India’s National Security Council proposed significant new restrictions on cross-border data flows, including a requirement that all communications between users in India must stay in India and be stored locally on Indian servers. India’s broad data localization requirements are contained in its Information Technology Act (IITA) and India’s Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules 2011. The IITA permits a corporation to transfer sensitive personal data or information to firms in India or outside India if the same level of data protection is guaranteed as that mandated under the IITA Rules.⁸¹² India’s Reasonable Security Practices impose wide-

⁸¹¹ USITC, hearing transcript, April 4, 2017, 267 (testimony of Christine Bliss, Coalition of Services Industries); industry representatives, interview by USITC staff, Washington, DC, March 8, 2017.

⁸¹² Transferring data may be allowed only if it is necessary for the performance of a lawful contract between the corporate entity or any person on its behalf and the information provider, or where there is consent by the person to transfer data. Government of India, Information Technology Act, 2011.

ranging obligations on any company that “collects, receives, possesses, stores, deals with or handles” personal information. These obligations require companies to maintain privacy policies, restrict the processing of sensitive personal data, restrict international transfers, and implement additional security measures.⁸¹³

Further, India has data localization measures that affect government procurement and entities using government funds. India’s National Data Sharing and Accessibility Policy requires that “non-sensitive data available either in digital or analog forms but generated using public funds” must be stored within the borders of India. The policy states that data will stay the property of the “agency/department/ministry/entity which collected them and reside in their IT enabled facility.”⁸¹⁴ India’s government also has data and server localization guidelines that cover Indian procurement contracts. For example, in 2015, India’s Department of Electronics and Information Technology (DEITY) issued guidelines for a cloud computing empanelment process under which cloud computing service providers may be provisionally accredited as eligible for government procurements of cloud services.⁸¹⁵ However, the guidelines require such providers store all data in India to qualify for the accreditation.

In 2015, India’s Department of Telecommunications released the “National Telecom Machine-to-Machine (M2M) Roadmap.” The Roadmap recommends requiring data localization and mandating that all M2M application servers and gateways serving customers in India be located solely in India. Reportedly, some ministries have also been advocating for local server requirements as part of new e-commerce policies. However, U.S. industry representatives have expressed hope that ongoing consultations over implementing guidelines may address their concerns regarding the Roadmap.⁸¹⁶

Indonesia

Indonesia’s Regulation No. 82, “Information and Electronic Transaction Law,” mandates that any company which provides Internet-enabled services directly to the consumer must locate its data centers within Indonesia.⁸¹⁷ Two other Indonesian measures require providers of a “public service” to establish local data centers and disaster recovery centers in Indonesia; however, the

⁸¹³ Metropolitan Corporate Counsel, “Data Protection and Privacy Laws in India,” October 2013, 2.

⁸¹⁴ ITI, “Data Localization Snapshot,” June 13, 2016, 1.

⁸¹⁵ As indicated in chapter 3 of this report, the three main types of cloud services are software as a service (SaaS), infrastructure as a service (IaaS), and platform as a service (PaaS).

⁸¹⁶ Dempsey, written testimony to the USITC, March 28, 2017, 5; USTR, *2016 National Trade Estimate Report*, 2016, 61.

⁸¹⁷ ITI, “Data Localization Snapshot,” June 13, 2016.

term “public service” is defined broadly and vaguely in these regulations.⁸¹⁸ Noncompliance may result in warnings (verbal and in writing), a temporary suspension of business activities, and an announcement on the website of the noncompliant party.⁸¹⁹

In May 2016, the Indonesian government released its “Draft Regulation Regarding the Provision of Application and/or Content Services through the Internet.” According to a U.S.-based trade association, the Draft Regulation places onerous and ill-defined requirements on providers of OTT services.⁸²⁰ In particular, one requirement states that an OTT services provider must “place a part of its servers at data centers within the territory of the Republic of Indonesia,” although the term “part of its servers” is not clearly defined. The trade association noted that while some larger companies may be able to absorb the costs of establishing a new operation in Indonesia or using Indonesian servers, these data localization requirements may be prohibitive for SMEs.⁸²¹ Moreover, industry representatives claim that Indonesia’s data localization regulations prevent service suppliers from leveraging economies of scale in data processing.⁸²²

Russia

Russia has increasingly implemented data localization requirements in its domestic legislation.⁸²³ Indeed, at least one industry expert contended that “Russia has some of the most severe data localization requirements” in the world.⁸²⁴ Russia’s Federal Law 242-FZ (Data Localization Law) “requires all operators—both local and foreign—that possess the personal data of Russian citizens to use databases located exclusively in Russia and disclose the address of those data centers to Russian authorities.”⁸²⁵ Russia’s Federal Law No. 907-FZ (Online Content Law) stipulates that anyone that organizes the dissemination of information on the Internet must “store online content generated on Russian citizens in Russia.”⁸²⁶ Further, Russia’s Federal Law No. 152-FZ, On Personal Data, as amended in July 2014 by Federal Law No.

⁸¹⁸ Two legal provisions—Article 1 of the Draft Ministerial Regulation concerning Data Centre Technical Guidelines and Article 17(2) of the Regulation on Electronic System and Transaction Operation—state that any electronic system administrator for public service would need to place a data center and a disaster recovery center in Indonesia. BSA | The Software Alliance, “2016 Global Cloud Computing Scorecard,” 2016.

⁸¹⁹ Innis, “Indonesia: New Regulation on Personal Data Protection,” January 25, 2017.

⁸²⁰ OTT is an acronym for “over the top” services, meaning those provided over the Internet, including streaming television and communication applications.

⁸²¹ ITI, submission in response to USTR request, October 26, 2016, 15.

⁸²² USITC, hearing transcript, April 4, 2017, 189 (testimony of Ed Brzytwa, Information Technology Industry Council).

⁸²³ Manyika, “Global Flows in a Digital Age,” April 2014, 8.

⁸²⁴ USITC, hearing transcript, April 4, 2017, 174 (testimony of Nigel Cory, Information Technology & Industry Foundation).

⁸²⁵ USITC, hearing transcript, April 4, 2017, 169 (testimony of Daniel O’Connor, Computer and Communications Industry Association).

⁸²⁶ ITI, “Data Localization Snapshot,” June 13, 2016, 2.

242-FZ, requires operators to ensure that the recording, systemization, accumulation, storage, clarification (i.e., updating and modification), and retrieval of Russian citizens’ personal data is conducted only in databases located within Russia. The law affects all business practices that involve the processing of Russian citizens’ personal data, whether or not the companies have a physical presence in Russia.⁸²⁷

These laws have reportedly forced U.S. firms operating in Russia to restrict their operations, while U.S. firms providing services from the United States have reportedly had to consider exiting the market or buying server space in order to provide the same services at a higher cost.⁸²⁸ An industry representative also noted that Russia’s telecommunications-related data localization law requires the actual content of telecommunication calls to be stored locally, which the representative characterized as a “fairly severe sort of barrier to digital trade.”⁸²⁹ As a result of Russia’s data localization regulations, Google moved servers to data centers in Russia.⁸³⁰ In November 2016, a Moscow court ruled that LinkedIn was not in compliance with the data laws and suspended its license.⁸³¹

Regulatory and Policy Measures Addressing Private and Public Cybersecurity

Limits on data flows may not only impede digital trade by U.S. firms operating in key overseas markets; they may also introduce vulnerabilities that increase the risk of cybercrime and data breaches.⁸³² According to industry representatives, governments claim that these measures are often implemented for security or cybersecurity reasons. However, measures requiring data localization, source code disclosure, and encryption restrictions may actually increase cybersecurity risks and their associated costs, which are significant.⁸³³

Cybercrime, which includes hacking, data damages, stolen funds, theft of intellectual property, and theft of data, is highly prevalent—and costly—for firms operating overseas. Microsoft

⁸²⁷ Bryan Cave LLP, “Russia Data Localization Requirements at a Glance,” May 2015, 1.

⁸²⁸ USITC, hearing transcript, April 4, 2017, 124 (testimony of Nigel Cory, Information Technology and Innovation Foundation).

⁸²⁹ USITC, hearing transcript, April 4, 2017, 123–24 (testimony of Nigel Cory, Information Technology and Innovation Foundation).

⁸³⁰ SIIA, prehearing submission, March 25, 2017, 10.

⁸³¹ Shead, “Russia Has Banned LinkedIn,” November 16, 2017.

⁸³² Industry representatives, interview with USITC staff, March 17, 2017.

⁸³³ USITC, hearing transcript, April 4, 2017, 23, 98–99 (testimony of Nigel Cory, Information Technology and Innovation Foundation); USITC, hearing transcript, April 4, 2017, 224 (testimony of Carl Schonander, Software and Information Industry Association); Schonander, written testimony to the USITC, March 28, 2017, 10.

estimates that 71 percent of all businesses were victims of cyberattacks in 2014.⁸³⁴ Estimates of the global annual cost of cybercrime range from \$400 billion to \$3 trillion.⁸³⁵

Cybercrime is not isolated to any particular location, but appears to be more prevalent in Asia. According to a survey by LogRhythm, almost 90 percent of firms operating in the Asia-Pacific region experienced some form of cyberattack in 2016, up from about 66 percent in 2014. In 2015, business-related losses due to cyberattacks reached \$81.3 billion in the Asia-Pacific region. Losses in the United States and the EU are lower, estimated to be \$20 billion each.⁸³⁶

The growth of cybercrime, particularly the cybertheft of trade secrets, has been especially marked in China. The U.S. Congressional Research Service states that U.S. businesses face a “growing and persistent” threat of Chinese entities stealing their trade secrets through cyberspace.⁸³⁷ In May 2014, the U.S. Department of Justice indicted five members of the Chinese People’s Liberation Army for government-sponsored cyber-espionage against U.S. companies, and for theft of proprietary information to aid state-owned enterprises.⁸³⁸ Given the high prevalence of cybercrime, firms supplying digital services rely on strong rule of law as a deterrent to cyberattacks, as well as efficient and secure cross-border data flows to minimize breaches.⁸³⁹ Firms have also taken a number of steps to protect their networks using third party software, as discussed in chapter 3.

While there is currently no international framework for cybersecurity law, the Budapest Convention on Cybercrime (2001) established a multilateral standard for national cybercrime laws and enforcement.⁸⁴⁰ Signatories agree to a certain level of domestic enforcement, including prosecuting cybercrimes committed in their territories. As of December 2016, 54 countries had ratified the Budapest Convention on Cybercrime. However, a lack of enforcement

⁸³⁴ Microsoft, “The Emerging Era of Cyber Defense and Cybercrime,” 2016.

⁸³⁵ McKinsey Global Institute, “Digital Globalization,” March 2016, 95; CSIS and McAfee, “Net Losses,” June 2014; Cybersecurity Ventures, 2016, “Hackerpocalypse,” 2016.

⁸³⁶ Lewis, Weinland, and Peel, “Asia Hacking,” September 20, 2016.

⁸³⁷ The loss attributable to trade secret theft is estimated to be between 1 and 3 percent of the U.S. GDP. It is unclear how much of this loss is due to theft by Chinese entities. CRS, *Digital Trade and U.S. Trade Policy*, January 13, 2017; CRS, *U.S.-EU Data Privacy*, May 19, 2016. A previous USITC study estimated that in 2009, approximately \$1.1 billion in losses could be attributed to Chinese trade secret misappropriation. USITC, *China: Effects of Intellectual Property Infringement*, May 2011.

⁸³⁸ CRS, *Digital Trade and U.S. Trade Policy*, January 13, 2017. In July 2016, a Chinese national received a 46-month federal prison sentence for his attempts to steal U.S. military technical data via cyber-espionage of major U.S. defense contractors in a conspiracy with hackers from the People’s Liberation Army Airforce, U.S. Department of Justice, “Chinese National Who Conspired to Hack,” July 2016.

⁸³⁹ Data transmission is most secure when it experiences little interruption or interference from the data host to the receiver. Interruptions at any point, including at country borders, increase vulnerabilities and the risk of data breach.

⁸⁴⁰ Council of Europe, “Convention on Cybercrime,” November 23, 2001.

in certain markets has created a digital environment that is vulnerable to cybercrime. According to the U.S. Chamber of Commerce Global Intellectual Property Center’s International IP Index among key markets reviewed in this report, only China is both not a signatory and does not have laws that are broadly compatible with the Budapest Convention (table 8.6).

Table 8.6: Cybersecurity law and the Budapest Convention in key markets

Country	Ratification of the Budapest Convention	Status of domestic cybersecurity measures	U.S. Chamber of Commerce IP enforcement indicators ^a
Brazil	No, but domestic cybercrime law is similar to Convention principles.	Criminal code amendments in 2012 incorporate cybercrime offenses.	34%
China	No. Cybercrime provisions need to be expanded to measure up to the Budapest Convention.	Cybercrime is covered under three national regulations.	35%
India	No, but criminal provisions closely follow Convention standards.	Information Technology Act enacted in 2000 (amended in 2008) covers cybercrimes.	31%
Indonesia	No, but the 2008 law provisions are similar to Convention provisions.	2008 law on information and electronic transactions includes cybercrime provisions.	22%
Russia	No, but criminal code is broadly compatible with the Convention.	Criminal code includes computer crime provisions.	29%
EU	Most countries are signatories of the Convention.	Most countries cover cybercrime in their criminal codes.	Ranges from 42% (Poland) to 93% (United Kingdom)

Source: BSA, “2016 BSA Global Cloud Computing Scorecard,” 2016; U.S. Chamber of Commerce, Global Intellectual Property Center, U.S. Chamber International IP Index, 2016.

^a The USITC calculated this indicator by averaging data from the U.S. Chamber of Commerce rankings for enforcement indicators related to software piracy rates, civil and procedural remedies, and criminal standards.

Source Code Disclosure Requirements

Some countries require source code disclosure to ensure that imported digital products or services do not pose threats to national security or cybersecurity.⁸⁴¹ U.S. industry representatives consider source code to be valuable proprietary information (trade secrets) and have stated that disclosure requirements may increase vulnerability to trade secret theft and piracy.⁸⁴² Brazil, China, and Indonesia have either implemented or introduced requirements for foreign firms to disclose digital source code (such as underlying code of business software or smartphone apps) as a prerequisite to operating in those countries.⁸⁴³ Enacted or proposed

⁸⁴¹ Friedman, “Cybersecurity and Trade,” September 2013, 7–8.

⁸⁴² Industry representatives, interview by USITC staff, Washington, DC, March 24, 2017; USITC, hearing transcript, 163 (testimony of Brian Scarpelli, The App Association).

⁸⁴³ BSA, written testimony to the USITC, April 21, 2017, 2; USITC, hearing transcript, April 4, 2017, 153 (testimony of Leticia Lewis, BSA).

measures require firms to provide a copy of the source code of their digital service (software or other type of digital service) to relevant government authorities. U.S. firms contend that the risks of intellectual property theft and cybercrime are particularly high in locations where source code may not be stored securely.⁸⁴⁴ These increased risks can be sufficient to keep digital service providers out of certain markets altogether, or force firms to offer inferior products or strictly open-sourced products to reduce the risk of intellectual property theft.⁸⁴⁵

In Brazil and Indonesia, draft measures have been introduced that would require firms to disclose source code as a condition of market access. A draft of Brazil's 2015 implementing regulations to Presidential Decree 8135 (2013) that regulates government procurement includes a requirement for information technology (IT) firms to disclose source code.⁸⁴⁶ The Indonesian government introduced a draft regulation on electronic systems software in 2015 that would in part require electronic systems providers to disclose software source code if they supply services related to public services.⁸⁴⁷

In China, the 1999 Commercial Encryption Regulations required makers of encryption products to disclose source code in order to receive a sales license.⁸⁴⁸ This is also true for software providers, app developers, and manufacturers using digital services.⁸⁴⁹ Source code disclosure can also be a part of local testing requirements, and U.S. firms have expressed a lack of confidence that testing authorities can securely store their source code once the firms have disclosed it.⁸⁵⁰

⁸⁴⁴ Industry representatives, interview with USITC staff, Washington, DC, March 17, 2017; USITC hearing transcript, April 4, 2017, 153 (testimony of Leticia Lewis, BSA); USITC hearing transcript, April 4, 2017, 163 (testimony of Brian Scarpelli, The App Association); USITC hearing transcript, April 4, 2017, 178 (testimony of K.C. Swanson, Telecommunications Industry Association); USITC hearing transcript, April 4, 2017, 219 (testimony of Carl Schonander, Software & Information Industry Association); Dempsey, NAM pre-hearing submission to the USITC, March 28, 2017, 7.

⁸⁴⁵ Industry representatives, interview with USITC staff, Washington, DC, March 17, 2017; USITC hearing transcript, April 4, 2017, 153 (testimony of Leticia Lewis, BSA); USITC hearing transcript, April 4, 2017, 163 (testimony of Brian Scarpelli, The App Association); USITC hearing transcript, April 4, 2017, 178 (testimony of K.C. Swanson, Telecommunications Industry Association); USITC hearing transcript, April 4, 2017, 219 (testimony of Carl Schonander, Software & Information Industry Association).

⁸⁴⁶ BSA, post-hearing submission to the USITC, April 21, 2007, 13. Open-sourced software is usually available to the public for use rather than held for sale or lease.

⁸⁴⁷ BSA, post-hearing submission, April 21, 2007, 10.

⁸⁴⁸ BSA, post-hearing submission, April 21, 2007, 5.

⁸⁴⁹ USITC, hearing transcript, April 4, 2017, 163 (testimony of Brian Scarpelli, The App Association).

⁸⁵⁰ Industry representative, interview with USITC Staff, Washington DC, March 24, 2017.

Restrictions on Cryptography

Cryptography is a mathematics-based methodology that enables sensitive information to be transmitted securely and privately.⁸⁵¹ According to industry representatives, regulations that restrict the use of cryptography keep firms from using certain methodologies to secure their products or require firms to use cryptography standards developed in the domestic market of the country imposing the regulations. Such regulations are often proposed and enacted for cybersecurity or national security reasons. But experts widely agree that restrictions on cryptography can actually increase the risk of cybertheft and of compromised security and privacy for most digital services, including cloud-based data processing, the IoT, communications, content, and e-commerce.⁸⁵² In addition, cryptography restrictions often compel firms to use outdated cryptography standards that could compromise data security and add compliance costs.⁸⁵³

End-to-end encryption refers to a method in which transmitted information is encrypted from the moment the information is sent until the information is received by the intended receiver. Service providers from other countries may not be able or willing to decrypt the information upon the local governments' request, depending on the encryption technology used. The use of cryptography has been a source of debate focusing on the balance of privacy, security, law enforcement, and national security. Nonetheless, digital service providers argue that cybercrime risks increase when restrictions on cryptography are in place. Again, they state that these increased risks impede digital trade by compromising or reducing security and privacy of digital goods.⁸⁵⁴ Cryptography restrictions can impede the cross-border flows of both encrypted data and physical goods that enable cryptography (box 8.1). China, India, and the UK are among countries that place restrictions on cryptography (table 8.7).

⁸⁵¹ ITIC, <http://itidecodes.org/what-were-decoding/encryption/en>.

⁸⁵² USITC, hearing transcript, April 4, 2017, 163-164, 228 (testimony of Brian Scarpelli, ACT App Association); Hooton, "The Rising Importance of Strong Encryption," 2017.

⁸⁵³ For example, India's encryption standards require 40-bit or lower encryption in the absence of additional regulatory approval, while strong encryption standards currently range from 128-bit to 256-bit to ensure security. BSA, written statement to USITC, April 21, 2017.

⁸⁵⁴ USITC, hearing transcript, April 4, 2017, 163 (testimony of Brian Scarpelli, ACT App Association); USITC, hearing transcript, April 4, 2017, 178 (testimony of K.C. Swanson, Telecommunications Industry Association).

Box 8.1: Vietnam’s Law on Network Information Security

Vietnam’s Law on Network Information Security (LONIS), passed in 2015, requires import and export permits and licensing for all goods identified as “civil cryptographic products.” LONIS was passed to ensure that “organizations, individuals . . . be responsible for ensuring network information security.”^a The provisions indicate a requirement for both permits and licenses. The difference between the two is not yet clear and is pending clarification through further decrees.^b

Semiconductor firms operating in Vietnam, including those that solely provide digital services, have indicated to the Vietnamese government that the law imposes significant costs and uncertainty on their business operations. LONIS allows firms to obtain permits to import and export civil cryptographic products if firms acquire a business license to trade in such goods, and if the firms verify that each import does not damage national defense or security. Applications are designated to be processed by the Government Cipher Committee. U.S. firms continue to be uncertain about permitting procedures.^c

^a LONIS, Law 86/2015/QH13.

^b LONIS, Article 34, “Importation and Exportation of Civil Cryptographic Products,” paragraph 1. English translation provided by Baker-McKenzie.

^c SIA, letter to Vietnamese government, 2016.

Table 8.7: Selected measures and policies related to restrictions on cryptography

Country	Measure
China	China’s 1999 commercial encryption regulations and subsequent cybersecurity-related regulations require foreign technology providers to use indigenously developed encryption technology, and require firms that develop, import, or sell encryption technology in China to obtain a license. The government regularly publishes lists of approved products for cybersecurity, including encryption products, antivirus software, and operating systems.
India	India’s encryption regulations require firms to use a 40-bit or lower standard encryption to secure digitally transmitted information, while most firms use much stronger standards, ranging from 128-bit to 256-bit. To use more sophisticated (and therefore more secure) cryptography, firms must procure a license. Firms also report that encryption standards differ from one regulatory agency to another.
United Kingdom	The proposed Investigative Powers Act passed in November 2016 in part requires communication service providers to remove any applied encryption when served with notice. The extent to which these requirements would apply to foreign firms operating in the UK is still uncertain.

Sources: BSA, written testimony to the USITC, April 21, 2017, 5, 7; USITC, hearing transcript, 163–64 (testimony of Brian Scarpelli, The App Association); USTR, *2016 National Trade Estimate*, 199; industry representative, interview by USITC staff, Washington, DC, March 7, 2017; industry representatives, interview by USITC staff, Washington, DC, March 24, 2017; Pickworth and Hickman, “Investigatory Powers Act 2016 Becomes Law,” December 12, 2016.

Regulatory and Policy Measures Relating to Intellectual Property Rights

The Internet’s accessibility and availability to a wide and diverse set of broadband users has led to increased abuses of IPRs—abuses which mainly affect digital trade related to digital content and e-commerce.⁸⁵⁵ In some instances, countries have imposed liability obligations on Internet intermediaries,⁸⁵⁶ such as Internet service providers (ISPs), and implemented ancillary copyright laws that have raised costs for U.S. firms to operate in foreign markets (box 8.2).

Box 8.2: Ancillary Copyright Laws in the EU

Ancillary copyright laws (also referred to as “neighboring rights” in the EU) give rights similar to copyrights to publishers and producers (e.g., broadcasting organizations, film and music producers, or performers) who have rights transferred or licensed to them from the original creator.^a The EU has been at the forefront of developing and enforcing ancillary copyright laws specifically for press publishers. Ancillary copyright laws have been used in Germany and Spain in order to justify imposing remuneration requirements (payments to publishers of the original news articles) on search engines and online platforms that provide short fragments of news text, including headlines and quotations, to the public.^b However, search engines and other online platforms view these payments to publishers as a measure that impedes trade because they must pay for fragments of news text that are generally protected under a longstanding “fair use” doctrine in the United States.^c

The EU introduced an EU-wide application of ancillary copyright laws for press publishers in its proposed Copyright Directive in the EU Digital Single Market (“Directive”). Specifically, publishers have an “exclusive right” under the proposed Directive that they can directly rely on to conclude licensing agreements with online platforms or when filing a lawsuit for copyright infringements.^d This new ancillary copyright in the Directive implies that publishers may be able to enforce their right to compensation from search engines and online platforms providing news fragments.^e This new Directive has created significant opposition among scholars and industry experts, on grounds that the law would not create the promised benefits for publishers, would be costly to administer, and would likely have adverse effects on freedom of the press and the public’s access to information.^f

In 2013, Germany imposed the EU’s first ancillary copyright law. After the law went into effect, many German publishers waived their rights to payment from search engines because it resulted in lost traffic to their websites; for instance, Google removed news snippets from German publishers to avoid paying the ancillary copyright fees.^g VG Media, a German publisher, filed legal actions to force Google to pay ancillary copyright fees, but as of June 2017 has not been successful.^h In 2014, Spain imposed an

⁸⁵⁵ USTR, *2016 Special 301 Report*, April 2016.

⁸⁵⁶ USTR’s request letter asks the Commission to describe examples of regulatory measures and policies related to ISP regulations, including limitations on ISPs intended to protect IPR. This chapter discusses liability for IPRs for Internet intermediaries in a broader context, of which ISPs are a subset. According to the OECD, Internet intermediaries are defined as “Internet access and service providers (ISPs), data processing and web hosting providers, Internet search engines and portals, e-commerce intermediaries, Internet payment systems, and participative networked platforms.” OECD, *The Economic and Social Role of Internet Intermediaries*, April 2010.

ancillary copyright law as well.ⁱ Spain's law does not allow publishers to waive payment collection; in response, Google shut down its news service in Spain in December 2014.^j

The laws appear to have generated unintended consequences. Small online publishers have been reluctant to demand fees from online platforms because they rely on traffic from those search engines, and industry experts have stated that ancillary copyright laws have not generated increased fees to publishers; rather, they have acted as a barrier to entry for news aggregators.^k Independent studies have found that small publishers were the most harmed by Google's decision to withdraw from Spain's market, and that the number of daily visits to Spanish news outlets decreased by 11 percent following the shutdown of Google News in Spain.^l Google reportedly plans to pull Google News out of the EU altogether if ancillary copyright laws are passed EU-wide. Google argues that it does not run advertisements on Google News, so the service does not collect revenue to offset the cost of ancillary copyright fees.^m

^a European Commission, "Questions and Answers on the Modernisation of EU Copyright Rules for the Digital Age," September 14, 2016.

^b Computer and Communications Industry Association, "Understanding Ancillary Copyright," n.d. (accessed June 12, 2017).

^c According to 17 U.S.C. § 107, the "fair use" doctrine allows content to be reproduced and used in ways that do not unreasonably harm the interests of the copyright holder. According to the Internet Association, "Fair use enables U.S. internet services to provide snippets of news articles, show thumbnails of photos, and index copies of webpages for search purposes." Internet Association, written testimony to the USITC, April 11, 2017; USITC, hearing transcript, April 4, 2017, 142 (testimony of Ari Giovenco, Internet Association).

^d European Commission, "Questions and Answers on the Modernisation," September 14, 2016.

^e Consumerist, "Proposed European Law Could Make Google Pay Publishers," August 26, 2016.

^f Hirche, "Our Statement on the Commission's Proposal," December 5, 2016; Hirche, "British Top Scholars against European Ancillary Copyright," December 17, 2016.

^g Dempsey, "Neighboring Rights and Wrongs," June 12, 2016; Kirkpatrick, "Google Gets Sued by German News Publishing Group," January 7, 2016.

^h Karnitschnig and Spillane, "Plan to Make Google Pay for News Hits Rocks," February 15, 2017.

ⁱ Meyer, "EU Lawmakers Are Still Considering," March 23, 2016; Computer and Communications Industry Association, "Understanding Ancillary" (accessed April 22, 2017).

^j LexisNexis, "Spain's New Copyright Law Hurts Consumers," December 22, 2014; Meyer, "EU Lawmakers Are Still Considering," March 23, 2016; Reuters, "Google to Shut Down News Site in Spain," December 11, 2014.

^k Dempsey, "Neighboring Rights and Wrongs," June 12, 2016; Meyer, "EU Lawmakers Are Still Considering," March 23, 2016.

^l NERA Economic Consulting, "Impacto del Nuevo Artículo 32.2" [Impact of the new article 32.2], (accessed on April 22, 2017); Meyer, "EU Lawmakers Are Still Considering," March 23, 2016; Calzada and Gil, "What Do News Aggregators Do?" September 11, 2016.

^m Meyer, "Why Europe's New Copyright Proposals Are Bad News," September 14, 2016.

In other cases, countries have not implemented or enforced their own measures combating digital piracy, undermining the profitability and commercial viability of digital content providers. The Office of the U.S. Trade Representative (USTR) has placed China, India, Indonesia, and Russia on its Priority Watch List for ineffective IPR protection and enforcement; these four countries also rank in the lower third of BSA's 2016 Global Cloud Computing Scorecard for protection of IPRs in digital trade.⁸⁵⁷ Table 8.8 summarizes several indicators of IPR protections for the countries of particular focus for this report.

⁸⁵⁷ BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016.

Table 8.8: Summary of intellectual property rankings and agreements in key markets

Country	BSA Global Scorecard ranking (out of 24)	USTR Watch List status (2016)	BSA: Member of TRIPS Agreement ^a	BSA: TRIPS implementing laws in place	BSA: WIPO Copyright Treaty ^b signatory	BSA: WIPO Copyright Treaty implementing laws in place
Brazil	24	Watch List	Yes	Yes	No	No
		Priority				
China	16	Watch List	Yes	Partially	Yes	Partially
		Priority				
India	19	Watch List	Yes	Yes	No	Yes
		Priority				
Indonesia	21	Watch List	Yes	Partially	Yes	Partially
		Priority				
Russia	17	Watch List	Yes	Partially	Yes	Yes
United States	11		Yes	Yes	Yes	Yes
EU						
France	8	None	Yes	Yes	Yes	Yes
Germany	9	None	Yes	Yes	Yes	Yes
Italy	1	None	Yes	Yes	Yes	Yes
Spain	13	None	Yes	Yes	Yes	Yes
United Kingdom	4	None	Yes	Yes	Yes	Yes

Sources: USTR Watch List status sourced from USTR, *2016 Special 301 Report*, April 2016; all other columns sourced from BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016

^a The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) contains many provisions relating to digital trade. One such provision in the TRIPS Agreement contains specific provisions on protecting the intellectual property of computer programs and data compilations, whether in source code or object code, and clarifies that databases and data compilations are eligible for copyright protection even when the databases include data not under copyright protection. CRS, *Digital Trade and U.S. Trade Policy*, January 13, 2017; CRS, *Protection of Trade Secrets*, April 22, 2016.

^b The World Intellectual Property Organization Copyright Treaty (WIPO Copyright Treaty) specifically protects literary, musical, audiovisual, and artistic works, including online writing, computer programs, and original databases. The WIPO Copyright Treaty clarifies that the existing right of copyright holders to control and be compensated for their creations continues even when their works are distributed over the Internet. WIPO, "WIPO Internet Treaties," n.d.

http://www.wipo.int/copyright/en/activities/internet_treaties.html (accessed April 4, 2017).

Digital Piracy

To address digital piracy, a country needs both a strong legal framework and effective enforcement.⁸⁵⁸ As Internet penetration increases in both developed and developing countries, digital piracy has reportedly also been rising rapidly among Internet users. According to a

⁸⁵⁸ Depending on the content, digital piracy can occur through a variety of means and devices. For example, digital piracy of films includes unauthorized recordings made in movie theaters of first-run motion pictures that are distributed worldwide via the Internet. Digital piracy of software includes pirate servers that allow users to play unauthorized versions of cloud-based entertainment software, as well as online distribution of software and devices that allow for "game copiers" and mod chips, enabling users to play pirated games on physical consoles. Digital piracy of music includes a user joining a file-sharing network and downloading unauthorized copies of copyrighted music for free, or paying a fee to join a file-sharing network not authorized to distribute copyrighted music and then downloading that music. USTR, *2016 Special 301 Report*, April 2016; Recording Industry Association of America, "About Piracy," accessed February 8, 2017.

representative from the Motion Picture Association of America (MPAA), “Online piracy is the most significant threat to the [U.S. film] industry generally and [its] exports more significantly.”⁸⁵⁹ A Frontier Economics report stated that digital piracy in film is the most costly of all types of intellectual property infringement, estimating its toll at \$160 billion in 2015.⁸⁶⁰ The music industry also reportedly continues to suffer from a major revenue-erosion problem as a result of digital piracy. But this form of crime has somewhat declined in recent years owing to the growing popularity of large commercial music-streaming platforms; use of technical protection measures which limit and control user access; and proactive antipiracy campaigns by the industry.⁸⁶¹

Many EU countries have strong laws to combat digital piracy, as well as dedicated law enforcement agencies that shut down websites and prosecute digital pirates. For example, in 2014 law enforcement in Sweden raided and moved to shut down Pirate Bay, a large torrent file-sharing site, for violating copyright laws.⁸⁶² In response to increasing digital piracy, Europe is in the process of pursuing stronger enforcement of rights and actions to combat piracy through the EU Digital Single Market platform.⁸⁶³

Some key markets (such as China, India, Indonesia, and Russia) have begun implementing stronger intellectual property laws or increasing enforcement of IPRs through local law enforcement agencies or domestic courts with mixed results.

For example, recent increased enforcement to combat digital piracy in China, Indonesia, and Russia has been largely ineffective because illegal content reappears within hours at an alternative website or in a new country after a website displaying pirated content is shut down.⁸⁶⁴

⁸⁵⁹ USITC, hearing transcript, April 4, 2017, 35 (testimony of Joanna McIntosh, MPAA).

⁸⁶⁰ Frontier Economics, *The Economic Impacts of Counterfeiting and Piracy*, 2017.

⁸⁶¹ Consumers prefer to listen to music using digital streaming services. In March 2017, Spotify reported 50 million total paid subscribers and Apple Music reported 20 million total paid subscriptions. Faughnder, “Music Piracy Is Down,” June 28, 2015; IBISWorld, “Global Music Production and Distribution,” January 2017, 27.

⁸⁶² Aguilar, Claussen and Peukert, “Online Copyright Enforcement, Consumer Behavior and Market Structure,” 2015.

⁸⁶³ European Commission, “Questions and Answers,” updated January 24, 2017.

⁸⁶⁴ USTR’s *2016 Special 301 Report* states that commercial-scale digital piracy occurs in Brazil, India, China and Russia, among other countries, because websites in these countries host, operate, or direct parties to violate IPRs in digital content. USTR, *2016 Special 301 Report*, April 2016; IIPA, written testimony to the USITC, March 22, 2017, appendix C.

Brazil

Brazil has not signed the WIPO Copyright Treaty. Attempts to reform Brazil’s copyright legislation stalled in 2014,⁸⁶⁵ and Brazil has no clear measures that target enforcement of IPRs in digital content. There is widespread digital piracy and copyright infringement in digital films, music, software, and games. Criminal sanctions are technically available for copyright infringements, but digital piracy is rarely prosecuted.⁸⁶⁶ One U.S. industry report estimated that Brazil’s overall piracy of online content cost almost \$100 billion in 2014, higher than in either the United States or India (both with higher Internet penetration rates and larger populations). Another report estimates Brazil’s piracy rate for unlicensed software at 47 percent, representing a commercial value of \$1.7 billion.⁸⁶⁷

China

Domestic Chinese laws make broadcasting unauthorized digital content illegal. Article 47(1) of China’s Copyright Law prohibits the reproduction and broadcast of content to the public through an information network without the copyright owner’s authorization.⁸⁶⁸ Despite these laws, China reportedly has historically not had strict enforcement of IPRs.⁸⁶⁹ According to U.S. industry sources, China’s legitimate market for digital music was \$151.9 million in 2015, smaller than those of South Korea or Sweden. Industry representatives contend that China’s small market is likely the result of high piracy levels. An industry source estimates that up to 70 percent of the software used in China is unlicensed; the commercial value of such software was estimated at nearly \$8.7 billion in 2015—the highest by far among all U.S. trading partners.⁸⁷⁰ Testimony at the Commission’s hearing, however, indicated that enforcement has increased somewhat.⁸⁷¹

India

Amendments to India’s Copyright Act of 2012 make unauthorized reproduction and broadcast of digital content illegal. The amendments also make it illegal to circumvent technological protection measures used by copyright holders to protect their work from piracy, to remove

⁸⁶⁵ BSA, “2016 BSA Global Cloud Computing Scorecard” (accessed February 8, 2017).

⁸⁶⁶ *Ibid.*

⁸⁶⁷ Tru Optik’s report also claimed that Brazil’s 1.16 billion illegal downloads in 2014 mostly comprised software, music, and games. TechinBrazil, “Piracy of Digital Content in Brazil,” February 26, 2015; Tru Optik, “Digital Media Unmonetized Demand,” 2014; BSA, “Submission to USTR’s Special 301 Report,” February 9, 2017.

⁸⁶⁸ BSA, “2016 BSA Global Cloud Computing Scorecard” (accessed February 8, 2017).

⁸⁶⁹ USITC, hearing transcript, April 4, 2017 (testimony of Kevin M. Rosenbaum, IIPA), 126–27.

⁸⁷⁰ IIPA, written testimony to the USITC, March 22, 2017; BSA, written submission to USTR’s Special 301 Report, February 9, 2017.

⁸⁷¹ USITC, hearing transcript, April 4, 2017 (testimony of Kevin M. Rosenbaum, IIPA), 126–27.

rights management information, and to distribute or broadcast digital content without authorization from the copyright holder. India provides for civil remedies for digital piracy as well.⁸⁷² Industry representatives report, however, that enforcement of these laws is weak, resulting in widespread digital piracy of movies, television shows, and unlicensed software.⁸⁷³ USTR has placed India on its Priority Watch List. Its *2016 Special 301 Report* notes that the value of losses from piracy of music and movies in India totals about \$4 billion per year, while the commercial value of unlicensed software used in India is approximately \$3 billion.⁸⁷⁴ One industry source estimates the rate of unlicensed software use in India at 58 percent, and ranks India near the bottom of its global index for IPR protection.⁸⁷⁵

Indonesia

Indonesia's Copyright Law, enacted in 2014, includes criminal sanctions and severe fines for organized commercial piracy. Under regulations implemented in 2015, a copyright holder can report websites that are infringing on IPRs, and there are procedures to block such websites. However, the Copyright Law provides a broad exception under Article 43(d) for use of non-commercial content to which the author has not explicitly objected.⁸⁷⁶

According to U.S. industry representatives, legitimate providers of digital content such as Netflix, iFlix, and iTunes are beginning to penetrate the Indonesian market. However, piracy websites continue to inhibit the growth of legal distribution of digital content.⁸⁷⁷ The Indonesian Association of Artists, Singers, Composers and Recording Businessmen estimates that pirated music causes the industry to lose \$291 million annually. According to one U.S. industry source, the use of unlicensed software in Indonesia is among the highest in the region, depressing the legitimate market and increasing the incidence of malware and other security vulnerabilities.⁸⁷⁸

Russia

Russia recently enacted several laws to combat digital piracy. In 2013, Federal Law No. 187 updated the copyright law, allowing Russian authorities to require Internet service providers

⁸⁷² BSA, "2016 BSA Global Cloud Computing Scorecard" (accessed February 8, 2017); Singh, "Online Piracy in India," July 29, 2016.

⁸⁷³ BSA, written submission to USTR's Special 301 Report, February 9, 2017.

⁸⁷⁴ USTR, *2016 Special 301 Report*, 2016.

⁸⁷⁵ BSA, written submission to USTR's Special 301 Report, February 9, 2017.

⁸⁷⁶ BSA, *2016 BSA Global Cloud Computing Scorecard* (accessed February 8, 2017); U.S. Department of Commerce, "Indonesia's Protection of Property Rights," February 22, 2017; IIPA, written submission to USITC, March 22, 2017.

⁸⁷⁷ IIPA, written submission to the USITC, March 22, 2017.

⁸⁷⁸ IIPA, "Indonesia: 2016 Special 301 Report," February 5, 2016; BSA, written submission to USTR's Special 301 Report (accessed February 10, 2017).

(ISPs) to cut off access to websites that pirate digital content relating to movies and TV shows. In 2014, Russia broadened its law to cover sites that share links to pirated music, books, and software. Accused digital pirates have 72 hours to respond to a complaint by a copyright holder before a permanent ban is placed on the website; a court order is not required for a website to be shut down by the authorities.⁸⁷⁹ However, according to press reports, Russia's enforcement of digital piracy remains lacking. According to one press report, two-thirds of Russians admitted in an online poll to accessing pirate file-sharing platforms; more than half said films, music, and books should be available on the Web for free. After the 2014 legislative changes, 175 websites were reported to authorities as copyright-infringing on digital content, but Russian authorities blocked only 12 of them. In 2016, the Russian government blocked access to its most popular file sharing website, ruTracker.org, but the website remains accessible within Russia, and industry experts claim that Internet users are able to unblock banned websites.⁸⁸⁰

Internet Intermediary Liability for Copyright Infringements

Most countries have “notice and takedown” provisions in their domestic copyright protection laws or implementing regulations that potentially hold Internet intermediaries⁸⁸¹ liable for copyright infringement if they continue to display content after notification from the copyright holder.⁸⁸² These laws place responsibility for IPR protection on intermediaries that display copyright-infringing content on their websites, but also generally include “safe-harbor” provisions that limit such liability if “notice and takedown” operates smoothly.

In order to minimize liability and to keep administrative costs low, most intermediaries act automatically upon notification, without devoting resources to investigating whether the claim is legitimate. Given the potential cost burden, intermediaries are hesitant to take on wider responsibility for addressing copyright-infringing content, such as searching for and deleting copies of infringing material on their platform, or blocking the posting of new copies in the future. However, content industry representatives contend that keeping intermediaries' responsibilities so narrowly defined encourages greater online piracy of content, diverting revenue from the content industries.

⁸⁷⁹ The 2014 law is Federal Law No. 364-FZ. BBC, “Russia Beefs Up Anti-piracy Laws,” May 1, 2015; Kozlov, “Russia Enters Brave New World,” April 30, 2015.

⁸⁸⁰ Shevchenko, “Is Russia Losing the Battle?” February 19, 2016; Trademark and Brands Online, “Russia Shuts Down Popular Torrent Site,” January 26, 2016; BBC, “Russia Beefs Up Anti-piracy Laws,” May 1, 2015; East West Digital News, “Russian Lawmakers Increase Pressure on Internet Providers,” February 16, 2017.

⁸⁸¹ Some examples of Internet intermediaries are ISPs, search engines, hosting services, social networks, online forums, and online platforms.

⁸⁸² UK Intellectual Property Office, “International Comparison of Approaches to Online Copyright,” 2015.

Content industries generally advocate placing increased responsibility on Internet intermediaries, particularly ISPs, to implement “notice and staydown.”⁸⁸³ They note that copyright-infringing material on a website can easily be uploaded onto another website once the original website displaying infringing material is shut down.⁸⁸⁴ A report by the EU Parliament came to much the same conclusion, stating that it is generally ineffective for Internet intermediaries to block websites because the hosts move illegal content to a different location on the Internet or use proxies.⁸⁸⁵ U.S. content industries also advocate for strong measures regarding the liability of Internet intermediaries, with some differences in approach. MPAA advocates limiting ISP liability for copyright-infringing material in exchange for a commitment from ISPs and other intermediaries to take action against illegal activity over their networks and to refrain from profiting from that activity. The American Association of Publishers (AAP) contends that a notice and takedown system is no longer sufficient to address the massive scale of copyright infringement occurring online, and advocates for stricter liability for Internet intermediaries.⁸⁸⁶ AAP believes the law should require an intermediary to ensure that pirated content is not re-uploaded, and should impose consequences if the intermediary fails to take adequate further measures to ensure that IPRs are protected.

Intermediaries, such as search engines, generally process notice and takedown orders quite rapidly once they receive notification from the copyright holder. For example, Google reports it processes takedown notices in less than six hours on average.⁸⁸⁷ Internet industry representatives contend that regulatory measures and policies aimed at increasing intermediary liability would impede digital trade for intermediary firms in markets where such measures are enforced, increasing cost and potentially restricting the ways an intermediary could combat piracy.⁸⁸⁸

⁸⁸³ “Notice and takedown” provisions in the U.S. Digital Millennium Copyright Act (DCMA) state that if a user has uploaded copyright-infringing material on a website, a copyright holder must send a notice to the Internet intermediary listing the specific violation and the Internet address of the infringing content. The Internet intermediary frequently takes down the content after receiving the notice in order to limit their liability under safe harbor provisions. In addition to laying out these procedures, the DCMA protects Internet intermediaries from liability for unknowingly displaying, transmitting or storing copyright-infringing content. Notably, the DCMA does not require intermediaries to adopt the wider “notice and staydown” approach, which is often advocated by content industry participants. Under “notice and staydown,” when an Internet intermediary receives a notice of copyright infringement, it must search and delete all copies of the copyright-infringing content, as well as block that content from being uploaded again. Springman and Lemley, “Why Notice-and-Takedown Is a Bit of Copyright Law Worth Saving,” June 21, 2016.

⁸⁸⁴ USITC, hearing transcript (testimony of George York, RIAA), April 4, 2017, 137.

⁸⁸⁵ European Parliament, “Review of EU Copyright Framework,” October 2015.

⁸⁸⁶ American Association of Publishers, written submission to the USITC, April 18, 2017.

⁸⁸⁷ Hall, “How Many Copyright Takedown Notices Does Google Handle?” March 7, 2016.

⁸⁸⁸ USITC, hearing transcript, April 4, 2017, 141–44 (testimony of Ari Giovenco, Internet Association); industry representative, interview by USITC staff, London, March 4, 2017.

The EU, China, and Russia have strong regulatory measures that place the responsibility on ISPs and other Internet intermediaries to take down illegal content, although in some instances these laws have not been uniformly enforced. Other countries are in the process of developing regulations to place liability on intermediaries. For example, Indonesia’s Copyright Law 2014 will list specific actions that ISPs need to take in order to avoid liability for copyright infringement, but that list has not yet been published.⁸⁸⁹ The following sections describe measures in key markets related to intermediary liability.

Brazil

In 2014, Brazil adopted its “Marco Civil” or Internet Civil Rights Framework (Federal Law No. 12.965/2014), discussed earlier. This law holds an intermediary liable for copyright infringement if infringing content is found on its website, and holds the intermediary responsible for removing infringing content after a court order.⁸⁹⁰

Although Brazil’s law is clear regarding intermediary liability, recent judicial action in Brazil has not exactly conformed to the domestic law. The first major court case in Brazil regarding intermediary liability came when Google was sued for hosting copyright-infringing videos of lectures and courses that had been uploaded by a third party through a Google-managed social media website named Orkut, which operated in Brazil. A Brazilian trial court originally held Google liable because they did not remove the videos after notification from the content owners. In 2015, Brazil’s Superior Court of Justice overturned the trial court’s decision, stating that Google was not liable. The court contended that finding the company liable for copyright infringement by a third party using Orkut—which is not, primarily, a file-sharing site—would be the same as holding the post office liable for the content of the mail it delivers.⁸⁹¹

China

China extends liability to intermediaries that infringe on copyrights through the 2009 Tort Liability Law.⁸⁹² A copyright holder has the right to inform the intermediary that it needs to delete the content, and if the intermediary fails to take action after being informed, the intermediary can be held liable. China is in the process of updating its copyright legislation to include clearer provisions on intermediary liability, but these reforms stalled in 2015. There

⁸⁸⁹ BSA, *2016 BSA Global Cloud Computing Scorecard* (accessed February 8, 2017).

⁸⁹⁰ *Ibid.*

⁸⁹¹ Licks Attorneys, “Internet Service Provider (ISP) Not Liable,” June 12, 2015.

⁸⁹² BSA, *2016 BSA Global Cloud Computing Scorecard* (accessed February 8, 2017).

have been no actions requiring ISPs to block copyright infringements; instead, China's enforcement actions have been mainly targeted towards Internet content providers.⁸⁹³

European Union

The EU is in the process of modifying its legal framework in order to clarify instances in which Internet intermediaries are responsible for copyright violations. There is no comprehensive legal framework in the EU that details liability for intermediaries' role in copyright infringement, and intermediary liability has met with mixed results in individual EU members' judiciary systems. The EU's new Digital Single Market proposal seeks to place the burden on intermediaries that display content to make sure, from the outset, that they are not displaying material that infringes on the rights of content owners.⁸⁹⁴ Currently, platforms for user-generated content such as YouTube and Facebook are responsible for removing material resulting in a copyright violation after notification from the content owner.⁸⁹⁵

India

India does not place an explicit obligation on ISPs to proactively monitor their websites for copyright infringement. India's Copyright Act of 2012 included some "safe harbor" provisions for ISPs, protecting them from liability in cases where ISPs provide transient or incidental access where the access is not expressly prohibited by the copyright holder. However, India's judicial and regulatory systems have been shifting the burden to ISPs to monitor their content.⁸⁹⁶

India's Copyright Act mandates that upon receipt of a written complaint from a copyright holder, an intermediary is required to take down copyright-infringing content or restrict access.⁸⁹⁷ In certain cases, online intermediaries that do not take down content after notification may lose their license.⁸⁹⁸ In the case of *Star India Pvt. Ltd v. Haneeth Ujwal*, the Delhi High Court held that ISPs are obliged to ensure that third-party IPRs are not violated through their networks.⁸⁹⁹ Although Indian courts have become more willing to impose civil

⁸⁹³ BSA, *2016 BSA Global Cloud Computing Scorecard* (accessed February 8, 2017); Hogan Lovells, "Access Denied," 2016.

⁸⁹⁴ The EU's new Digital Single Market proposal would essentially require intermediaries to conduct proactive software checks to determine if they are hosting copyright-infringing content on their websites. Robinson and Madhumita, "EU Copyright Reforms to Strip Likes of YouTube," September 14, 2016.

⁸⁹⁵ Robinson and Madhumita, "EU Copyright Reforms to Strip Likes of YouTube," September 14, 2016.

⁸⁹⁶ *Intellectual Property Watch*, "Inside Views: The Indian Copyright (Amendment) Act, 2012," October 23, 2014.

⁸⁹⁷ *Ibid.*

⁸⁹⁸ BSA, *2016 BSA Global Cloud Computing Scorecard* (accessed February 8, 2017).

⁸⁹⁹ *Intellectual Property Watch*, "Inside Views: The Indian Copyright (Amendment) Act," October 23, 2014.

sanctions on intermediaries that fail to manage copyright protections on their website, they have yet to impose criminal sanctions thus far.⁹⁰⁰

India is currently working on proposed intermediate liability measures that contain notice and takedown provisions. The International Intellectual Property Alliance (IIPA) is concerned that India's proposed notice and takedown provisions are inadequate because the takedown period lasts only 21 days, and an intermediary then has the right to reinstate the copyright-infringing content on its website, unless the copyright holder has obtained a court order.⁹⁰¹

Russia

Russia's legal protection of IPRs has been strengthened in recent years. Russia's Federal Law No. 187 (2013) extended liability for copyright-infringing Internet content to intermediaries (including ISPs) and contained a legal "test" for determining whether an intermediary knew or should have known about a copyright infringement; intermediaries had to pass this test to be exempted from liability.⁹⁰² Under this law, a copyright holder could seek a court injunction if its rights were violated in order to block the content or limit access to the content on the ISP's website. Russia's law states that a copyright holder does not have to contact an intermediary about the IPR infringement, and instead can go directly to the courts for an injunction.⁹⁰³ In February 2017, the Russian government passed a new law that now imposes fines on ISPs that fail to restrict access to blacklisted websites that are blocked by Russia's federal IT government authority, Roskomnadzor.⁹⁰⁴

In practice, enforcement of IPRs appears still to be weak. The IIPA stated that a few ISPs and website owners have been complying with the notice and takedown requests after the implementation of the new laws, but most do not respond to takedown requests.⁹⁰⁵ The IIPA also stated that response times by ISPs and website owners asked to take down material is very slow, and that they sometimes take weeks to remove the content from their website.⁹⁰⁶ The IIPA stated that the motion picture industry reported that most ISPs in Russia voluntarily cooperated and responded to "cease and desist" letters for their works, but others "merely forwarded notices to users without taking down material, or did not respond at all."⁹⁰⁷

⁹⁰⁰ BSA, *2016 BSA Global Cloud Computing Scorecard* (accessed February 8, 2017).

⁹⁰¹ IIPA, written testimony to the USITC, March 22, 2017.

⁹⁰² BSA, *2016 BSA Global Cloud Computing Scorecard* (accessed February 8, 2017).

⁹⁰³ *Ibid.*

⁹⁰⁴ *East West Digital News*, "Russian Lawmakers Increase Pressure on Internet Providers," February 16, 2017.

⁹⁰⁵ IIPA, written testimony to the USITC, March 22, 2017.

⁹⁰⁶ *Ibid.*

⁹⁰⁷ *Ibid.*

Censorship Measures

The outright blocking or filtering by governments in some markets of their Internet platforms and content is the most direct measure impeding digital trade for many U.S. companies. Instances of government-mandated disruptions to digital networks or particular digital apps or services—frequently justified on grounds of maintaining public order, ensuring national security, or protecting local businesses—have increased sharply in recent years. In the first six months of 2016, the countries where the costs to the local economy of such Internet shutdowns are likely to have been largest were India, Saudi Arabia, Morocco, and Iraq.⁹⁰⁸ For the most part, developed countries do not block or filter Internet content or applications, although specific exceptions do exist. For example, several European countries, including France, Italy, and the UK, block websites that promote terrorism or contain certain types of adult content.⁹⁰⁹

Overall, the blocking of certain types of content is acceptable under several international trade agreements. The WTO’s General Agreement on Trade in Services (GATS), for example, allows countries to maintain exemptions to certain obligations in order to protect public morals or maintain public order; to protect human, animal, or plant life or health; or to secure compliance with laws or regulations, including measures to prevent deceptive or fraudulent practices.⁹¹⁰ However, incidents of censorship that may fall outside of these exceptions are becoming increasingly common.⁹¹¹

Brazil

The only reported incidents of interference by the Brazilian government in the operation of social media websites occurred in 2015 and 2016. During those years, three separate judicial orders required telecommunications and Internet companies to temporarily block access to the popular communications application WhatsApp for failing to comply with information requests pertaining to criminal investigations.⁹¹²

⁹⁰⁸ West, “Internet Shutdowns Cost Countries \$2.4 Billion Last Year,” October 2016, 7.

⁹⁰⁹ Freedom House, *Freedom on the Net 2016*, November 2016.

⁹¹⁰ WTO, “The General Agreement on Trade in Services (GATS),” n.d. (accessed June 28, 2017). The GATS Annex on Financial Services also entitles countries to implement measures for prudential reasons, including the protection of depositors, investors, or policy holders. The TPP e-commerce chapter also allows signatories to maintain exemptions to certain obligations if such measures achieve a legitimate public policy objection. TPP, Chapter 14: E-Commerce, November 2015.

⁹¹¹ West, “Internet Shutdowns Cost Countries \$2.4 Billion Last Year,” October 2016, 3–4.

⁹¹² Leite, “WhatsApp Ordered Blocked Again,” December 2, 2016; *Guardian*, “WhatsApp Block in Brazil Overturned,” May 3, 2016.

China

China blocks and filters Internet content using a highly advanced censorship apparatus that employs not only human censors but also a sophisticated technical platform, the so-called “Great Firewall” of China. The main goal of this apparatus is reportedly to prevent the Chinese populace from reading content that criticizes Chinese government policies, discusses sensitive historical events (such as the Tiananmen Square massacre), or scrutinizes individual government leaders.⁹¹³ In August 2015, for example, websites and social media accounts were blocked or closed for publishing information about the explosions at a container storage facility in Tianjin, China. Similarly, in April 2016, following the release of the so-called “Panama Papers”—confidential documents containing information from more than 214,000 offshore accounts—China blocked any discussion of such accounts belonging to current or former Chinese leaders.⁹¹⁴ An image of Winnie-the-Pooh in a toy car was censored during a military parade in September 2016 because the image was used to spoof the president, Xi Jinping.⁹¹⁵

Overall, during 2015–16, the most commonly censored topics involved issues related to official misconduct and reputational issues, economics, and the topic of media censorship itself.⁹¹⁶ During the past few years, international news sources have also increasingly been censored, particularly those with websites aimed at the Chinese market. In mid-2016, for example, 15 of the 18 news websites tracked by ProPublica, a nonprofit news organization, were blocked in China, including those of *The Economist* and *Time* magazine.⁹¹⁷

A wide variety of common web applications are also inaccessible in China. According to GreatFireChina, a nonprofit organization that monitors Internet censorship in China, more than 100 of the top 1,000 websites are blocked in China, including YouTube, Google, Facebook, Flickr, SoundCloud, and WordPress.⁹¹⁸

China’s “Great Firewall” employs a variety of techniques to censor content. In some cases, entire domain names or IP addresses are blocked, with messages about illegal content being displayed to users.⁹¹⁹ China’s firewall also employs “deep packet inspection” technologies to scan both content requests and delivered results for blacklisted keywords, with the detection of such words causing the connection to be severed. These techniques are less noticeable because

⁹¹³ Freedom House, *Freedom on the Net 2016*, November 2016.

⁹¹⁴ Phillips, “All Mention of Panama Papers Banned,” April 5, 2016.

⁹¹⁵ Wong, “The Military Parade Posts That China Censored,” September 3, 2015.

⁹¹⁶ Freedom House, *Freedom on the Net: China*, November 2016.

⁹¹⁷ Wei, “Inside the Firewall,” February 13, 2015; Feng, “China Blocks *Economist* and *Time* Websites,” April 8, 2016.

⁹¹⁸ GreatFireChina, “Censorship of Alexa Top 1000 Domains,” n.d. (accessed March 20, 2017).

⁹¹⁹ *China Tech News*, “In Tandem with Slower Economy,” November 6, 2012; Freedom House, *Freedom on the Net: China*, November 2016.

they can block individual pages within an approved website and, therefore, appear to be a technical issue. Other subtle means of censoring content include so-called domain name system (DNS) poisoning, in which the firewall returns a request with a fake page or substitutes unrelated content, and “throttling,” or deliberately slowing the delivery of requested content.⁹²⁰ The firewall is also constantly evolving. In response to the use of personal virtual private networking (VPN), a service that encrypts traffic and reroutes it through a server outside the firewall, in 2015 China began blocking popular VPN providers, namely StrongVPN, Astrill, and Golden Frog.⁹²¹ In June 2017, China’s federal government shut down over 60 news outlets and social media accounts that publish entertainment gossip using China’s newly implemented Cybersecurity Law as a justification for censorship.⁹²²

India

The Indian government’s authority to block Internet content derives from section 69A of the Information Technology Act, as well as follow-on legislation called the Information Technology Rules (IT Rules). The IT Rules empower the central government to direct agencies to block access to information when “necessary or expedient” in the interest of the “sovereignty and integrity of India, defense of India, security of the state, friendly relations with foreign states or public order or for preventing incitement to the commission of cognizable offence relating to the above.”⁹²³ Indian courts also have the authority to issue orders to block or filter Internet content without central government approval. Overall, between January and November 2015, India blocked 844 social media pages; of these, 492 were blocked under section 69A, while the remainder were blocked via court orders.⁹²⁴

In most cases, there is very little, if any, information about the content targeted through these actions. However, some reports of what appears to be overly broad content blocking that affects legitimate online activity have surfaced. In May 2016, for example, BuyDomains.com, a domain name service, was blocked by some ISPs and mobile Internet providers; no information as to the cause was released.⁹²⁵ In addition, over the past five years, India’s courts have blocked Internet content involving copyright violations using so-called “John Doe” orders, which do not name a defendant.⁹²⁶ In July 2015, for example, a company named Phantom Films was granted

⁹²⁰ Freedom House, *Freedom on the Net: China*, November 2016; *ChinaTechNews*, “In Tandem With Slower Economy,” November 6, 2012.

⁹²¹ BBC, “China Blocks Virtual Private Network Use,” January 26, 2015.

⁹²² Yang and Yang, “Online Gossip Clampdown in China Leads to Netizen Outcry,” June 11, 2017.

⁹²³ Section 69A(1), The Information Technology Act, 2008.

⁹²⁴ PTI, “844 Social Media Pages Blocked in India,” December 18, 2015.

⁹²⁵ Mukherjee, “BuyDomains Blocked Once Again in India,” May 27, 2016.

⁹²⁶ *Legally India*, “Bombay HC Passes First Anti-Piracy John Doe Order,” June 15, 2012.

a John Doe order by the Bombay High Court, with the goal to block websites used to pirate its movie “Masaan.” Overall, since 2015, more than 200 websites have been blocked to prevent piracy aimed at the film industry.⁹²⁷

India also censors adult content under the IT Act.⁹²⁸ In July 2015, for example, the Department of Telecommunications ordered all ISPs operating in India to block 857 URLs containing adult content, although the ban was officially rescinded a few days later.⁹²⁹ Since then, the Indian government has officially censored only certain highly offensive adult content, as opposed to imposing a blanket ban on all adult content. Yet even though censorship is no longer required by law, the government informed ISPs that they were free to continue blocking the list of 857 websites; most ISPs continued to block the full list.⁹³⁰

Indonesia

The Indonesian government’s authority to block or filter Internet content is derived from the Information and Electronic Transactions Law (ITE Law),⁹³¹ with such activities generally focused on adult content, gambling, and illegal business activities. In 2015, the Ministry of Communications and Information (MCI) reported that hundreds of thousands of websites were blocked. MCI stated that it had placed a special emphasis on sites containing adult content (753,497 blocked websites) and gambling (1,164 blocked websites), as well as fraud and other prohibited commercial practices (452 blocked sites).⁹³²

In 2014, the MCI issued a technical regulation, Permenkominfo 19/2014, designed to implement the ITE Law. The regulation specified that Trust Positive—a software application and database of banned content managed by the MCI—would become the government’s official blocking/filtering service.⁹³³ Article 7 of the regulation also allowed Indonesian citizens/companies to develop filtering applications and databases that banned websites over and above those contained in Trust Positive. Some observers believe this practice reduces

⁹²⁷ *Deccan Chronicle*, “Telangana Plans Anti-piracy Policy to Save Films,” October 29, 2015.

⁹²⁸ Section 67(B), The Information Technology Act 2000.

⁹²⁹ BBC, “India Blocks Access to 857 Porn Sites,” August 3, 2015; Khomami, “India Lifts Ban on Internet Pornography after Criticism,” August 5, 2015.

⁹³⁰ Singh, “We Are Not a Totalitarian State,” August 5, 2015; Rajagopal, “Not for Moral Policing,” August 11, 2015; Mirani, “India Has Lifted Its Online Porn Ban,” August 5, 2015; Pahwa, “India’s Porn Ban Hasn’t Exactly Been Lifted,” *Medianama*, August 4, 2015.

⁹³¹ Law No. 11/2008, Article 40.

⁹³² Panji, “766 Thousand Kemkominfo Websites Blocked in 2015,” December 12, 2015.

⁹³³ Regulation of Minister of Communication and Information No. 19, 2014 (Indonesia, July 17, 2014), https://jdih.kominfo.go.id/produk_hukum/view/id/215/t/peraturan+menteri+komunikasi+dan+informatika+nomo+r+19+tahun+2014+tanggal+17+juli+2014 (accessed July 17, 2017).

regulatory oversight and creates uncertainty about the criteria that are used to include banned websites in filtering databases.⁹³⁴

According to some sources, Article 7 has increased the arbitrary blocking of websites by some ISPs. In 2016, for example, Telkomsel, a leading private telecommunications carrier in Indonesia, blocked both Reddit and Imgur, even though neither site was in the Trust Positive database. Telkomsel also blocked access to Netflix in 2016, stating that the company had not complied with legislation pertaining to acceptable multimedia content in Indonesia.⁹³⁵

Religious websites were also subject to content blocking in 2015 and 2016. In 2015, for example, following a request submitted by the National Body of Counterterrorism, MCI blocked 22 websites that were reported to contain extreme religious content; after widespread debate, MCI subsequently unblocked 12 of these sites.⁹³⁶ Similarly, following a terrorist attack in Jakarta, the capital city, in January 2016, MCI blocked 34 websites and several Twitter and YouTube videos, stating that they were promoting radical content supportive of the attack.⁹³⁷

Russia

In Russia, the government reportedly tends to block Internet content pertaining to the political opposition or thought to offend cultural sensitivities. In 2013, for example, legislation was enacted that gave several government agencies—including the Federal Services for Supervision of Telecom, Information Technologies, and Mass Communication (Roskomnadzor); the Federal Drug Control Service; the Federal Service for Surveillance on Consumer Rights and Human Wellbeing; and the Prosecutor General’s Office—the authority to block certain categories of Internet content without a court order. Categories included content related to suicide and drug propaganda, copyright violations, political extremism, juvenile crime victims, unsanctioned political protests, and certain types of adult content. Actions to block Internet content not included in these categories requires a court order.⁹³⁸

Using both legislative authority and court orders, the Russian government has reportedly blocked tens of thousands of websites in Russia over the past few years. For example, in late 2015 RosKomSvoboda, a nonprofit organization that monitors content blocking issues in Russia, reported incidents of content/website blocking in the following categories: unsanctioned

⁹³⁴ Article 7(1), Permienkominformasi 19/2014; Freedom House, *Indonesia*, November 2016.

⁹³⁵ Freedom House, *Indonesia*, November 2016.

⁹³⁶ BNPT, letter no. 149/K.BNPT/3/2015; Kominformasi, “Klarifikasi Kemkominfo mengenai Rencana Pemblokiran Situs Tumblr” [Kemkominfo clarification on Tumblr site blocking plan], February 17, 2016.

⁹³⁷ Freedom House, *Indonesia*, November 2016.

⁹³⁸ Freedom House, *Russia*, November 2016.

protests and political extremism (1,587 blocked websites); drug propaganda (9,982 blocked websites); suicide propaganda (228 blocked websites); gambling (6,313 blocked websites); certain adult content (5,253 blocked websites); and miscellaneous prohibited information (9,593 blocked websites).⁹³⁹

The Russian authorities have reportedly also censored websites that publish content deemed to encourage opposition to the government's policies. In July 2016, for example, Roskomnadzor blocked the websites srywwyborow.blogspot.ru and activism.win for posting content that encouraged boycotting a legislative election.⁹⁴⁰ Roskomnadzor also blocked the communist workers' website, work-way.com, for posting an article on an upcoming truck drivers' strike.⁹⁴¹

Topics related to the conflict with Ukraine over Crimea are also frequently blocked by the Russian government. In May 2016, for example, the website Crimea.Realities (Krym.Realii), a cooperative venture between Radio Free Europe and Radio Liberty, was blocked in Russia and Crimea by Roskomnadzor after a government official accused it of inciting extremism and bad relations among ethnic groups.⁹⁴² Similarly, Ukrainian news websites Korrespondent.net, Bigmir.net, and Liga.net were blocked for quoting a national movement leader's comments that Crimea should be returned to Ukraine.⁹⁴³

Market Access Measures Affecting Digital Trade

As digital trade grows, stakeholders have also reported an increase in constraints that exporters may face at the border. Although digital products pass through borders invisibly, these constraints act as impediments to the delivery of physical goods ordered through e-commerce.⁹⁴⁴ The regulatory environment includes a number of interrelated regulations and policy measures that may affect digital trade in a number of ways. The most prevalent of these impediments are low de minimis thresholds⁹⁴⁵ and restrictions on electronic payment (e-payment) systems. Regulations that impose country-specific technical standards on hardware and software products can also act as impediments to U.S. exports of such goods and services.

⁹³⁹ RosKomSvoboda, "Distribution of Blocked Sites across Departments" (accessed March 20, 2017).

⁹⁴⁰ SOVA, "Chronology of Internet Filtration in Russia" (in Russian), February 16, 2016.

⁹⁴¹ Ibid.

⁹⁴² Konovalov, "Crimea.Realities Website Is Blocked in Russia," May 16, 2016.

⁹⁴³ SOVA, "Chronology of Internet Filtration in Russia (in Russian)," February 16, 2016.

⁹⁴⁴ Further discussion of border measures affecting digital trade can be found in USITC, *Digital Trade in the U.S. and Global Economics, Part 1*, 2013, 5-22.

⁹⁴⁵ "De minimis" refers to the requirement that exporters who fulfill international orders face duties, taxes, and related paperwork if the value of a given shipment is above a certain threshold value.

Government procurement rules that give preference to domestic firms can also act as impediments to U.S. exports. With digital trade issues gaining prominence, countries are moving to update their policies in this area (box 8.3).

Box 8.3: New Digital Regulations in Southeast Asia: Indonesia and Vietnam

Both Indonesia and Vietnam have recently moved to update a variety of regulations governing the information and communications technology sector, some of which remain in draft form.

Indonesia: In 2016, Indonesia proposed new regulatory frameworks for e-commerce and over-the-top (OTT) services that have significant potential to act as burdensome trade barriers to foreign providers of these services if implemented as proposed. Indonesia's electronic commerce roadmap, introduced in November 2016, includes 31 proposed regulatory provisions that would affect financing, taxation, consumer protection, education and human resources, logistics, communication infrastructure, and cybersecurity.

According to U.S. industry representatives, particularly troublesome provisions in the draft regulations, especially for SMEs, include requirements for OTT service providers to maintain a physical presence in Indonesia, for mandatory partnerships between OTT service providers and telecommunications providers, and for localized data storage or processing. The last provision includes requirements for providers to use national payment gateways legally incorporated in Indonesia; to use an Indonesian Internet protocol (IP) number and data centers in Indonesia; and to store data in Indonesia for a minimum of three months, or longer upon request of law enforcement.^a The Indonesian government is in the process of finalizing a presidential regulation that will form the legal basis for the roadmap.^b

Indonesia's Ministry of Communication and Information Technology also released a circular letter "Concerning the Provision of Application Services and/or Content over the Internet (OTT)" in March 2016, which proposes a range of new regulations on Internet services. The packages include proposed requirements that ISPs establish a local business entity to do business with Indonesian citizens, use a national payment gateway, use local IP numbers, and store data within Indonesia. Providers must also comply with regulations prohibiting unfair business competition, protecting consumers and IPRs, and other provisions that regulate broadcasting, film, advertising, pornography, antiterrorism, taxation, transportation and logistics, tourism and hospitality, finance, and health, among others. Foreign firms would find it difficult to comply with these regulations as proposed.^c U.S. industry representatives have stated that requiring OTT providers to establish a local business entity within a particular market would be cost-prohibitive for most companies, effectively barring them from the market.^d According to a January 2017 press report, the Indonesian government plans to issue a final regulation after Indonesia's tax dispute with Google is resolved.^e

Vietnam: In late 2015, Vietnam introduced new legislation to update a number of its regulations related to digital trade. New regulations that took effect in March 2016 state that foreign channels can comprise no more than 30 percent of the total number of channels on a pay-TV service, and requires foreign providers of pay-TV services to use a local agent to translate most movies and television programming into Vietnamese before airing. As discussed in more detail in box 8.1 above, a new Law on Information Security (LONIS) took effect on July 1, 2016, centralizing previously scattered regulations aimed at ensuring Internet security. In addition, while import limits on used IT products were eased, imports of refurbished IT products remain prohibited. New information security regulations applicable to banking operations, which for the first time included foreign-owned banks, also took effect in March 2016. A

draft circular related to OTT services, which raised concerns from the U.S. government, reportedly remains on hold.^f

Sources: USTR, *2017 National Trade Estimate Report*, 2017, 236, 268–71; Treutler et al., “Legal Update,” March 2016; ACT, written submission to the USITC, April 21, 2017, 10–11.

^a ACT, written submission to the USITC, April 21, 2017, 10–11; The Internet Association, written submission to the USITC, April 24, 2017, 23–4.

^b USTR, *2017 National Trade Estimate Report*, 2017, 236.

^c USTR, *2017 National Trade Estimate Report*, 2017, 236; Baker & McKenzie, “Indonesia –Ministry of Communications and Informatics Issues OTT Circular,” April 2016; TeleGeography, “MCIT Issues Draft Regulation on OTT in Indonesia,” May 5, 2016.

^d USITC, hearing transcript, April 4, 2017, 74 (testimony of Nigel Cory, Information Technology and Innovation Foundation); 162 (testimony of Brian Scarpelli, ACT).

^e Hermansyah, “Govt to Issue OTT Regulation after Google’s Tax Problem,” January 12, 2017.

^f Treutler et al., “Legal Update: New Regulations in the ICT Sector,” March 2016; USTR, *2017 National Trade Estimate Report*, 2017, 468–71.

De Minimis Thresholds and Small Exporters

According to industry representatives, an ongoing concern in e-commerce has been low thresholds for “de minimis” obligations—requirements that exporters who fulfill international orders must ensure payment of duties, and taxes, and must complete related paperwork if the value of a given shipment is above a certain threshold value. If the threshold is set low, these requirements become particularly burdensome for small exporters who engage in e-commerce through online marketplaces such as eBay and Etsy. Such exporters generally do not have employees that are solely responsible for ensuring compliance with customs regulations. As a result, employees at these firms can spend upwards of 50 percent of their time handling administrative tasks instead of other duties.⁹⁴⁶ According to an industry representative, this burden is exacerbated by a distinct lack of transparency from many customs agencies in terms of the compliance process. It can be quite unclear which forms to fill out, how to fill them out properly, and how they differ from destination to destination.⁹⁴⁷ If sellers make a mistake, their shipments may be held up. For small sellers, this can lead to the loss of thousands of dollars in revenue. It can also damage their reputation when their international customers must wait for orders to arrive.⁹⁴⁸

Table 8.9 presents the de minimis thresholds for the United States and the key trading partners covered in this report. The United States’ de minimis threshold increased from \$200 to \$800 in

⁹⁴⁶ USITC, hearing transcript, April 4, 2017, 287 (testimony of Julie Stitzel, Etsy).

⁹⁴⁷ U.S. industry representative, interview by USITC staff, Washington, DC, March 13, 2017. To counter this lack of transparency, the industry representative stated that U.S. express delivery companies have developed their own Internet databases where exporters can get detailed information on complying with location-specific customs procedures.

⁹⁴⁸ USITC, hearing transcript, April 4, 2017, 288 (testimony of Julie Stitzel, Etsy).

2015, and is now the highest in the world.⁹⁴⁹ One industry representative contended that the resistance to increasing de minimis levels in other nations largely stems from the fact that low thresholds increase the base of traded goods on which governments may collect revenue.⁹⁵⁰ This incentive applies to both emerging markets and industrialized nations, with Canada maintaining a threshold of \$15 (20 CAD) and Australia now proposing to eliminate the duty-free level entirely. (The current level in Australia is \$756, or 1,000 AUD).⁹⁵¹

Table 8.9: De minimis thresholds compared for the United States and selected trading partners, 2013 and 2017 (U.S. dollars)^a

Country	2013 de minimis threshold	2017 de minimis threshold
Australia	918	756
Brazil ^b	50	50
Canada	19	15
China	8	290
EU	25 (VAT ^c)/ 170 (customs duty)	25 (VAT)/ 170 (customs duty)
India ^d	170	150
Indonesia	50	50
Russia	247	119
United States	200	800

Sources: Global Express Association, “Overview of De Minimis Value Regimes,” April 2016; United Parcel Service, “Indonesia Increases the De Minimis Threshold,” February 7, 2017; Digital Commerce 360, “China Changes the Tax Rules on Purchases,” February 25, 2016; USITC, *Digital Trade in the U.S. and Global Economies, Part 1*, 2013, 5-23.

^a Conversions to USD based on exchange rates dated July 25, 2013 and April 6, 2016 respectively.

^b Threshold only applies to postal shipments. All shipments via express delivery services are subject to duty.

^c VAT = value-added tax.

^d Threshold applies only to products shipped as samples or gifts.

Generally, the de minimis threshold is a single value. However, the EU has two thresholds: the first is currently \$25 (22 euros), at or above which only value-added taxes (VATs) are collected; the second is \$170 (150 euros), at or above which both VATs and duties are assessed. In some countries, de minimis applies only in certain situations. In Brazil, for example, duty-free treatment for shipments under \$50 is available only if using the postal service; all shipments using express delivery services are subject to duties.⁹⁵² In India, the de minimis exemption is available only for products that are shipped as commercial samples or gifts.⁹⁵³

⁹⁴⁹ See <https://global.ups.com/wp-content/themes/upsglobal/assets/pdfs/De-minimis-infographic.pdf>.

⁹⁵⁰ U.S. industry representative, interview by USITC staff, Washington, DC, March 13, 2017.

⁹⁵¹ USITC, hearing transcript, April 4, 2017, 55 (testimony of Brian Bieron, eBay).

⁹⁵² USTR, *2017 National Trade Estimate Report*, 2017, 54; Export.gov, “Brazil—Express Delivery,” <https://www.export.gov/article?id=Brazil-Express-Delivery> (accessed July 17, 2017).

⁹⁵³ Air Cargo Complex Mumbai Customs, <http://accmumbai.gov.in/aircargo/import/fag.html> (accessed April 20, 2017).

Electronic Payments

Other factors affecting e-commerce are measures relating to the electronic payment (e-payment) systems described in chapter 5. According to industry representatives, the most burdensome restrictions facing the industry stem from not being traditional banks; although e-payment companies do not offer financial services like banks, they do allow customers to carry a monetary balance in their accounts, unlike nonbanks. Because measures that take this intermediate position into account have not been put in place, and because governments want to maintain oversight over financial institutions, e-payment companies end up falling within the ambit of many banking regulations that do not necessarily apply to their main business lines.⁹⁵⁴

One requirement that an industry representative has called especially challenging is the requirement that these companies have a banking license to do business in foreign markets. In practice, this requirement can be used to protect the domestic industry, as the lack of transparency in the bureaucratic application process in many countries makes it easy to deny licenses to foreign applicants.⁹⁵⁵ These licenses may also change to include restrictions that are impracticable to comply with. For example, in 2016, PayPal had to suspend services to Turkey because of changes in the license rules, which required payment systems to be completely localized in the country.⁹⁵⁶

Other banking regulations that are applied to e-payment companies include ones that require verifying customer information to prevent money laundering (also known as “know your customer” requirements), as well as other prudential requirements meant to maintain the solvency of banks.⁹⁵⁷ Although the purpose of requiring banks to verify customer information before financial transactions is to combat financial crime, one e-payment company (PayPal) asserts that the current process of collecting data to verify identity may be inadequate and that identity documents may be falsified.⁹⁵⁸ Specific situations in China and Indonesia are outlined in table 8.10.

⁹⁵⁴ U.S. industry representative, interview by USITC staff, Washington, DC, February 27, 2017; U.S. industry representative, telephone interview by USITC staff, March 15, 2017.

⁹⁵⁵ U.S. industry representative, telephone interview by USITC staff, March 15, 2017.

⁹⁵⁶ Ahmed (PayPal Inc.), testimony before the U.S. House Ways and Means Subcommittee hearing, “Expanding U.S. Digital Trade and Eliminating Barriers to U.S. Digital Exports,” July 13, 2016, 7.

⁹⁵⁷ To verify customer information, customers may be required to submit substantial personal information including scans of government identification, such as a passport.

⁹⁵⁸ PayPal, “A Smart Step: Putting Innovation at the Heart,” 28 (accessed March 7, 2017).

Table 8.10: Selected measures and policies related to electronic payment systems

Country	Measure
China	China requires electronic payments providers to hold licenses issued by the People’s Bank of China. For the first time in 2013, the bank issued these licenses to 2 foreign-invested entities (out of the 250 licenses issued since the requirement was initiated in 2011). Until more licenses are issued to them, foreign service providers are limited to developing relationships with Chinese firms to access the market. For example, PayPal has joined with LianLianPay to allow users to transfer money in their PayPal account to bank accounts in mainland China.
Indonesia	In November 2016, Indonesia banned the use of bitcoin and other virtual currencies. An official has claimed that Bitcoin and PayPal are being used to transfer funds to finance terrorist organizations.

Sources: Paul Hastings LLP, “China Opens Door to Foreign Payment Service Providers,” July 19, 2013; PayPal website, <https://www.paypal.com/c2/webapps/mpp/cny-withdrawal>; KPMG, “Retail Payments in Indonesia,” 2017; Cryptocoins News, “Terrorists Use Bitcoin and PayPal in Indonesia,” January 9, 2017.

Technical Standards

Local testing requirements can reportedly impede global digital trade, as can government efforts to develop country-specific technical standards for hardware or software. Industry representatives have noted that they may not be made aware of new requirements or given an opportunity to comment on changes to existing requirements in a timely manner. Countries may propose technology requirements that mandate the use of specific technologies or products, which they justify on the grounds of national security or public policy objectives. In practice, however, according to U.S. industry observers, such regulations may serve as protectionist measures that are not well defined and thus may be nearly impossible to satisfy. The observers state that the result of these measures is to raise the costs of new technologies for both consumers and businesses. These measures may impact companies that directly provide Internet-related services, or small and large businesses in other sectors that rely on digital platforms to provide services, handle internal processes, or move goods across borders.⁹⁵⁹

Over 80 jurisdictions have reportedly instituted technical standards related to the information and communications technology (ICT) sector, many of which are not consistent with global standards and norms.⁹⁶⁰ Key markets with existing or proposed policies in this area include Brazil, China, India, and Russia (table 8.11).⁹⁶¹ To reverse these trends, industry representatives

⁹⁵⁹ Computer & Communications Industry Association, written testimony to the USITC, March 28, 2017, 5; Intel Corporation, written testimony to the USITC, April 21, 2017, 5–6.

⁹⁶⁰ Groups promoting global standards and norms include the International Electrotechnical Commission’s System for Conformity Assessment Schemes for Electrotechnical Equipment and Components (see <http://www.iecee.org/>) and the International Organization for Standardization (see <https://www.iso.org/standards.html>).

⁹⁶¹ USITC, hearing transcript, April 4, 2017, 256–57 (testimony of Sean Heather, U.S. Chamber of Commerce); 154, (testimony of Leticia Lewis, BSA, The Software Alliance); USITC, hearing transcript, April 4, 2017, 178 (testimony of K.C. Swanson, Telecommunications Industry Association); USITC, hearing transcript, April 4, 2017, 168–69 (testimony of Daniel O’Connor, Computer and Communications Industry Association).

advocate for global standardization of technical standards for manufactured goods, preferably under the auspices of voluntary, private sector organizations. They state that this step is especially critical for the development of the IoT.⁹⁶²

Table 8.11: Selected measures and policies related to technical standards and testing

Country	Measure
Brazil	In 2013, the government adopted Decree 8.135, which imposes cyber-auditing requirements on IT systems used by government entities. The decree has been implemented in stages since 2013 and may become prohibitively costly for foreign firms.
China	In 2015 and 2016, China enacted a series of laws and development plans that would impose restrictions on foreign IT products and services. In September 2015, the government published an IT development plan that would require certain IT products and services to be “secure and controllable” and subject to security examinations. According to U.S. industry associations, these requirements are unclear and make the implicit and explicit costs of compliance for foreign firms unappealing. The Counterterrorism Law (enacted in December 2015) and the Cybersecurity Law (enacted November 2016) further impose trade restrictions on imported IT products and services. In the areas of wireless communication and IT security certification, China has imposed special national standards on foreign providers, such as local certification and accreditation requirements for IT security, in addition to general IT standards. The government publishes a list of approved IT products, which exclude some products that meet international standards. These standards are in addition to local testing requirements for telecom and IT products.
India	The government of India has issued the Compulsory Registration Order, which requires manufacturing firms to submit product samples for testing by a recognized testing facility located in India. Product samples must be domestically tested regardless of whether they have already been tested outside of India using methods based on international standards. U.S. trade associations have stated that the requirements for registration in India are costly and potentially intrusive for U.S. firms.
Russia	The government requires certification by Russia’s Federal Service for Technical and Export Control for all data security products for sale in Russia. Encryption products certified by the service are required for many public procurement opportunities. In general, according to BSA, local standards requirements are not in compliance with accepted international standards.

Sources: USTR, *2017 National Trade Estimate Report*, 2017, 53; Computer & Communications Industry Association, written testimony to the USITC, March 28, 2017; industry representatives, interview by USITC staff, March 14, 2017; BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016; ITI, submission for the 2017 National Trade Estimate Report, October 26, 2016, 11–12; USITC, hearing transcript, April 4, 2017, 178 (testimony of K.C. Swanson, Telecommunications Industry Association); BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016, 3.

Government Procurement

Government procurement represents a significant market for digital firms’ sales of both hardware and software. However, existing or proposed restrictions on government procurement for foreign software products reportedly exist in a number of countries, including Brazil, China, India, and Nigeria.⁹⁶³ Nigeria, for example, requires that design, procurement, testing, deployment, maintenance, and support of government ICT equipment and software be

⁹⁶² USITC, hearing transcript, April 4, 2017, 326 (testimony of Sean Heather, U.S. Chamber of Commerce); Heather, written testimony to the USITC, April 11, 2017, 1.

⁹⁶³ USITC, hearing transcript, April 4, 2017 (testimony of Leticia Lewis, BSA), 154; U.S. Chamber of Commerce, *Globally Connected, Locally Delivered*, 2016, 9.

completed by Nigerian ICT companies where possible, or else by Nigerian subsidiaries or partners of international ICT manufacturing companies. The rules apply to both government and private sector procurement.⁹⁶⁴ The World Trade Organization’s Government Procurement Agreement (GPA) establishes a framework of rules that require open competition in government procurement among its 47 signatory countries—but of the six markets highlighted in this report, only the EU is a party to the GPA. Digital goods and services are included in the GPA, provided that they are not specifically excluded from each country’s schedule of commitments.⁹⁶⁵

Brazil

According to the Buy Brazilian Act, a preference margin of 25 percent is given to domestic goods and services in public bids. The act is applicable to all industries. Additionally, under Decree 7174 of the Act, the government must give preferential treatment to locally produced ICT goods and services based on a price/technology matrix. Brazilian law allows the procurement of so-called “strategic” IT goods and services to be restricted to those with domestically developed technology. In general, a Brazilian government agency may contract services to a foreign firm only if the service cannot be provided by a domestic firm.⁹⁶⁶

China

In an opinion issued under the Chinese Procurement Act of 2003, the State Council of China states that the procurement of imported high-tech equipment is permissible only if no similar products are available in China.⁹⁶⁷

EU

Available information about government procurement in the EU does not specifically reference digital trade or Internet-related industries. However, general concerns about procurement are relevant to digital trade as well. According to USTR, U.S. firms seeking to participate in procurements in Bulgaria, the Czech Republic, France, Greece, Hungary, Italy, Lithuania, Romania, Slovakia, and Slovenia have all voiced concerns over a lack of transparency, including

⁹⁶⁴ Government of Nigeria, *Guidelines for Nigerian Content Development in ICT*, December 3, 2013; U.S. Chamber of Commerce, *Globally Connected, Locally Delivered*, 2016, 9; European Commission, “Overview of Potentially Trade Restrictive Measures,” May 2016, 63; USITC, hearing transcript, April 4, 2017, 256–57 (testimony of Sean Heather, U.S. Chamber of Commerce); Heather, written testimony to the USITC, April 4, 2017, 3.

⁹⁶⁵ WTO, “Agreement on Government Procurement.”

⁹⁶⁶ U.S. Chamber of Commerce, “2017 Special 301 Submission,” February 9, 2017, 40; USTR, *2017 National Trade Estimate Report of Foreign Trade Barriers*, 2017, 52.

⁹⁶⁷ BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016, 7.

with respect to overly narrow definitions of tenders; language and documentation barriers; and implicit biases toward local vendors and state-owned enterprises. Concerns related to specific countries include:

- In Greece, difficult certification and documentation requirements.
- In Hungary, the awarding of government contracts on a preferential basis to state-owned enterprises and other companies with close ties to the government.
- In Italy, complaints of corruption, especially for local-government procurement contracts.
- In Poland, that lowest cost is the paramount award criterion, ignoring other criteria such as quality.
- In Slovenia, an opaque, difficult-to-understand bidding process, and short timeframes for preparing bids.⁹⁶⁸

India

The National Manufacturing Policy promotes local content requirements in government procurement for certain sectors, including ICT. Following this national policy, the government implemented the Preferential Market Access plan for government procurement (PMA-G), which requires government entities to source a share of their electronic products in India. Of significant concern for U.S. industry trade groups is India's recent announcement of plans to expand the application of PMA-G to high-end systems, such as servers and storage equipment. If implemented, according to one U.S. trade group, U.S. firms would be unable to fairly compete for government IT contracts. In addition, in March 2015 the government of India adopted a formal preference for reportedly open-source software in all e-governance systems used by government organizations, essentially shutting out foreign cloud service providers.⁹⁶⁹

Indonesia

Under Indonesia's Presidential Instruction 2/2009, domestic bidders are given favorable treatment in public procurement in the form of price preferences. Under Presidential Regulation 4/2015, Indonesia requires that 40 percent of goods and services be sourced locally in government procurement contracts. This rule also applies to goods and services provided in the public interest by the private sector—in other words, the local content provisions apply to public-private partnerships as well. The regulation has also been interpreted to mean that some procurement by private companies for public infrastructure would also be considered

⁹⁶⁸ USTR, *2017 National Trade Estimate Report*, 2017, 174–75.

⁹⁶⁹ USTR, *2017 National Trade Estimate Report*, 2017, 209; ITI, pre-hearing submission for the USTR National Trade Estimate Report, 2017, October 26, 2016, 14; BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016.

government procurement. This would apply particularly to telecommunications equipment, but also, potentially, to digital-related equipment such as broadband network equipment.⁹⁷⁰

In general, Indonesia grants special preferences to encourage domestic sourcing and to maximize the use of local content in government procurement of both goods and services. But it does not specifically target digital trade with its government procurement regulations.⁹⁷¹

Russia

Russia mandates preferential treatment for domestic ICT companies in public procurement contracts.⁹⁷² Amendments to Russia's national procurement law in 2016 mandated the creation of a Russian software registry. Foreign-made software not listed in the registry will not qualify for government procurement. In July 2016, these restrictions were extended through an order launching a three-year plan to switch all agencies to Russian-made software.⁹⁷³

⁹⁷⁰ This regulation amends the previous regulation 54/2010, which also placed limits on government procurement contracts by foreign companies. U.S. Chamber of Commerce, *Globally Connected, Locally Delivered*, 2016, 9; European Commission, "Overview of Potentially Trade Restrictive Measures," May 2016, 63.

⁹⁷¹ The applicable laws are Presidential Regulations 2/2009 and 54/2010. These require maximizing local content in procurement, using foreign components only when necessary, designating foreign contractors as subcontractors to local companies, and optimizing the use of domestic goods and services, including through price preferences for domestic goods and providers. USTR, *2017 National Trade Estimate Report*, 2017, 228.

⁹⁷² USITC, hearing transcript, April 4, 2017, 257 (testimony of Sean Heather, U.S. Chamber of Commerce)

⁹⁷³ USTR, *2017 National Trade Estimate Report*, 2017, 379; Bankovskiy and Eltovskiy, "Russian Software Developers and Makers To Enjoy Monopoly Status in the State Sector," October 2016.

Investment-Related Policy Measures Affecting Digital Trade

Digital-related foreign direct investment (FDI) is subject to a wide range of measures that vary by country and sector. Obstacles impeding FDI may be institutional, such as a burdensome bureaucracy, weak rule of law, poor regulatory quality, and corruption. FDI also may be impeded by measures that target particular segments of the industry or types of firms. Such impediments generally aim to restrict the free entry of foreign firms, with the goals of protecting the profits and viability of domestic firms. There are a number of specific investment-related policy measures that affect digital trade, including foreign ownership restrictions, discriminatory licensing and taxation, and content restrictions that favor local content; these are highlighted briefly below.

Limitations on Foreign Ownership and Equity Participation

Foreign ownership limitations can be widespread, affecting all sectors, including digital. For example, Indonesia limits foreign equity participation to 67 percent in many industries, as defined in its Negative Investment List.⁹⁷⁴ In most countries, however, ownership limitations that impact investment in digital services are sector-specific, especially those pertaining to telecommunications. Mandatory joint ventures and equity caps ensure that significant control of the enterprise rests with domestic partners, and also often require forced transfer of technology to the host country.

Nonetheless, industry groups at the USITC's hearing on April 4, 2017, noted that in China, partnerships with domestic firms are not always problematic. But they did not believe partnerships should be required, especially when IP protections, rule of law, and contract enforcement in the partner country are weak.⁹⁷⁵ In particular, many foreign firms see China's requirement that majority ownership in cloud computing be held by a local joint venture partner as a significant step backwards in terms of market access.⁹⁷⁶

A number of countries impose investment restrictions on pay-TV services. In Taiwan, for example, foreign investors may own a maximum of 20 percent of a pay-TV operator's total

⁹⁷⁴ USTR, *2017 National Trade Estimate Report*, 2017, 233.

⁹⁷⁵ USITC, hearing transcript, April 4, 2017, 104 (testimony of George York, Recording Industry Association of America).

⁹⁷⁶ *Ibid.*, 210 (testimony of K.C. Swanson, Telecommunications Industry Association); USITC hearing transcript, April 4, 2017, 98 (testimony of Nigel Cory, ITIF).

issued shares. The constitution of the Philippines prohibits all foreign investment in mass media, including pay-TV. Vietnam imposes a number of restrictions on pay-TV services: it has placed a 30 percent cap on the total number of foreign channels that a pay-TV service may carry, requires all pay-TV operators to work through local agents, requires most foreign programming to be edited by a licensed local agent, and requires commercial advertisements airing on pay-TV to be produced in Vietnam.⁹⁷⁷

Brazil

Foreign ownership in all telecom services (fixed, mobile, or Internet) in Brazil is capped at 49 percent. The remaining 51 percent must be held by a local Brazilian firm. Foreign ownership in media outlets is restricted to 30 percent.⁹⁷⁸

China

China has restrictions on foreign investment in telecom services and Internet publishing. China caps foreign investment in value-added telecom services at 50 percent, but allows 100 percent foreign equity and ownership in e-commerce.⁹⁷⁹ Investment in Internet publishing, which includes online games, is wholly prohibited. In order to bring U.S. content into China, particularly online content, a publisher must use a local intermediary to manage all aspects of the business, including the content to be published. This imposes added costs and delays to both publishers and content producers, while limiting the content available to Chinese consumers.⁹⁸⁰

India

India allows 100 percent investment in business-to-business (B2B) e-commerce, but foreign investment in B2C e-commerce is largely prohibited. An exception, however, allows single-brand retailers who operate a physical store in India to conduct trade through e-commerce. This exception is narrow, and the B2C prohibition has been noted as a significant impediment

⁹⁷⁷ Coalition of Services Industries, written submission to the USITC, April 24, 2017, 8.

⁹⁷⁸ U.S. Department of State, *Investment Climate Report, 2016*; European Centre for International Political Economy, Digital Trade Estimates Project database (accessed February 6, 2017) ; USTR, *2017 National Trade Estimate Report, 2017*, 54.

⁹⁷⁹ Value-added telecom services include online database storage and search, online data processing, IP-VPN, ISP, and electronic data exchange. USDOS, *Investment Climate Report, 2016*; European Centre for International Political Economy, Digital Trade Estimates Project database (accessed February 6, 2017).

⁹⁸⁰ U.S. Department of State, *Investment Climate Report, 2016*; European Centre for International Political Economy, Digital Trade Estimates Project Database (accessed February 6, 2017); American Association of American Publishers, written submission to USITC, April 18, 2017.

to investment by industry experts, alongside taxation and other market access barriers.⁹⁸¹ For both wireless and fixed telecom providers, government review and approval is required for foreign ownership above 49 percent.⁹⁸²

Indonesia

Indonesia's investment law, which dates from 2007, mandates that FDI in Indonesia must take the form of a limited liability company, with the foreign investor holding shares in the company. Certain equity caps and other FDI restrictions apply to different industries, as outlined in a Negative Investment List that is updated periodically. In May 2016, however, the Indonesian government announced a major revision to the Negative Investment List which opened e-commerce, film, tourism, and other sectors to foreign investment. For e-commerce, FDI with 100 percent equity ownership is now permitted for projects valued at more than about \$7.5 million.⁹⁸³ Indonesia's 2005 Broadcasting Law includes a requirement that any advertising shown on pay-TV must be made in Indonesia.⁹⁸⁴

Russia

According to USTR, foreign ownership restrictions in Russia can be confusing and discriminatory. Russia's all-encompassing 1999 Investment Law gives considerable discretion to the government to prohibit or limit foreign investment at any time for "the protection of the constitution, public morals and health, and the rights and lawful interest of other persons, and the defense of the state."⁹⁸⁵ In 2014, Russia introduced the "On Mass Media" law, which restricts foreign ownership of media companies to 20 percent. Firms had until February 1, 2017, to adjust ownership structures to comply. This law has prompted divestment from the market by both U.S. and European firms, including the sale of the leading domestic business newspaper, *Vedomosti*, by Pearson, Dow Jones, and Sanoma.⁹⁸⁶

⁹⁸¹ USDOS, *Investment Climate Report*, 2016; USTR, *2016 National Trade Estimate Report*, 2016.

⁹⁸² Additionally, but outside the purview of traditional ownership restrictions, any international content providers that use satellite technology to transmit to India must establish a domestic office or use a local agent. Because the government of India holds equity in several telecom firms, wireless spectrum has been allocated to these firms, instead of privately held firms and firms with foreign investment. U.S. Department of State, *Investment Climate Report*, 2016.

⁹⁸³ The 2016 version of the Negative Investment List is available at the BKPM website (the Investment Coordinating Board of the Republic of Indonesia): <http://www2.bkpm.go.id/en/investment-procedures/negative-investment-list>; industry representative, telephone interview by USITC staff, March 13, 2017.

⁹⁸⁴ Coalition of Services Industries, written submission to the USITC, April 24, 2017, 8.

⁹⁸⁵ USTR, *2017 National Trade Estimate Report*, 2017, 380; American Society of International Law, "Russia: Federal Law on Foreign Investment," July 2000.

⁹⁸⁶ USDOS, *Investment Climate Report*, 2016; European Centre for International Political Economy, Digital Trade Estimates Project database (accessed February 6, 2017).

Discriminatory Licensing and Taxes

While foreign ownership restrictions are fairly obvious barriers to entry, onerous licensing and capital requirements, large fees, prohibitive taxation policies, and burdensome approval processes that target foreign entities can similarly restrict entry, especially for SMEs. New taxation approaches have also raised concerns. In recent years governments have highlighted the difficulties they face in raising tax revenue from digital companies that do business by providing services online, particularly when providing those services from offshore, or with only a minimal local presence, compared to more traditional foreign investors. In some cases, this has led governments to try new methods for taxing certain companies, or types of companies, which may be seen as a form of “digital protectionism.”⁹⁸⁷

Brazil

Brazil imposes a range of tariffs, up to 25 percent, on imported or delivered software and IT services. Additionally, the government has implemented a “social economic interference contribution,” which is reportedly a tax on the transfer of technology in essence that imposes a 10 percent surcharge on technology remittances.⁹⁸⁸ Taxes are imposed on each foreign film released in theaters and on foreign programming for television. These taxes tend to be higher than taxes for domestic productions.⁹⁸⁹

According to industry representatives, the government is considering legislation to limit the ability of foreign insurers to service the Brazilian market. In particular, the government may require consent for processing personal data and may impose high liability standards on data processors.⁹⁹⁰

China

The licensing process for foreign providers in China has been noted as both strict and prohibitive. For each value-added telecom service, a separate license is required. These licenses can only be obtained through a joint-venture company, in theory. In practice, however, China’s Ministry of Industry and Information Technology has yet to issue any such licenses, forcing foreign firms to enter into arrangements with domestic firms that already hold the necessary

⁹⁸⁷ USITC, hearing transcript, April 4, 2017, 83 (testimony of Joshua Meltzer, Brookings Institution).

⁹⁸⁸ BSA, *2016 BSA Global Cloud Computing Scorecard*, 2016.

⁹⁸⁹ USTR, *2017 National Trade Estimate Report*, 2017, 54; KPMG, “Film Financing and Television Programming: A Taxation Guide,” March 2015, 65–67.

⁹⁹⁰ American Insurance Association, written testimony to the USITC, April 4, 2017.

license. The minimum registered capital for foreign investment in value-added telecom services is \$1.5 million.⁹⁹¹

India

India requires government approval for foreign ownership above 49 percent in the wireless and fixed telecom sector, and also has a one-time licensing fee between \$800,000 and \$2.7 million (depending on the license), which tends to be a barrier to SMEs seeking entry.⁹⁹² India has also used tariff barriers to protect local digital industries, increasing tariffs on IT products several times since 2012.⁹⁹³ According to the U.S.-based Telecommunications Industry Association, these duties contravene India's obligations as a member of the Information Technology Agreement to maintain zero duties on covered ICT goods.⁹⁹⁴ Tariffs are also increasing for ICT products and are occasionally not consistent with the Information Technology Agreement.⁹⁹⁵

Indonesia

Indonesia has proposed tax changes that would require foreign IT service providers to set up an affiliate in Indonesia to do business in the country. The process would require foreign firms to register with both the IT regulator and the Investment Coordinating Board. Industry representatives contend that this would be a burdensome process, particularly for SMEs. These tax proposals reportedly deviate from standard international practice as embodied in norms, bilateral tax treaties, and World Trade Organization commitments. Frequently, international companies will register a local presence in Singapore or another jurisdiction with more favorable tax regulations and provide services cross-border through Indonesia.⁹⁹⁶ One particularly well known example of this is the arrangement made by Alphabet/Google, which has led to a public disagreement between Alphabet/Google and the government of Indonesia over the company's tax liabilities (box 8.4).

⁹⁹¹ BSA, *2016 2016 BSA Global Cloud Computing Scorecard*, 2016, 8.

⁹⁹² USTR, *2017 National Trade Estimate Report*, 2017; European Centre for International Political Economy, Digital Trade Estimates Project database (accessed February 6, 2017).

⁹⁹³ National Association of Manufacturers, written submission to the USITC, March 18, 2017, 6.

⁹⁹⁴ USITC, hearing transcript, April 4, 2017, 178 (testimony of K.C. Swanson, Telecommunications Industry Association).

⁹⁹⁵ Industry representative, telephone interview by USITC staff, March 14, 2017.

⁹⁹⁶ ITI, submission in response to USTR request, October 26, 2016, 15; industry representative, telephone interview by USITC staff, March 13, 2017.

Box 8.4: Digital Companies' Tax Issues in Indonesia

In September 2016, the Indonesian government announced that it would seek five years of unpaid taxes from Alphabet Inc., parent company of Google. With back taxes and fines included, the bill reportedly could reach more than \$400 million for 2015 alone, according to an Indonesian tax official.^a

Service providers active in Indonesia reportedly operate through many different business models, with the Indonesian government endeavoring to regulate and tax these businesses. It is common for Internet companies to provide services and offer advertising platforms in Indonesia, but to perform billing functions, book profits, and pay most of their taxes in Singapore. Most of the revenue that Alphabet generates in Indonesia is booked through the company's Asia-Pacific headquarters in Singapore, so Alphabet argues that it does not owe additional tax payments in Indonesia.

Indonesian tax officials have also discussed plans to recoup back tax payments from other Internet-based companies, including Facebook. The effort to increase tax collections from Internet firms comes amid Indonesia's efforts to deal with a budget deficit and fund new infrastructure investment. Estimates of annual Internet-related advertising revenue in Indonesia that is theoretically available to be taxed vary, ranging from \$300 million, according to private sector sources, to \$830 million, according to Indonesian tax officials.^b It typically takes at least three years for tax-related cases to be resolved in Indonesian courts, so the question of Alphabet's final tax liabilities will not be settled immediately.^c

As of April 2017, it was not clear whether the targeted companies, reportedly including Apple, Twitter, Yahoo and Facebook as well as Google, would agree to a tax settlement with the Indonesian government or face new regulations. The resulting regulatory uncertainty can act as a barrier to companies like Google that are doing business in Indonesia, or to other digital companies considering entry into the market.^d Other governments around the world have also pursued efforts to increase tax collections from Internet-based companies.^e

Sources: Google and Temasek, "E-economy SEA," May 2016; Business Insider, "The Indonesian Government Says Google Has Dodged," September 19, 2016; industry representative, telephone interview by USITC staff, March 13, 2017.

^a Business Insider, "The Indonesian Government Says Google Has Dodged \$400 Million in Taxes," September 19, 2016.

^b Google and Temasek, "e-economy SEA," joint report, May 2016.

^c Business Insider, "The Indonesian Government Says Google Has Dodged," September 19, 2016; Gayatri Suroyo and Eveline Danubrata, "Exclusive: Google May Face over \$400 Million," September 19, 2016.

^d Industry representative, telephone interview by USITC staff, March 13, 2017.

^e For a review of taxation issues related to Internet companies and the digital economy, see, for example, OECD, *Addressing the Tax Challenges of the Digital Economy*, October 2015.

Russia

A law commonly known as the "Google Tax," which went into effect January 1, 2017, imposes a value-added tax (VAT) of up to 18 percent on online purchases. The tax affects 14 types of IT services and products, including online retailers; data storage; hosting providers; software applications and games databases; advertising platforms; online auctions; domain registration; search services; and digital goods. Russia is also exploring the possibility of taxing all small

business imports via a marketplace collection mandate. If applied, this could impact the competitiveness of U.S. small businesses and sellers on eBay and Etsy.⁹⁹⁷

Local Content Requirements and Access

Content requirements can be both physical and programmatic. Physical content requirements mandate that foreign firms use a certain share of domestically produced components in the products they sell in certain markets. Programmatic content requirements mandate that foreign firms provide a certain amount of domestically produced content on their platforms. Local content requirements have been increasing around the world in recent years. According to one industry representative, 146 such measures are currently active in 39 countries.⁹⁹⁸ Local content requirements can prohibit U.S. firms from providing services to foreign markets on a cross-border basis; such requirements can also interrupt the flow of data, disrupting firms' operations.⁹⁹⁹

In China, content requirements are both physical and programmatic, and vary by industry. In general, the series of government measures that mandate the use of “secure and controllable” technology and software, such as the Cybersecurity Law, National Security Law, and Counterterrorism Law, reportedly favor domestic firms and local content by requiring foreign products to undergo local testing, disclose source code to the government, and comply with China-specific security standards.¹⁰⁰⁰

Relatedly, industry representatives have stated that the Chinese government is either considering applying or has already applied a security ranking system mandating that only products featuring Chinese intellectual property be used for cloud computing, IoT, insurance, mobile Internet, and industrial controls. These restrictions effectively exclude U.S. and other foreign ICT equipment from China.¹⁰⁰¹

The EU imposes programmatic local content requirements related to audiovisual services, but does not impose physical ones related to digital trade. Under the 2007 EU Directive on Audiovisual Media Services (AVMS), on-demand audiovisual media services provided over the Internet face minimum content quotas for broadcasting that must be enforced by all member states. Member states may choose to exceed this minimum quota for EU content, and several

⁹⁹⁷ USTR, *2017 National Trade Estimate Report*, 2017, 383; USITC, hearing transcript, April 4, 2017, 124 (testimony of Brian Bieron, eBay, Inc.).

⁹⁹⁸ USITC, hearing transcript, April 4, 2017, 256–57 (testimony of Sean Heather, U.S. Chamber of Commerce).

⁹⁹⁹ *Ibid.*, 266 (testimony of Christine Bliss, Coalition of Services Industries).

¹⁰⁰⁰ National Association of Manufacturers, written submission to the USITC, March 18, 2017, 5.

¹⁰⁰¹ USITC, hearing transcript, April 4, 2017, 178 (testimony of K.C. Swanson, Telecommunications Industry Association).

have done so. AVMS does not set any strict content quotas for video on demand services, but it does require member states to ensure that on-demand services encourage production of, and access to, “European works.” The method of such promotion is not specifically defined, although examples provided include financial contributions made by such services for the production and rights acquisition of EU works, and the share and/or prominence of EU works in the catalogs of video on-demand services.¹⁰⁰² The AVMS has been identified by U.S. industry representatives as a longstanding barrier of considerable concern.¹⁰⁰³

A 2016 legislative proposal would impose additional requirements: (1) to establish a minimum 20 percent threshold for European content in their catalogs, and (2) to give prominence to European content in their offerings. Under the proposal, member states would also have the option of requiring on-demand service providers based outside their territory, but whose targeted audience is in their territory, to contribute financially to European works, based on revenues generated there.¹⁰⁰⁴

In India, content localization regulations require local production of many products. Ranging from medical devices to clean energy equipment, these also include IT products.

Indonesian regulations impose significant barriers to trade for U.S. phone hardware manufacturers.¹⁰⁰⁵ The government maintains local content requirements on investors, particularly with regard to mobile handset production. According to U.S. industry representatives, the Indonesian government is trying to force mobile handset makers to localize production there. Samsung has opened handset production outside of Jakarta, and another company has stated that it is under pressure to do the same. Reportedly, Apple may have come to an agreement with the Indonesian government to invest in local research and development as a way to meet the local content requirement.¹⁰⁰⁶ Industry representatives have also expressed concerns that Indonesia will soon require OTT services operating in Indonesia to establish formal business operations within the country (rather than Singapore) in order to increase the government’s ability to tax social media and app-based companies such as Facebook, Google, Uber, Twitter, and Instagram (see box 8.4 above).¹⁰⁰⁷

¹⁰⁰² EU, Directive 2010/13/EU (Audiovisual Media Services Directive), Article 11, April 15, 2010; USTR, *2017 National Trade Estimate Report*, 2017, 167.

¹⁰⁰³ USITC, hearing transcript, April 4, 2017, 266 (testimony of Christine Bliss, Coalition of Services Industries).

¹⁰⁰⁴ USTR, *2017 National Trade Estimate Report*, 2017, 167.

¹⁰⁰⁵ ITI, submission in response to USTR request, October 26, 2016, 15; industry representatives, telephone interviews by USITC staff, February 13 and March 20, 2017.

¹⁰⁰⁶ Industry representatives, telephone interviews by USITC staff, March 13, 2017.

¹⁰⁰⁷ Amcham Indonesia, “Information Communication Technology,” January 2017.

Nigeria's Guidelines for Nigerian Content Development in ICT impose local content requirements on hardware, software, services, and data for both government and private sector procurements. U.S. companies must offer the government a local content development plan that outlines its intended program for recruitment of local employees, job creation, and value creation. According to U.S. industry representatives, these guidelines, along with Nigeria's data localization requirements, obstruct U.S. companies' ability to compete in Nigeria.¹⁰⁰⁸

Measures and Policies Related to Programming Local Content Requirements

In Brazil, content quotas require that channels air at least 3.5 hours per week of Brazilian programming during prime time and that one-third of all channels included in a TV package must be Brazilian. Cable and satellite providers are subject to fixed levies on foreign programming.¹⁰⁰⁹

For online TV suppliers, China imposes a 30 percent cap on foreign films and TV dramas, and the content must first be submitted to government controls for censor approval. This restriction limits the distribution of foreign online entertainment.¹⁰¹⁰ Further, local cable networks are prohibited from carrying foreign satellite channels without government approval.¹⁰¹¹

France, Poland, and Spain are three EU countries with programming content requirements. Internet, cable, and satellite networks in France are required to broadcast 50 percent EU content and 30–35 percent French-language content (the AVMS minimum). But such channels and services are also required to increase their investment in the production of French-language content. Video on demand services must wait four months after a movie leaves the cinema before they can show it on their service. On-demand audiovisual media services providers in Poland must promote content of EU origin, especially content originally produced in Polish, and dedicate at least 20 percent of their catalog to EU content. Broadcasters and providers of other audiovisual media services in Spain are required to invest 5 percent of their annual revenues in the production of EU and Spanish films and other audiovisual programs. Video on demand services in Spain must reserve 30 percent of their catalogs for European

¹⁰⁰⁸ USITC, hearing transcript, April 4, 2017, 256–57 (testimony of Sean Heather, U.S. Chamber of Commerce); Heather, written testimony to the USITC, April 4, 2017, 3.

¹⁰⁰⁹ USTR, *2017 National Trade Estimate Report*, 2017, 54; Castellanos and Berro, "Film Financing and Television Programming," 2015, 16.

¹⁰¹⁰ Cable Satellite Broadcasting Association of Asia, submission to USTR Special 301 Report, February 9, 2017, 3.

¹⁰¹¹ Motion Picture Association of America, written submission to USITC, March 28, 2017, 5.

works (half of these in an official language of Spain) and contribute 5 percent of their turnover to the funding of audiovisual content.¹⁰¹²

Under the 2009 Law on Film, Indonesia imposes a 60 percent local content requirement for local exhibitors. This requirement includes the authority to implement unspecified import restrictions, prohibit dubbing of foreign films into Indonesian, and prohibit foreign companies from distributing or exhibiting films, although implementing regulations have not yet been released.¹⁰¹³ In addition, Indonesia's 2005 Broadcasting Law includes a requirement that any pay-TV advertising must be made in Indonesia.¹⁰¹⁴

Measures and Policies Related to Physical Local Content Requirements

To be eligible to win a recent spectrum auction in Brazil, bidders were required to include a preference for domestically produced and developed goods and services for their network build-out. Under the Basic Production Process, Brazil provides tax incentives for domestic goods produced in several sectors, including ICT equipment. The EU is currently challenging this tax at the World Trade Organization, claiming that it provides preference and support to local content and imposes a higher tax burden on imported goods.¹⁰¹⁵

The Chinese government is reportedly considering draft regulations requiring foreign insurance companies to give preference to local software, hardware, and encryption.¹⁰¹⁶

India's Preferential Market Access policy on computers, electronics, and telecom equipment imposes some local content requirements on purchases by government entities.¹⁰¹⁷

Two Indonesian regulations impose strict local content rules on 4G LTE ("long-term evolution") smartphones, laptops, tablet computers, and all related equipment. All 4G LTE-enabled devices must contain 30 percent local content, and all 4G LTE base stations must contain 40 percent local content by January 2017; the level of local content must be calculated according to the regulations. Indonesia's Ministry of Communication and Informatics (MCIT) Regulations 07/2009 and 19/2011 require that equipment used in certain wireless broadband services

¹⁰¹² USTR, *2017 National Trade Estimate Report*, "European Union," 2017, 169.

¹⁰¹³ USTR, *2016 National Trade Estimate Report*, 2016, 227; AmCham Indonesia, "Creative Industries," January 2017.

¹⁰¹⁴ Coalition of Services Industries, written submission to the USITC, April 24, 2017, 8.

¹⁰¹⁵ USTR, *2017 National Trade Estimate Report*, 2017, 56.

¹⁰¹⁶ American Insurance Association, written submission to USITC, April 4, 2017, 8.

¹⁰¹⁷ USTR, *2017 National Trade Estimate Report*, 2017, 217; European Centre for International Political Economy, Digital Trade Estimates Project Database (accessed February 6, 2017).

contain at least 30 percent local content for subscriber stations and 40 percent for base stations, and that all wireless equipment contain 50 percent local content within five years.¹⁰¹⁸ In addition, in February of 2016, the Ministry of Trade publicized a new draft amendment for its Regulation 82/2012 that would roll back many restrictions on investing and importing mobile phones into Indonesia. But it would continue to bar importers from selling directly to consumers and would require some importers to obtain a recommendation from the ministry in order to import.¹⁰¹⁹

In 2015, the government of Russia implemented steps to support the domestic IT sector, including mandating a preference for Russian-produced technology in government contracts. In general, the government mandates local content requirements in government procurement; it expanded this in 2015 to also include state-owned and state-controlled enterprises.¹⁰²⁰

¹⁰¹⁸ Government of Indonesia, Regulation 27/2015, “Technical Requirements of Equipment and Telecommunication Devices Standards—Based on Long Term Evolution (LTE) Technology,” and Regulation 65/2016, “Conditions and Procedures for Calculating the Value of the Domestic Components in Cell Phones, Handheld Computers, and Tablets,” July 27, 2016. ITI, submission in response to USTR request, October 26, 2016, 15; Library of Congress, “Indonesia: Local Content Rules for Electronic Products,” September 15, 2016; USTR, *2017 National Trade Estimate Report*, 2017, 236.

¹⁰¹⁹ ITI, submission in response to USTR request, October 26, 2016, 15; industry representatives, telephone interviews by USITC staff, February 13 and March 20, 2017.

¹⁰²⁰ Volfson, “Russian Federation: Russia Expands Restrictions on Government Procurement,” September 7, 2016; USTR, *2017 National Trade Estimate Report*, 2017, 377; USDOS, *Investment Climate Report*, 2016.

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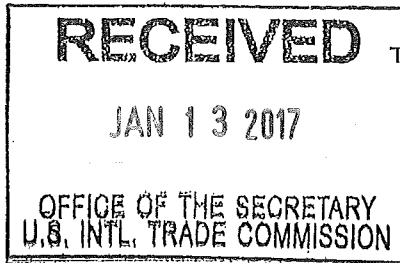
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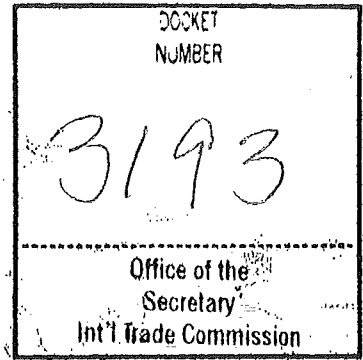
Appendix A

Request Letter



EXECUTIVE OFFICE OF THE PRESIDENT
THE UNITED STATES TRADE REPRESENTATIVE
WASHINGTON, D.C. 20508

January 13, 2017



The Honorable Irving A. Williamson
Chairman
U.S. International Trade Commission
500 E St, S.W.
Washington, DC 20436

Dear Chairman Williamson,

I am writing to request that the U.S. International Trade Commission (“the Commission”) conduct three investigations under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)) regarding the value of new digital technologies for U.S. firms and the impact of barriers to digital trade on U.S. firms’ competitiveness in international markets. These investigations will provide an update and extension of the analysis presented in the Commission’s two recent reports on digital trade, *Digital Trade in the U.S. and Global Economies, Part 1* (July 2013) and *Part 2* (August 2014). Building on this prior work, the requested investigations would address gaps in our understanding of the current digital trade landscape, identify the major trade barriers that U.S. firms in digitally intensive industries face in key foreign markets, and provide additional insight into the global competitiveness of U.S. digitally intensive industries.

The importance of the digital economy to United States, in terms of innovation, job growth, and our nation’s long-term competitiveness motivated this Administration to make tackling digital trade barriers a key priority. We have done this both by proposing comprehensive, high-standard provisions to protect the Internet-enabled economy in our trade agreements, as well as in broader policy engagement with our trading partners, consistent with priorities set forth in the Bipartisan Congressional Trade Priorities and Accountability Act of 2015. Because countries are increasingly adopting policies that disrupt global data networks and distort trade flows, it is critical that the U.S. government monitor and address regulatory and other policy barriers to digital trade on an ongoing basis.

These investigations will assist the Office of the U.S. Trade Representative (USTR) in its ongoing examination of the ways in which companies and workers in every sector of the U.S. economy use the Internet and related data networks to deliver innovative products and services abroad. These investigations will also assist in USTR’s assessment of the impact of barriers to trade in important digital products and services, such as cloud data and software services, data analytics, new Internet communication services, and digital services supporting various production processes, as well as to trade in manufactured goods connected by data networks and supported by digitally enabled services.

I therefore request that the Commission conduct three investigations and provide accompanying reports summarizing their analysis and assessment, as described below.

Report 1: Based on a review of literature and other available information, I request that the Commission provide a report that, to the extent practicable:

- Describes the broad landscape and recent developments of important business-to-business (B2B) digital technologies used primarily by firms (such as cloud-based data processing, storage, software applications, as well as communications services and digital services related to manufacturing and the Internet of Things);
- Provides an overview of developments in the provision of business-to-consumer (B2C) digital products and services used primarily by consumers and individuals;
- Provides information on the market for digital products and services, both in the United States and in key foreign markets, such as the EU, China, Russia, Brazil, India, and Indonesia, with a particular focus on products and services that can scale globally for the purpose of assessing U.S. firms' global competitiveness;
- Provides up-to-date information on the rate of adoption of digital technologies, domestically and abroad, and documents the importance of data-flows (domestic and cross-border) to a wide range of sectors across the economy; and
- Describes regulatory and policy measures currently in force in important markets abroad that may significantly impede digital trade. Such measures affecting digital trade might include: FDI and other market access restrictions; cross-border data flow limitations (data localization requirements, Internet blocking, censorship, cultural regulations of digital content, and data privacy protections); cybersecurity regulations and limitations on the choice of encryption technologies; ISP regulations, including limitations on ISPs intended to protect IPR; and rules determining liability for third-party content.

The report should be delivered no later than August 29th, 2017.

Report 2: Based on available information, including a survey of U.S. firms in selected industries particularly involved in digital trade, I request that the Commission provide a second report that:

- Provides qualitative, and to the extent possible, quantitative analysis of measures in key foreign markets (identified in the first report) that affect the ability of U.S. firms to develop and/or supply B2B digital products and services abroad; and
- Assesses, using case studies or other qualitative and quantitative methods, the impact of these measures on the competitiveness of U.S. firms engaged in the sale of digital products and services, as well as on international trade and investment flows associated with digital products and services related to significant B2B technologies.

The report should be delivered no later than October 28th, 2018.

Report 3: Based on available information, including a survey of U.S. firms in selected industries particularly involved in digital trade, I request that the Commission provide a third report that:

- Provides qualitative, and to the extent possible, quantitative analysis of measures in key foreign markets (identified in the first report) that affect the ability of U.S. firms to develop and/or supply B2C digital products and services abroad; and
- Assesses, using case studies or other qualitative and quantitative methods, the impact of these measures on the competitiveness of U.S. firms engaged in the sale of digital products and services, as well as on international trade and investment flows associated with digital products and services related to significant B2C technologies.

The report should be delivered no later than March 29th, 2019.

As we intend to make the Commission's first report available to the public, it should not include confidential business or national security classified information. All confidential business information collected in the course of these investigations should be aggregated such that the individual operations of any one firm would not be revealed.

In accordance with USTR policy on implementing Executive Order 13526, as amended, I direct you to mark or identify as "Confidential," for a period of ten years, such portions of the Commission's second and third reports and related working papers that contain the Commission's analysis of the impact of barriers to digital trade on (1) U.S. imports and exports of digital products and services and (2) the competitiveness of U.S. companies. Consistent with the Executive Order, this information is being classified on the basis that it concerns economic matters relating to national security that impact USTR negotiation and enforcement priorities. USTR intends to treat the Commission's second and third reports as interagency memoranda containing pre-decisional advice subject to the deliberative process privilege.

I request that you submit an outline of the second and third reports as soon as possible to enable USTR officials to provide you with further guidance on their classification, including the extent to which portions of the reports will require classification and for how long. Based on this outline, an appropriate USTR official will provide you with written instructions.

I appreciate the Commission's assistance and cooperation in this matter.

Sincerely,



Ambassador Michael B. G. Froman

Appendix B

Federal Register Notice

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–561]

Global Digital Trade I: Market Opportunities and Key Foreign Trade Restrictions; Institution of Investigation and Scheduling of Hearing

AGENCY: United States International Trade Commission.

ACTION: Institution of investigation and scheduling of public hearing.

SUMMARY: Following receipt of a request from the U.S. Trade Representative (USTR) dated January 13, 2017 under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), the U.S. International Trade Commission has instituted investigation no. 332–561, *Global Digital Trade I: Market Opportunities and Key Foreign Trade Restrictions*, for the purpose of preparing the first of three reports requested by the USTR. The Commission will hold a public hearing in the investigation on April 4, 2017.

DATES:

March 21, 2017: Deadline for filing requests to appear at the public hearing.

March 23, 2017: Deadline for filing pre-hearing briefs and statements.

April 4, 2017: Public hearing.

April 11, 2017: Deadline for filing post-hearing briefs and statements.

April 21, 2017: Deadline for filing all other written submissions for the first report.

August 29, 2017: Transmittal of the first Commission report to the USTR.

ADDRESSES: All Commission offices, including the Commission’s hearing rooms, are located in the United States International Trade Commission Building, 500 E Street SW., Washington, DC. All written submissions should be addressed to the Secretary, United States International Trade Commission, 500 E Street SW., Washington, DC 20436. The public record for this investigation may be viewed on the Commission’s electronic docket (EDIS) at <https://edis.usitc.gov>.

FOR FURTHER INFORMATION CONTACT: Project Leader David Coffin (202–205–2232 or david.coffin@usitc.gov) or Deputy Project Leader Jeremy Streatfeild (202–205–3349 or jeremy.streatfeild@usitc.gov) for information specific to this investigation. For information on the legal aspects of these investigations, contact William Gearhart of the Commission’s Office of the General Counsel (202–205–3091 or william.gearhart@usitc.gov). The media should contact Margaret O’Laughlin,

Office of External Relations (202–205–1819 or margaret.olaughlin@usitc.gov). Hearing-impaired individuals may obtain information on this matter by contacting the Commission’s TDD terminal at 202–205–1810. General information concerning the Commission may also be obtained by accessing its Web site (<https://www.usitc.gov>). Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202–205–2002.

Background: As requested, the Commission will deliver to the USTR three reports relating to digital trade. The first report, titled *Global Digital Trade I: Market Opportunities and Key Foreign Trade Restrictions*, will be based on a review of the literature and other available information, and will, to the extent practicable:

- Describe the broad landscape and recent developments of important business-to-business (B2B) digital technologies used primarily by firms (such as cloud-based data processing, storage, software applications, as well as communications services and digital services related to manufacturing and the Internet of Things);
- Provide an overview of developments in the provision of business-to-consumer (B2C) digital products and services used primarily by consumers and individuals;
- Provide information on the market for digital products and services, both in the United States and in key foreign markets, such as the European Union, China, Russia, Brazil, India, and Indonesia, for the purpose of assessing U.S. firms’ global competitiveness;
- Provide up-to-date information on the rate of adoption of digital technologies, domestically and abroad, and document the importance of data-flows (domestic and cross-border) to a wide range of sectors across the economy; and
- Describe regulatory and policy measures currently in force in important markets abroad that may significantly impede digital trade. Such measures affecting digital trade might include: FDI and other market access restrictions; cross-border data flow limitations (data localization requirements, Internet blocking, censorship, cultural regulations of digital content, and data privacy protections); cybersecurity regulations and limitations on the choice of encryption technologies; ISP regulations, including limitations on ISPs intended to protect IPR; and rules determining liability for third-party content.

The Commission expects to transmit the first report to the USTR by August, 29, 2017.

The Commission will institute a second investigation at a later date for the purpose of preparing the second report. As requested by the USTR, the second report will build on the first report to:

- Provide qualitative, and to the extent possible, quantitative analysis of measures in key foreign markets (as identified in the first report) that affect the ability of U.S. firms to develop and/or supply B2B digital products and services abroad; and

- Assess, using case studies or other qualitative and quantitative methods, the impact of these measures on the competitiveness of U.S. firms engaged in the sale of digital products and services, as well as on international trade and investment flows associated with digital products and services related to significant B2B technologies.

The Commission will deliver to the USTR its report on the second investigation by October 28, 2018. More information regarding the second report will be made available when the second investigation is instituted.

The Commission will institute a third investigation at a later date for the purpose of preparing the third report. As requested by the USTR, the third report will build on the first and second reports to:

- Provide qualitative, and to the extent possible, quantitative analysis of measures in key foreign markets (as identified in the first report) that affect the ability of U.S. firms to develop and/or supply B2C digital products and services abroad; and

- Assess, using case studies or other qualitative and quantitative methods, the impact of these measures on the competitiveness of U.S. firms engaged in the sale of digital products and services, as well as on international trade and investment flows associated with digital products and services related to significant B2C technologies.

The Commission will deliver to the USTR its report on the third investigation by March 29, 2019.

Public Hearing: A public hearing in connection with this investigation will be held at the U.S. International Trade Commission Building, 500 E Street SW., Washington, DC, beginning at 9:30 a.m. on April 4, 2017. Requests to appear at the public hearing should be filed with the Secretary, no later than 5:15 p.m., March 21, 2017, in accordance with the requirements in the “Submissions” section below. All pre-hearing briefs and statements should be filed not later than 5:15 p.m., March 28, 2017; and all

post-hearing briefs and statements responding to matters raised at the hearing should be filed not later than 5:15 p.m., April 11, 2017. In the event that, as of the close of business on March 21, 2017, no witnesses are scheduled to appear at the hearing, the hearing will be canceled. Any person interested in attending the hearing as an observer or nonparticipant should contact the Office of the Secretary at 202-205-2000 after March 21, 2017, for information concerning whether the hearing will be held.

Written Submissions: In lieu of or in addition to participating in the hearing, interested parties are invited to submit written statements concerning this investigation. All written submissions should be addressed to the Secretary, and should be received not later than 5:15 p.m., April 21, 2017. All written submissions must conform with the provisions of section 201.8 of the Commission's *Rules of Practice and Procedure* (19 CFR 201.8). Section 201.8 and the Commission's Handbook on Filing Procedures require that interested parties file documents electronically on or before the filing deadline and submit eight (8) true paper copies by 12:00 p.m. eastern time on the next business day. In the event that confidential treatment of a document is requested, interested parties must file, at the same time as the eight paper copies, at least four (4) additional true paper copies in which the confidential information must be deleted (see the following paragraph for further information regarding confidential business information or "CBI"). Persons with questions regarding electronic filing should contact the Office of the Secretary, Docket Services Division (202-205-1802).

Confidential Business Information: Any submissions that contain CBI must also conform to the requirements of section 201.6 of the *Commission's Rules of Practice and Procedure* (19 CFR 201.6). Section 201.6 of the rules requires that the cover of the document and the individual pages be clearly marked as to whether they are the "confidential" or "non-confidential" version, and that the CBI is clearly identified by means of brackets. All written submissions, except for those containing CBI, will be made available for inspection by interested parties.

In its request letter, the USTR stated that his office intends to make the Commission's first report available to the public in its entirety, and asked that the Commission not include any CBI or national security classified information in the report that it delivers to the USTR. All information, including CBI,

submitted in this investigation may be disclosed to and used: (i) By the Commission, its employees and Offices, and contract personnel (a) for developing or maintaining the records of this or a related proceeding, or (b) in internal investigations, audits, reviews, and evaluations relating to the programs, personnel, and operations of the Commission including under 5 U.S.C. Appendix 3; or (ii) by U.S. government employees and contract personnel for cybersecurity purposes. The Commission will not otherwise disclose any CBI in a manner that would reveal the operations of the firm supplying the information.

Summaries of Written Submissions: The Commission intends to publish summaries of the written submissions filed by interested persons. Persons wishing to have a summary of their submission included in the report should include a summary with their written submission. The summary may not exceed 500 words, should be in MSWord format or a format that can be easily converted to MSWord, and should not include any CBI. The summary will be published as provided if it meets these requirements and is germane to the subject matter of the investigation. The Commission will identify the name of the organization furnishing the summary and will include a link to the Commission's Electronic Document Information System (EDIS) where the full written submission can be found.

By order of the Commission.

Issued: February 6, 2017.

Lisa R. Barton,

Secretary to the Commission.

[FR Doc. 2017-02752 Filed 2-9-17; 8:45 am]

BILLING CODE 7020-02-P

DEPARTMENT OF JUSTICE

Drug Enforcement Administration

John P. Moore, III, M.D.; Decision and Order

On June 30, 2016, the Assistant Administrator, Division of Diversion Control, issued an Order to Show Cause to John P. Moore, III, M.D. (Respondent), of Centerville, Ohio. The Show Cause Order proposed the revocation of Respondent's DEA Certificate of Registration No. FM1335353. GX 2, at 1.

With respect to the Agency's jurisdiction, the Show Cause Order alleged that Respondent is the holder of Certificate of Registration No. FM1335353, which "is valid for Drug Schedules II-V," at the address of 950

E. Alex Bell Road, Centerville, Ohio. *Id.* at 2. The Order further alleged that this registration does not expire until January 31, 2018. *Id.*

The Show Cause Order further alleged three separate grounds for the proposed action. First, it alleged that on April 5, 2016, Respondent pled guilty in the Ohio courts to four state felony counts of knowingly selling or offering to sell zolpidem and diazepam (both schedule IV controlled substances) and Suboxone (buprenorphine and naloxone, a schedule III controlled substance), as well as a further felony count of knowingly permitting real estate or other premises to be used for drug trafficking. *Id.* (citing Ohio Rev. Code §§ 2925.03, 2925.13). *See also* 21 U.S.C. 824(a)(2).

Second, the Show Cause Order alleged that on May 11, 2016, Respondent's Ohio medical license was suspended and that he is currently without authority to dispense controlled substances in the State in which he is registered with the Agency. GX 2, at 2 (citing 21 U.S.C. 802(21), 824(a)(3)). And third, the Show Cause Order alleged that Respondent has also been "convicted of felony Medicaid fraud," thus rendering him subject to mandatory exclusion from participation in federal health care programs under 42 U.S.C. 1320a-7(a) and subjecting his registration to revocation for this reason as well. GX 2, at 2 (citing 21 U.S.C. 824(a)(5)).

The Show Cause Order also notified Respondent of his right to request a hearing on the allegations of the Order or to submit a written statement of position while waiving his right to a hearing, the procedure for electing either option (including the time period for filing), and the consequence of failing to elect either option as well as the failure to do so in compliance with the Agency's regulations. *Id.* at 3 (citing 21 CFR 1301.43). Finally, the Show Cause Order informed Respondent of his right to submit a corrective action plan under 21 U.S.C. 824(c)(2)(C). *Id.*

On or about June 30, 2016, the Government sent the Show Cause Order by certified mail, return receipt requested, addressed to Respondent at his residence in the Correctional Reception Center in Orient, Ohio. GX 5, Appendix A, at 1, 3-4. As evidenced by the signed return receipt card, on July 6, 2016, the Government accomplished service.¹ *Id.* at 3,

¹ While I find that the mailing provided constitutionally adequate service, the Government also produced evidence showing that it had emailed a copy of the Show Cause Order to corrections officers at the Ohio Correctional Reception Center and that Respondent was personally served with a

Appendix C

Calendar of Hearing Witnesses

CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject: Global Digital Trade I: Market Opportunities and Key Foreign Trade Restrictions

Inv. No.: 332-561

Date and Time: April 4, 2017 - 9:30 am

Sessions were held in connection with this investigation at the United State International Trade Commission, 500 E Street SW (room 101), Washington, DC.

PANEL 1

ORGANIZATION AND WITNESS:

Singapore Management University
Singapore

Henry Shuchao Gao, Associate Professor of Law

Brookings Institution
Washington, DC

Joshua Meltzer, Senior Fellow

Appendix C: Calendar of Hearing Witnesses

Information Technology and Innovation Foundation (“ITIF”)

Washington, DC

Nigel Cory, Trade Policy Analyst

International Intellectual Property Alliance (“IIPA”)

Washington, DC

Kevin M. Rosenbaum, Counsel

Motion Picture Association of America (“MPAA”)

Washington, DC

Joanna McIntosh, Executive Vice President,

Global Policy and External Affairs

Recording Industry Association of America (“RIAA”)

Washington, DC

George E.C. York, Senior Vice President,

International Policy

PANEL 1 (continued)

ORGANIZATION AND WITNESS:

George Washington University
The Elliott School of International Affairs
Washington, DC

Susan Ariel Aaronson, Research Professor of International
Affairs and Cross Disciplinary Fellow

eBay, Inc.
Washington, DC

Brian Bieron, Executive Director, Global Public Policy

PANEL 2

ORGANIZATION AND WITNESS:

Internet Association (“IA”)
Washington, DC

Ari Giovenco, Director, Trade and International Policy

Information Technology Industry Council (“ITI”)
Washington, DC

PANEL 2 (continued)

ORGANIZATION AND WITNESS:

Ed Brzytwa, Director of Global Policy for Localization,
Trade, and Multilateral Affairs

BSA | The Software Alliance (“BSA”)
Washington, DC

Leticia S. Lewis, Director, Policy

Software & Information Industry Association (“SIIA”)
Washington, DC

Carl Eric Schonander, Senior Director for International
Public Policy

ACT | The App Association
Washington, DC

Brian Scarpelli, Senior Policy Counsel

Computer & Communications Industry Association (“CCIA”)
Washington, DC

Daniel O'Connor, Vice President, Public Policy

Telecommunications Industry Association (“TIA”)

Arlington, VA

K.C. Swanson, Director, Global Policy

PANEL 3

ORGANIZATION AND WITNESS:

U.S. Chamber of Commerce

Washington, DC

Sean Heather, Vice President for Global Regulatory

Cooperation (“GRC”)

Coalition of Service Industries (“CSI”)

Washington, DC

Christine Bliss, President

American Insurance Association (“AIA”)

Washington, DC

Stephen Simchak, Director of International Affairs

Property Casualty Insurers Association of America (“PCI”)

Washington, DC

Appendix C: Calendar of Hearing Witnesses

David Fleming Snyder, Vice President, International Policy

Rapid7

Boston, MA

Harley Geiger, Director of Public Policy

Etsy

Washington, DC

Julie Stitzel, Senior Manager, Federal Advocacy and Policy

-END-

Appendix D

Summary of the Views of Interested Parties

Views of Interested Parties

Interested parties had the opportunity to file written submissions to the Commission in the course of this investigation and to provide summaries of the positions expressed in the submissions for inclusion in this report. This appendix contains these written summaries, provided that they meet certain requirements set out in the notice of investigation. The Commission has not edited these summaries. This appendix also contains the names of other interested parties who filed written submissions during investigation but did not provide written summaries. A copy of each written submission is available in the Commission's Electronic Docket Information System (EDIS).¹⁰²¹ The Commission also held a public hearing in connection with this investigation on April 4, 2017. The full text of the transcript of the Commission's hearing is also available on EDIS.

Written Submissions

Dr. Susan Aaronson

No written summary. Please see EDIS for full submission.

ACT The App Association

No written summary. Please see EDIS for full submission.

American Insurance Association

No written summary. Please see EDIS for full submission.

BSA The Software Alliance

No written summary. Please see EDIS for full submission.

Coalition of Services Industry

No written summary. Please see EDIS for full submission.

Computer & Communications Industry Association

No written summary. Please see EDIS for full submission.

¹⁰²¹ Available online at <http://edis.usitc.gov>.

Copyright Alliance

No written summary. Please see EDIS for full submission.

Department for Professional Employees, AFL-CIO

No written summary. Please see EDIS for full submission.

Digital Citizens Alliance

No written summary. Please see EDIS for full submission.

eBay

No written summary. Please see EDIS for full submission.

Entertainment Software Association

No written summary. Please see EDIS for full submission.

Etsy

No written summary. Please see EDIS for full submission.

Dr. Henry Gao

No written summary. Please see EDIS for full submission.

Information Technology and Innovation Foundation

No written summary. Please see EDIS for full submission.

Information Technology Industry Council

No written summary. Please see EDIS for full submission.

Intel Corporation

No written summary. Please see EDIS for full submission.

International Intellectual Property Alliance

No written summary. Please see EDIS for full submission.

Internet Association

No written summary. Please see EDIS for full submission.

Internet Infrastructure Coalition

No written summary. Please see EDIS for full submission.

Motion Picture Association of America, Inc.

No written summary. Please see EDIS for full submission.

National Association of Manufacturers

No written summary. Please see EDIS for full submission.

PCIAA

No written summary. Please see EDIS for full submission.

Rapid7

Rapid7 commends the US International Trade Commission for producing this report on the increasingly important issue of digital trade barriers, and appreciated the opportunity to testify at your Apr. 2017 hearing. Digital trade issues are growing in significance to us as we seek to expand our global customer base.

By leveraging cloud computing, digital commerce offers significant opportunities to scale globally for individuals and companies of all sizes – not just large companies or tech companies, but for any transnational company that stores customer data. However, this growth depends on the free flow of information across international borders.

Companies seeking to provide global access to digital services are impeded by “data localization” – laws or norms compelling companies that do business within a country to store data associated with that country’s citizens locally, rather than in data centers located elsewhere. Data localization erodes the analytic capabilities, standardization, and cost savings that cloud computing can provide. Segregating data collected from particular countries,

maintaining servers locally in those countries, and navigating complex geography-based laws are all activities that require significant resources, increasing overhead costs without boosting product development or innovation. These costs can price smaller companies out of a country market entirely, which also reduces the commercial choices for the citizens in the localizing country. In addition, the resulting fragmentation undermines the fundamental concept of a unified and open global internet.

A major driver of customer concern is US intelligence and law enforcement access to data, such as through the Electronic Communications Privacy Act and the Foreign Intelligence Surveillance Act. We respect the legitimate needs of government agencies to access data for security, but abroad there is a perception that agencies have easy access to data located in the US, and will use that data to infringe on privacy in a way that would not occur if the data were stored locally. There is also a lack of legal clarity regarding jurisdictional rules for data –who owns it, which government agencies can access it, under what legal standard, where disputes get resolved.

Rapid7 urges the ITC to help ensure that digital economy issues are prioritized in multilateral and bilateral agreements and standard setting bodies. We have five recommendations:

1. Pursue international agreements that prevent forced localization of data, and that increase coordination on rules regarding cross-border data flow and government access to data. These legal frameworks should be transparent and respectful of human rights and due process.
2. International agreements should include an express presumption that governments should minimize disruptions to the flow of commercial electronic information across borders.
3. Agreements should streamline government licensing requirements for digital services, and ensuring the transparency of licensing requirements.
4. Pursue oversight measures, implemented by international trade bodies, designed to explicitly track and quantify global trade barriers related to data.
5. Support federal legislation updating the Electronic Communications Privacy Act and the Foreign Intelligence Surveillance Act to clarify standards for US government access to data stored domestically and overseas.

Recording Industry Association of America

Specifically, in this Pre-Hearing Brief and Statement, RIAA will summarize its position with respect to the five topics to be covered by the Commission’s first report:

1. Describe the broad landscape and recent developments of important business-to-business (B2B) digital technologies used primarily by firms (such as cloud-based data processing, storage,

software applications, as well as communications services and digital services related to manufacturing and the Internet of Things);

2. Provide an overview of developments in the provision of business-to-consumer (B2C) digital products and services used primarily by consumers and individuals;

3. Provide information on the market for digital products and services, both in the United States and in key foreign markets, such as the European Union, China, Russia, Brazil, India, and Indonesia, for the purpose of assessing U.S. firms' global competitiveness;

4. Provide up-to-date information on the rate of adoption of digital technologies, domestically and abroad, and document the importance of data-flows (domestic and cross-border) to a wide range of sectors across the economy; and

5. Describe regulatory and policy measures currently in force in important markets abroad that may significantly impede digital trade. Such measures affecting digital trade might include: FDI and other market access restrictions; cross-border data flow limitations (data localization requirements, Internet blocking, censorship, cultural regulations of digital content, and data privacy protections); cybersecurity regulations and limitations on the choice of encryption technologies; ISP regulations, including limitations on ISPs intended to protect IPR; and rules determining liability for third-party content.

Software & Information Industry Association

No written summary. Please see EDIS for full submission.

Telecommunications Industry Association

No written summary. Please see EDIS for full submission.

U.S. Chamber of Commerce

The U.S. Chamber of Commerce is the world's largest business federation representing the interests of more than 3 million businesses of all sizes, sectors, and regions, as well as state and local chambers and industry associations. The Chamber is dedicated to promoting, protecting, and defending America's free enterprise system.

Digital trade has proven to be transformative and will continue to impact how Americans interact with one another, work, and do business. The benefits of the digital economy are not limited to "technology" companies but are experienced by companies across all industries from agriculture to manufacturing. U.S. businesses of all sizes rely on the Internet.

Appendix D: Summary of Views of Interested Parties

Foreign governments are endeavoring to forcibly create their own “Silicon Valleys” by implementing policies on the movement of digital goods and services that serve as regulatory barriers that limit digital trade, cross-border data flows, and market access:

Data localization requirements directly limit the movement of data. Some requirements U.S. companies are facing include mandatory establishment of a data center, physical presence within a jurisdiction in order to operate, and restrictions on how data can be transferred internationally. The ability for data to flow through the global economy is becoming just as important as the ability to move goods, services, or capital.

- Local content requirements force companies to ensure a certain amount of their final good or service is manufactured or sourced locally. Such requirements hinder long-term growth by lowering productivity, increasing prices, and diverting investment.
- Data protection and cybersecurity regulations are rising globally. U.S. companies face differing regulations throughout the world as well as new privacy and security policies that potentially masquerade protectionist motives. These challenges are not necessarily traditional “trade” type problems. More often these issues require intensive engagement on the part of U.S. regulators engaging in regulatory cooperation type activities.
- Intellectual property protection and the legal frameworks that govern such rights are also critical to the digital economy.

A more liberalized approach to digital trade adopted globally benefits American and foreign business alike by allowing the increased uptake of technology and the ability to safely and seamlessly move data. In fact, a recent study commissioned by the U.S. Chamber of Commerce found that reducing market and regulatory barriers to cross-border ICT services could produce \$1.72 trillion in global GDP gains. Such actions could also generate billions of dollars in potential new government revenues, millions of new jobs, and hundreds of thousands of new businesses.¹⁰²²

¹⁰²² The U.S. Chamber of Commerce commissioned Spire Research and Consulting to create a model in order to quantify the economic impact of full liberalization of cross-border ICT services and rules globally by creating an open, competitive marketplace. In order to better demonstrate that both end users and providers are winners in an open ICT services environment, the study examines a group of eight globally important markets from a diverse range of economic development, including Brazil, the European Union, Indonesia, Japan, Korea, Nigeria, Turkey, and Vietnam. Our findings demonstrate across the board benefits. Access report here: <https://www.uschamber.com/report/globally-connected-locally-delivered-the-economic-impact-cross-border-ict-services>.

Appendix E

Data Protection and Privacy Regulation

Data Protection and Privacy Regulation

This appendix provides additional information about the status of data protection and privacy regulation in each of the six key markets that are the focus of this report. The European Union (EU) has been the leader in developing a comprehensive approach to data protection and privacy through its General Data Protection Regulation (GDPR), which will be implemented in May 2018 by individual EU members. The EU's new electronic data privacy ("e-Privacy") Directive is an additional data privacy standard that expands its current regulation to apply to any company processing data in connection with communications services. This appendix also gives information on the two mechanisms through which U.S. businesses can comply with the EU's strict privacy requirements to permit the legal transfer of personal data between both countries, as well as the impact of Brexit on U.S. businesses' ability to protect data and participate in the EU's Digital Single Market Platform.

Other key markets, including China and Indonesia, are planning to replace their current sectoral approach to data protection and privacy regulations with more comprehensive regulatory frameworks. Data protection and privacy in Brazil and India is guided only by general principles. However, regulators in these two countries are in the process of developing national, comprehensive data protection and privacy measures.

Brazil

As of May 2017, Brazil does not have a specific law that establishes a data protection and privacy framework, unlike other countries in Latin America.¹⁰²³ Instead, data privacy in Brazil is regulated by general principles, laws, and regulations in the Brazilian federal constitution and the Brazilian civil code. Brazil's constitution guarantees the right to privacy. However, the Brazilian Internet Civil Rights Law, enacted in 2014, states that if a service provider collects, shares, or stores information in Brazil, it must protect the rights of all affected Brazilian citizens.

In addition, in May 2016 the Brazilian government drafted the Bill on the Protection of Personal Data, which provides a comprehensive legal framework addressing data protection and privacy.¹⁰²⁴ The bill is modeled after the EU Data Protection Directive, which ensures basic

¹⁰²³ Eleven other Latin American countries have enacted data protection and privacy laws, including Colombia, Costa Rica, Ecuador, Nicaragua, Peru, Argentina, Chile, Mexico, Saint Lucia, Trinidad and Tobago, and Uruguay. Sombra, "Will Brazil Seize This Opportune Moment?" August 23, 2016; DLA Piper, "Data Protection Laws of the World" (accessed February 6, 2017).

¹⁰²⁴ Article 5 of Brazil's 1998 Constitution; UNCTAD, *Data Protection Regulations and International Data Flows*, 2016.

rights and gives citizens greater control over the use and processing of their personal information, whether the data is located in Brazil or in servers abroad.¹⁰²⁵

Brazil and other Latin American countries are also using EU's new GDPR as a template for drafting their own regulatory measures, which is of concern to some U.S. businesses that contend that the EU's new GDPR rules may be overly expansive.¹⁰²⁶ Brazil's draft bill also protects users against the disclosure of their personal data to companies unrelated to the products or services offered to the user.¹⁰²⁷ According to Brazil's data protection and privacy measures, users have the right to request that their personal data should be eliminated once a relationship or contract between the parties has ended (except in cases of mandatory log retention).¹⁰²⁸ Furthermore, Brazil does not currently have a data privacy agency or a regulator to oversee enforcement of data privacy, although the draft Bill on the Protection of Personal Data may establish a regulator.¹⁰²⁹ Brazil's draft bill has not passed the national congress, despite the Brazilian president's declaring that passage is urgent.¹⁰³⁰

Some U.S. and international companies are hesitant about doing business in Brazil, partially due to the lack of clear guidelines on data protection and privacy: they perceive legal uncertainty in commercial relationships and increased risks to business activities.¹⁰³¹ Industry analysts reported to the Commission that they are unsure whether Brazil's data privacy provisions, restrictions on data collection, and requirements that Brazilians' data must remain stored on servers within the country could limit the use of large-scale data analytics.¹⁰³²

China

Many of the Chinese regulations addressing data protection and privacy are scattered throughout various federal statutes, giving China a sectoral approach to data protection and privacy. China's current data privacy regulation states that data subjects have the right to access their data and may ask the person or institution in charge of the processing to correct, block, or delete personal data. In order to adopt a more comprehensive approach to data privacy, the Chinese government has been reviewing a draft Personal Data Protection Law for

¹⁰²⁵ Baker McKenzie, *Global Privacy Handbook* (accessed February 6, 2017); UNCTAD, *Data Protection Regulations and International Data Flows*, 2016.

¹⁰²⁶ USITC, hearing transcript, April 4, 2017, 257–58 (testimony of Sean Heather, U.S. Chamber of Commerce).

¹⁰²⁷ Baker McKenzie, *Global Privacy Handbook* (accessed February 6, 2017).

¹⁰²⁸ European Centre for International Political Economy (ECIPE), Digital Trade Estimates Project database (accessed February 6, 2017).

¹⁰²⁹ BSA | The Software Alliance, "2016 BSA Global Cloud Computing Scorecard" 2016.

¹⁰³⁰ Sombra, "Will Brazil Seize This Opportune Moment?" August 23, 2016.

¹⁰³¹ Pereira, "Privacy and Data Protection," January 19, 2016; industry representatives, interview by USITC staff, Washington, DC, March 7, 2017.

¹⁰³² McKinsey Global Institute, *Digital Globalization*, March 2016, 101.

many years, but there is no indication when the law will be passed or implemented. In November 2016 China passed a Cybersecurity Law (implemented in June 2017) that introduces enhanced data protection as binding legal obligations for both Chinese companies and international companies doing business in China.¹⁰³³

U.S. businesses have expressed concerns over China's new data protection and privacy laws because they would require foreign firms to hand over sensitive personal information on national security grounds. According to industry analysts, these laws could negatively affect U.S. businesses, adding significant costs and limiting their ability to sell information technology (IT) products in China—a market that is worth \$465 billion in 2017.¹⁰³⁴

European Union

Data privacy concerns have been a major issue in the EU, prompting the adoption of stricter data privacy and protection laws in recent years. The EU pioneered the development of a global data protection and privacy framework with the implementation of the European Data Protection Directive in 1995.¹⁰³⁵ In January 2012, the European Commission proposed the GDPR, which represents a comprehensive reform of data protection and privacy laws. It updates and replaces the Data Protection Directive, and establishes that data protection and privacy is a fundamental right of data subjects residing within the EU. The GDPR entered into force on May 24, 2016, and must be adopted by all EU members by May 28, 2018.¹⁰³⁶

The main objectives of the GDPR are to give data subjects control over their personal data, and to simplify the regulatory environment for businesses.¹⁰³⁷ Under GDPR, businesses must gain “clear and affirmative” consent from the user to use his or her data (i.e., the user chooses to opt in to give consent, as opposed to checking off pre-ticked boxes or assenting by doing nothing), and consent terms must be unambiguous.¹⁰³⁸ A UK government representative stated that businesses will have to show documentation that users have consented to having their data used, and must provide an audit trail to show accountability in accordance with the GDPR.¹⁰³⁹

¹⁰³³ ECIPE, Digital Trade Estimates Project database (accessed February 6, 2017); DLA Piper, “Data Protection Laws of the World” (accessed February 6, 2017).

¹⁰³⁴ CRS, “Digital Trade and U.S. Trade Policy,” January 13, 2017.

¹⁰³⁵ UNCTAD, *Data Protection Regulations and International Data Flows*, 2016.

¹⁰³⁶ EC, “Protection of Personal Data,” updated November 24, 2016.

¹⁰³⁷ GDPR Portal, “GDPR: Key Changes” (accessed February 7, 2017).

¹⁰³⁸ UK Information Commissioner's Office, “Consultation: GDPR Consent Guidance,” March 2, 2017; Ustaran, “Keeping Up With EU Privacy,” IAPP European Data Protection Intensive Conference, March 15–16, 2017.

¹⁰³⁹ Wood, “Opening General Session,” IAPP European Data Protection Intensive Conference, March 15–16, 2017.

In another major change from the EU Data Protection Directive, the GDPR extends EU's legal jurisdiction to companies that process the personal data of EU data subjects, regardless of the physical location of the company.¹⁰⁴⁰ The GDPR also applies to non-EU-based companies (including controllers¹⁰⁴¹ and processors¹⁰⁴²) that process personal data of EU data subjects related to offering goods or services in the EU (regardless of whether payment is required) and to monitoring behavior that takes place within the EU.¹⁰⁴³ Other specific changes to the EU Data Protection Directive that are addressed in the GDPR are discussed below. They include (1) procedures for notifying authorities, and often users, about data breaches; (2) provisions supporting the right of data subjects residing in the EU to access their personal information; (3) provisions supporting EU data subjects' "right to be forgotten"; and (4) stronger penalties and stricter enforcement than the EU Data Protection Directive.¹⁰⁴⁴

Breach Notification Procedures. Unlike the EU Data Protection Directive, the new GDPR imposes stringent obligations on data processors and controllers. The new regulation states that when a breach of security occurs, this breach should be reported to the supervisory authority within 72 hours. Moreover, it states that if the security breach is likely to result in a high privacy risk for individuals, then these individuals should also be informed of the breach.¹⁰⁴⁵ Both U.S. and multinational businesses have expressed concerns about being able to meet the 72-hour breach notification rule under the GDPR, since they are not always immediately aware of such a breach or of the extent to which the breach has infiltrated their systems.¹⁰⁴⁶

Rights to Access. The EU GDPR gives data subjects residing within the EU the right to access their personal information from the data controller. This is a dramatic shift in data privacy regulation, empowering the data subjects and providing more transparency on data collected about them. The GDPR states that data subjects have the right to inquire whether their

¹⁰⁴⁰ Furthermore, in instances where the data controller or processor is not established in the EU, the GDPR will also apply to processing of personal data if the activity relates to offering goods or services to EU data subjects (even if no payment is required for these goods or services) and if there is monitoring of behavior within the EU. GDPR Portal, "GDPR: Key Changes" (accessed February 7, 2017).

¹⁰⁴¹ According to Article 4(7) of the GDPR (EU Regulation 2016/679), a controller is defined as "natural or legal person, public authority, agency or any other body which alone or jointly with others determines the purposes and means of the processing of personal data; where the purposes and means of processing are determined by EU or Member State laws, the controller (or the criteria for nominating the controller) may be designated by those laws."

¹⁰⁴² Article 4(8) of the GDPR (Regulation 2016/679) defines a processor as "natural or legal person, public authority, agency or any other body which processes personal data on behalf of the controller."

¹⁰⁴³ GDPR Portal, "GDPR: Key Changes" (accessed February 7, 2017).

¹⁰⁴⁴ The full text of the GDPR is available at http://ec.europa.eu/justice/data-protection/reform/files/regulation_oj_en.pdf.

¹⁰⁴⁵ Aafjes, "The General Data Protection Legislation" (accessed February 14, 2017).

¹⁰⁴⁶ Simpson, "Understanding the Impact of the GDPR," IAPP European Data Protection Intensive Conference, March 15–16, 2017.

personal data is being processed, where it was processed, and for what purpose. The data controller must provide data subjects a copy of their personal data that is undergoing processing.¹⁰⁴⁷

Right to be Forgotten. The new GDPR also adopts and extends data subjects' "right to be forgotten" (data erasure), a legal concept created by a European Court of Justice (CJEU) ruling in 2014.¹⁰⁴⁸ In its ruling, the CJEU required search engines to honor requests from individual users to remove links to personal, inaccurate, or outdated information.¹⁰⁴⁹ The GDPR extended the ruling to enable data subjects to have a data controller entirely erase data concerning them. However, exceptions to the GDPR allow data controllers to retain data for historical, statistical, scientific, and public health purposes, to exercise their right to freedom of expression, or where required by law or to fulfill a contract.¹⁰⁵⁰

Penalties and Enforcement. The GDPR also prescribes penalties for companies that do not comply with the provisions of the regulation, using a tiered approach to imposing penalties. Under GDPR, companies could face massive fines in 25 EU countries if they mishandle customers' personal information. Beginning in 2018, data protection authorities will be able to impose fines of up to 4 percent of a company's worldwide revenue or 20 million euros (\$22 million), whichever is greater, for the most serious infringements, such as not having sufficient customer consent to process data.¹⁰⁵¹ Both data controllers and data processors (including cloud service providers¹⁰⁵²) would also be subject to these enforcement penalties.¹⁰⁵³ An industry representative stated that U.S. and multinational businesses are concerned about the GDPR's severe monetary penalties.¹⁰⁵⁴

According to the U.S. Chamber of Commerce, consistent implementation of GDPR represents an "immense regulatory burden" that affects U.S. businesses operating in the EU, as well as broader EU competitiveness in the digital economy.¹⁰⁵⁵ Small businesses in particular have

¹⁰⁴⁷ Simpson, "Understanding the Impact of the GDPR," IAPP European Data Protection Intensive Conference, March 15–16, 2017.

¹⁰⁴⁸ Sayer, "EU Gives Companies Two Years to Comply," April 14, 2016.

¹⁰⁴⁹ McKinsey Global Institute, "Digital Globalization," March 2016, 101.

¹⁰⁵⁰ Sayer, "EU Gives Companies Two Years to Comply," April 14, 2016.

¹⁰⁵¹ Ibid.

¹⁰⁵² IAPP states that cloud service providers are considered processors under GDPR, while equipment manufacturers, vendors, and lessors are not considered processors. Hon, "GDPR: Killing Cloud Quickly?" March 17, 2016.

¹⁰⁵³ GDPR Portal, "GDPR: Key Changes" (accessed February 7, 2017).

¹⁰⁵⁴ Ustaran, "Keeping Up With EU Privacy," IAPP European Data Protection Intensive Conference, March 15–16, 2017.

¹⁰⁵⁵ USITC, hearing transcript, April 4, 2017, 257–58 (testimony of Sean Heather, U.S. Chamber of Commerce).

expressed concern about the high administrative costs associated with GDPR compliance.¹⁰⁵⁶ Such costs are likely to include conducting privacy impact assessments, hiring legal and compliance professionals to implement GDPR, notifying customers after a breach has occurred (regardless of whether the breach is considered “high risk” or “low risk”), paying for public relations and crisis management services after a breach, instituting a call center for customers who have been subjected to a breach, and fraud monitoring services.¹⁰⁵⁷

Privacy Shield and Model Contractual Clauses

Due to differences in data privacy approaches, the EU and the United States negotiated the Safe Harbor Agreement of 2000, which allowed U.S. companies to adequately meet the EU’s already strict data protection requirements and permitted the legal transfer of personal data between the two trading partners. However, unauthorized disclosures about the United States’ National Security Agency surveillance programs led to concerns in the EU about how U.S. technology firms were assisting U.S. government in using personal data for government ends.¹⁰⁵⁸ In October 2015, the CJEU invalidated the Safe Harbor Agreement in *Schrems v. Facebook* on the grounds that it failed to meet EU protection data standards, and cited the U.S. surveillance programs in its legal opinion.¹⁰⁵⁹ According to the Congressional Research Service, at the time of the ruling 4,500 U.S. companies were using the Safe Harbor Agreement to transfer data across borders, and the ruling left them uncertain as to how their digital trade with the EU would be affected.¹⁰⁶⁰

As a result of the CJEU decision, a new EU-United States agreement known as Privacy Shield was concluded in February 2016. Under Privacy Shield, U.S. companies wanting to import personal data from Europe must commit to certain obligations to ensure that data subjects’ rights are guaranteed. Privacy Shield also has a stronger enforcement mechanism than Safe Harbor. The U.S. Department of Commerce will monitor compliance, and U.S. companies that fail to comply with the terms of Privacy Shield will lose their ability to use the program.¹⁰⁶¹ Privacy Shield was immediately challenged before the CJEU by two EU-based privacy activist groups, Digital Rights Ireland and La Quadrature du Net, on the grounds that U.S. law enforcement and national security practices lack sufficient privacy safeguards.¹⁰⁶² However,

¹⁰⁵⁶ Simpson, “Understanding the Impact of the GDPR,” IAPP European Data Protection Intensive Conference, March 15–16, 2017; UK industry representatives, telephone interview by USITC staff, March 29, 2017.

¹⁰⁵⁷ Simpson, “Understanding the Impact of the GDPR,” IAPP European Data Protection Intensive Conference, March 15–16, 2017.

¹⁰⁵⁸ CRS, “U.S.-E.U. Data Privacy,” May 19, 2016, 1.

¹⁰⁵⁹ Electronic Privacy Information Center, “*Schrems v. Data Protection Commissioner*” (accessed April 21, 2017); CRS, “U.S.-E.U. Data Privacy,” May 19, 2016, 1.

¹⁰⁶⁰ CRS, “U.S.-E.U. Data Privacy,” May 19, 2016, 1.

¹⁰⁶¹ *Ibid.*

¹⁰⁶² BSA | The Software Alliance, written submission to USTR’s Special 301 Report, February 9, 2017.

one UK government representative stated that the EU expects Privacy Shield to be upheld by EU courts because the agreement addresses deficiencies cited by the CJEU in the repeal of the Safe Harbor Agreement. U.S. and EU industry representatives have stated that about 1,800 U.S. companies are using Privacy Shield to comply with data privacy rules in the EU, and that roughly half of these businesses are small and medium-sized enterprises (SMEs).¹⁰⁶³

In some instances, since the repeal of the Safe Harbor Agreement businesses have reverted to using model contract clauses¹⁰⁶⁴ between U.S. and EU businesses, partly due to concerns on the part of some U.S. businesses that Privacy Shield will also be repealed.¹⁰⁶⁵ However, the legality of such contract clauses has been challenged by Ireland’s Data Protection Authority, and an eventual judgment from the CJEU is expected.¹⁰⁶⁶

Proposed ePrivacy Regulation

In January 2017, the EU proposed changes to its existing ePrivacy Directive that would apply to any company processing data in connection with communications services, including over-the-top (OTT) services¹⁰⁶⁷ and machine-to-machine communications used in the Internet of Things (IoT);¹⁰⁶⁸ the current ePrivacy Directive only applies to telecommunications providers.¹⁰⁶⁹ The new ePrivacy Regulation will contain more specific privacy rules related to direct marketing, use

¹⁰⁶³ Fennessey, “Privacy Shield in Practice.” IAPP European Data Protection Intensive Conference, March 15–16, 2017; CRS, “U.S.-E.U. Data Privacy,” May 19, 2016, 14.

¹⁰⁶⁴ There are three different mechanisms that businesses can use to transfer data from the United States to the EU: Privacy Shield, model contract clauses (also known as “standard contractual clauses”), and binding corporate rules. Model contract clauses can be used in instances where a contract between an EU and a U.S. company fully reflects requirements of the Standard Contractual Clauses adopted by the EU for data transfers to controllers or processors. For the purposes of the EU, the contract will be presumed to contain adequate safeguards and will be in compliance with EU law. EC, “A Guide to the U.S.-EU Privacy Shield,” 2016; EC, “The EU-U.S. Privacy Shield Framework Principles” (accessed April 29, 2017); Bloomberg Law, Privacy, and Data Security, “The EU-U.S. Privacy Shield versus Other,” September 12, 2016.

¹⁰⁶⁵ Fennessey, “Privacy Shield in Practice,” IAPP European Data Protection Intensive Conference, March 15–16, 2017; U.S. industry representatives, interviews by USITC staff, Washington DC, March 7 and March 20, 2017.

¹⁰⁶⁶ In May 2016, the Irish Data Protection Authority confirmed that it will ask the CJEU whether personal data transfers from the EU to the United States under the model contract clauses’ mechanisms provides adequate protections for EU nationals against U.S. government surveillance. This was very similar to the issue raised in the CJEU decision when it invalidated the Safe Harbor Agreement. Other Data Protection Authorities in the EU have also stated concerns about model contract clauses, including Germany. Munz et al., “New Threats to Transatlantic Data Flows,” June 16, 2016.

¹⁰⁶⁷ OTT Services are a term typically used for Internet communication services and apps.

¹⁰⁶⁸ See chapter 6 for discussion of the Internet of Things.

¹⁰⁶⁹ European Commission, “Digital Single Market: Proposal” January 19, 2017; IAPP, “European Commission Proposes,” January 10, 2017.

of cookies,¹⁰⁷⁰ and online tracking or monitoring.¹⁰⁷¹ The new regulation has significant effects beyond the EU, affecting non-EU providers of electronic services (whether free or paid) to EU nationals. As a result of the proposed ePrivacy Regulation, websites will have to respect the e-privacy rights of EU-based visitors, even if these websites are not based in the EU.¹⁰⁷² Penalties under the regulation are severe. Infringements involving cookie information, consent rules, privacy-by-design obligations, respecting opt-in rules¹⁰⁷³ and provisions on publicly available directories may result in administrative fines of 10 million euros (\$11 million) or 2 percent of a company's worldwide annual turnover (whichever is higher). In instances where there is infringement of the confidentiality of communications, unlawful processing of electronic communications data, or noncompliance with time limits for erasing data, the penalties will be 20 million (\$22 million) euros or 4 percent of a company's total worldwide annual turnover.¹⁰⁷⁴

BSA | The Software Alliance has noted that the new ePrivacy Regulation contains many onerous requirements for businesses, including “confidentiality requirements that would restrict commercial uses of metadata (such as traffic data) and content data without user consent; stricter, express consent requirements, including for the use of cookies for profiling and data analysis; and creating a foreseeable conflict of law regarding the obligations to respond to data requests from EU governments.”¹⁰⁷⁵ Industry experts have stated that OTT communication service providers will incur additional costs to adapt their services to the new ePrivacy Regulation, while communication providers and web browsers will incur costs for designing new privacy settings and updating their software to obtain users' consent for third-party cookies.¹⁰⁷⁶

Box E.1: The Potential Impacts of Brexit on the EU’s Data Protection and Privacy Regime

EU Digital Single Market: The United Kingdom (UK) generates 4 percent of the world’s GDP and accounts for 12 percent of EU digital cross-border trade flows. UK government representatives stated that it is difficult to assess whether the UK will stay in the EU Digital Market platform due to Brexit, although some in the EU Commission criticized the idea of the UK remaining in the platform. A report by techUK, the UK’s largest technology trade association, states that after Brexit, some UK-based businesses will have to relocate significant business functions to the EU, most likely to Brussels, to continue to benefit from single market access.

¹⁰⁷⁰ A piece of data sent from a website and stored on the user’s computer. The common purpose is to store login or password information (for instance a cookie is sent to a computer when a user clicks “remember this computer”).

¹⁰⁷¹ Todd, “The New ePrivacy Regulation,” April 18, 2017.

¹⁰⁷² Frontier Privacy, “Data Regulation: How ePrivacy Regulation Changes,” February 2, 2017.

¹⁰⁷³ Rules where a user actively decides to do something.

¹⁰⁷⁴ Todd, “The New ePrivacy Regulation,” April 18, 2017.

¹⁰⁷⁵ BSA | The Software Alliance, written submission to the USITC, April 21, 2017, 12.

¹⁰⁷⁶ Ulessi, “EU: Draft ePrivacy Regulation,” January 12, 2017.

GDPR: UK government and industry representatives stated that the UK will likely be a part of the GDPR after Brexit. Of 1,200 UK-based companies surveyed, 94 percent are already preparing for GDPR. For example, Google UK stated that the company is preparing for GDPR compliance by conducting privacy assessments, despite having its own internal global privacy program that adheres to a higher level of compliance and user controls. Some UK industry representatives have voiced concerns that Brexit will reduce British firms' adherence to global data protection and privacy standards.

Privacy Shield: Industry experts have stated that there are several possibilities for the status of the Privacy Shield in the UK post-Brexit. If the UK remains part of the European Economic Area, then UK organizations could transfer data to U.S. organizations under the Privacy Shield. Alternatively, if the UK exits the EU completely, an alternative arrangement could be developed, such as a new bilateral Privacy Shield between the United States and the UK, similar to the new Swiss-EU Privacy Shield currently in development.

Sources: techUK, "techUK Priorities for European Exit Negotiations," January 24, 2017; Brans, "Privacy Shield Post-Brexit," September 7, 2016; Frontier Economics, "UK Digital Sectors after Brexit," January 24, 2017; IAPP European Data Protection Intensive Conference, March 15–16, 2017; UK industry representatives, telephone interview by USITC staff, March 29, 2017; UK government representatives, interview by USITC staff, London, March 17, 2017.

India

As of 2017, India does not have comprehensive legislation addressing data protection and privacy. Instead, data privacy is governed by a series of patchwork laws and regulations. The Information Technology Act of 2000 is the overarching law that protects electronic data, including information that is intended to be processed electronically. In 2011, India adopted the Information Technology Rules (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information Rules), also known as the "Privacy Rules." The Privacy Rules require corporate entities that collect, process, and store personal data, including sensitive personal information, to comply with certain procedures.¹⁰⁷⁷

India is in the process of developing a more comprehensive approach to data protection and privacy through the Right to Privacy Bill, which was unveiled in 2011 but has not been passed. India's Privacy Bill maintains that the right to privacy is covered under Article 21 of India's Constitution,¹⁰⁷⁸ and that no person or entity can disclose sensitive personal data without the prior consent of the person whose data is collected. The Privacy Bill also seeks to establish a Data Protection Authority, which will investigate any data security breaches and issue orders to safeguard the data of its citizens. The Right to Privacy Bill also provides guidance for data controllers, who would be responsible for confidentiality while dealing with personal data.¹⁰⁷⁹

¹⁰⁷⁷ DLA Piper, Data Protection Laws of the World database (accessed February 6, 2017).

¹⁰⁷⁸ Article 21 of India's Constitution does not specifically guarantee a right to privacy; however, the Indian courts have interpreted Article 21 to give Indian citizens a limited right to privacy, through Article 21's right to life and liberty. Privacy International, "The Right to Privacy in India," October 2016.

¹⁰⁷⁹ Data Privacy Asia, "Privacy and Data Protection Laws in India," July 24, 2016.

India has a strong global reputation in the IT outsourcing sector. This sector has continued to grow in recent years, as more U.S.- and EU-based companies have established outsourcing operations in India. After the implementation of the Privacy Rules in 2011, India's Ministry of Communications and Information issued a clarification in August 2011, which allows exemptions to the Privacy Rules for companies working as outsource providers. These companies are not subject to the requirements for consent, collection, and disclosure of information. In order for this exemption to apply, these companies cannot have direct contact with the data subjects. This provision applies regardless of whether the service is provided for a company located within or outside India. Although the absence of strong data privacy measures has been an impediment to U.S. companies outsourcing their services to India, some Indian companies have taken it upon themselves to enforce strict privacy requirements.¹⁰⁸⁰

Indonesia

Indonesia's legal approach to data protection and privacy is currently mostly limited to certain sectors, such as telecommunications, public entities, and financial services (table E.1).¹⁰⁸¹

Indonesia does have two general measures that govern data protection and privacy: Law No. 11 of 2008 regarding Information and Electronic Transactions (the IET Law) and Government Regulation No. 82 of 2012 (Regulation 82).¹⁰⁸² Both of these measures state that providers must ensure that personal data are protected and used only for the purpose that was communicated to its data subjects.¹⁰⁸³ Regulation 82 does not clarify the scope of the data that it protects, a question that is instead addressed through laws applying to domestic sectors. Indonesia has plans to propose a comprehensive framework on data protection and privacy through its new Bill on the Protection of Private Personal Data that is anticipated to be passed in 2017. Indonesia's new draft bill makes a distinction between "personal data" and "sensitive personal data," and also contains stricter requirements for notifying users of breaches.¹⁰⁸⁴

¹⁰⁸⁰ CRID, "First Analysis of Data Law," 2005, 45.

¹⁰⁸¹ DLA Piper, Data Protection Laws of the World database (accessed February 6, 2017).

¹⁰⁸² Wulansari and Socarana, "Data Protection in Indonesia," September 1, 2016.

¹⁰⁸³ BSA | The Software Alliance, *2016 BSA Global Cloud Computing Scorecard*, 2016; Herbert Smith Freehills, "Indonesia Readies First Omnibus Data Protection Law," February 2016.

¹⁰⁸⁴ Personal data is defined as any data collected by an individual who can be directly or indirectly identified through electronic and nonelectronic systems. Sensitive personal data is defined as personal data requiring special protection such as an individual's religion, health (physical and mental status), and financial information, among others. Herbert Smith Freehills, "Indonesia Readies First Omnibus Data Protection Law," February 2016.

Table E.1: Selected examples of Indonesia’s data protection and privacy measures by sector

Sector	Law	Regulations
Telecommunications	Article 40 of Law No. 36 of 1999 (“Telecommunications Law”)	Prohibits any person from using any method to tap information transmitted through any type of telecommunications network.
Telecommunications	Article 42 of Law No. 36 of 1999 (“Telecommunications Law”)	Requires telecommunications service operators to keep confidential any information transmitted or received by telecom subscribers through telecommunications networks and/or telecommunications services provided by the operator.
Financial Services	Article 31 of Financial Services Authority Regulation No. 1/POJK.07/2013	Prohibits financial service providers from disclosing customer data to third parties, except with the written consent of the customer or as required by lawful authority.
Public information	Article 6 of Law No. 14 of 2008 regarding Disclosure of Public Information	Provides that information relating to personal rights may not be disclosed by public bodies.
Public information	Article 17 of Law No. 14 of 2008 regarding Disclosure of Public Information	Prohibits the disclosure of private information of any person, particularly that which concerns family history, medical and psychological history, financial information, and education records.

Sources: DLA Piper, Data Protection Laws of the World database (accessed February 6, 2017); Emmerson and Yuriutomo, “Data Protection in Indonesia,” February 8, 2017.

Russia

Russia has a comprehensive approach to data protection and privacy that is codified in Russia’s Data Protection Act No. 152, implemented in July 2006. Other measures include Chapter 14 of the Russian Labor Code, which regulates the protection of employees’ personal data, and other Russian laws that contain data protection provisions related to specific areas of state services or industries.¹⁰⁸⁵

Overall government security issues and increased personal data leaks prompted Russia to further standardize its data protection and privacy measures by broadening the Data Protection Act in September 2015. Amendments to the act require that all personal data operators store and process the personal data of Russian individuals in databases located in Russia, subject to few exceptions. The new amendment clarifies that all personal information provided by Russian citizens when registering on websites, making online purchases, or sending electronic messages

¹⁰⁸⁵ Baker McKenzie, *Global Privacy Handbook*, March 2017.

is considered personal data and must be stored inside Russia.¹⁰⁸⁶ The penalty for violating this requirement is, ultimately, the blocking of websites handling any Russian personal data unlawfully.¹⁰⁸⁷

In the first major enforcement action since Russia's data privacy law entered into force, a Russian federal court found that U.S.-based LinkedIn violated Russian data protection law for failing to store data about Russians on servers located in Russian territory, and for processing information about Russian individuals who are not registered on the LinkedIn website and who have not signed the company's user agreement. It should be noted that LinkedIn does not have a physical presence in Russia and only operates a Russian-language version of its website, yet this was enough for Russian courts to apply jurisdiction to the company's operations. On November 17, 2016, Roskomnadzor (Russia's government communications regulator) officially blocked Russians' access to LinkedIn.¹⁰⁸⁸

The new legislation has reportedly discouraged foreign companies from entering the Russian market. For example, the Swedish-based music streaming company, Spotify, canceled its plans to launch the service in Russia because of the new personal data storage law. At the same time, Russia already has 2.6 million IT companies within its borders, consisting of both local and multinational companies that process personal data in the country. These companies will most likely remain in the Russian market, despite the financial and organizational challenges imposed by the new data privacy laws.¹⁰⁸⁹

¹⁰⁸⁶ Kozlov, "Russian Personal Data Law Set," August 2015; DLA Piper, Data Protection Laws of the World database (accessed February 6, 2017).

¹⁰⁸⁷ Reportedly, however, the storing and processing of Russian individuals' personal data outside of Russia can still be compliant with the law as long as initial storage and processing of the data is done in Russia. DLA Piper, Data Protection Laws of the World database (accessed February 6, 2017).

¹⁰⁸⁸ Kozlov, "Russian Personal Data Law Set," August 2015; Hunton and Williams, "Russia Set to Block Access to LinkedIn," November 15, 2016.

¹⁰⁸⁹ Kozlov, "Russian Personal Data Law Set," August 2015.

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Appendix F

Regulatory Developments Related to Digital Piracy

Digital Piracy

This appendix provides information on the latest regulatory developments aimed at strengthening intellectual property rights (IPRs) and efforts to combat digital piracy in key markets (these are Brazil, China, EU, India, Indonesia, and Russia). Industry representatives and other observers contend that digital piracy is a significant trade barrier for content industries, leading to lost profits for U.S. businesses. Digital piracy can result in some instances from the lack of clear regulatory measures protecting IPR; in others, from the lack of enforcement of those measures. In either case it leads to higher rates of illegal downloading, streaming, and broadcasting of content. As broadband penetration rates have risen in many key markets, digital piracy has also increased. In response, many governments have adopted stronger regulations to protect IPRs and have worked to combat digital piracy by shutting down offending websites.

This appendix does not include the European Union (EU) because it has lower digital piracy rates than other key markets. This distinction is attributed to its strong IPR measures and record of enforcement.

Brazil

Brazil does not have clear measures that target enforcement of IPRs in digital content, leading to widespread digital piracy and copyright infringement in digital films, music, software, and games. Brazil has not signed the World Intellectual Property Organization (WIPO) Copyright Treaty; attempts to reform Brazil's copyright legislation stalled in 2014, and have not restarted.¹⁰⁹⁰ A private/public body within Brazil's Ministry of Justice, the National Council to Combat Piracy and Intellectual Property Crimes, is responsible for enforcing IPRs in digital media, but has limited resources to enforce copyright protection.¹⁰⁹¹ Although criminal sanctions are technically available for copyright infringements, digital piracy is rarely prosecuted.¹⁰⁹² Brazil's federal authorities have been more proactive in shutting down websites that pirate movies in recent years—for example, it took down three piracy websites in 2016. Nonetheless, one industry group noted that more needs to be done to combat online piracy, especially with respect to stream-ripping services, which are a "particular threat to digital music services."¹⁰⁹³

¹⁰⁹⁰ BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

¹⁰⁹¹ IIPA, written submission to USITC, March 2017.

¹⁰⁹² BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

¹⁰⁹³ IIPA, written submission to USITC, March 22, 2017; USTR, *2015 Out of Cycle Notorious Markets Report*, December 2015.

Several recent expert reports attest to the widespread and harmful nature of Brazilian digital piracy. The U.S. Trade Representative (USTR) placed Brazil on its Watch List in 2016 and on its Notorious Markets Report in 2015, citing Brazil's inadequate protection of digital content. Another industry group placed Brazil at the bottom of its Global Cloud Computing Scorecard, based on Brazil's poor ratings on a worldwide survey of IPR protections.¹⁰⁹⁴ An industry report by Tru Optik, a U.S.-based digital media intelligence company, claimed that Brazil's overall piracy of online content cost rights holders almost \$100 billion in 2014, a figure higher than those of either the United States or India (both of which have larger populations, larger gross domestic products, and higher Internet penetration rates than Brazil).¹⁰⁹⁵ BSA | The Software Alliance estimates that 47 percent of the software used in Brazil is unlicensed, representing a commercial value of \$1.7 billion (a figure much higher than in any other Latin American country).¹⁰⁹⁶

China

Historically, China has not stringently enforced measures against piracy of digital content. This is true despite a domestic law that makes it illegal to broadcast unauthorized digital content: Article 47(1) of China's Copyright Law prohibits the reproduction and broadcast of content to the public through an information network without the copyright owner's authorization.¹⁰⁹⁷ This law imposes both civil and criminal penalties on digital content infringement. Despite a recent initiative by China to enforce its copyright law, China continued to appear on USTR's Priority Watch List in 2016 due to concerns about IPR protection and enforcement.¹⁰⁹⁸

Recently, China's federal and provincial governments have stepped up enforcement actions to curtail the distribution of pirated digital media. In 2014, a provincial regulatory authority in China's Shenzhen province issued a \$42 million fine against Shenzhen QVOD Technology for allowing pirated movies and television shows to be distributed through Kuaibo, its peer-to-peer file sharing network.¹⁰⁹⁹ After the fine was issued, QVOD shut down its Kuaibo website and changed its business model to support only licensed video content.¹¹⁰⁰ In July 2016, China's State Copyright Administration launched Jian Wang 2016, a program designed to restrict intellectual property (IP) infringement in digital film, TV, literature and news. The Chinese government stated that its Jian Wang program has resulted in the closure of 290 copyright-infringing websites, and it has prosecuted a number of entities that have illegally downloaded

¹⁰⁹⁴ USTR, "2016 Special 301 Report," April 2016; BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

¹⁰⁹⁵ TechinBrazil, "Piracy of Digital Content in Brazil," February 26, 2015.

¹⁰⁹⁶ BSA, written submission to USTR's 2017 Special 301 Report, February 9, 2017.

¹⁰⁹⁷ BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

¹⁰⁹⁸ USTR, *2016 Special 301 Report*, 2016, 29.

¹⁰⁹⁹ Ma, *China's Mobile Economy, 2017*; Kan, "Top Online Pirated Video Provider in China," June 17, 2014.

¹¹⁰⁰ Kan, "Top Online Pirated Video Provider in China," June 17, 2014.

material, with 33 court cases pending as of December 2016.¹¹⁰¹ Other actions by the Chinese federal authorities include banning illegal streaming of content through third-party apps and set-top boxes, and combating the unauthorized camcording of movies.¹¹⁰²

A representative of the International Intellectual Property Alliance (IIPA) has stated that China's crackdown was targeted towards websites that broadcast music illegally, noting that China's efforts created a "helpful environment to increase licensed content in [China] for the music industry." However, the representative contended that there are "many other areas where [China] has not shown the same willingness to enforce against content theft."¹¹⁰³ According to USTR, China's increased enforcement activities against online piracy have helped to decrease the distribution of illegal content; however, USTR states that more action is needed to make a difference for content creators and rights holders, specifically for small- and medium-sized enterprises.¹¹⁰⁴ U.S. industry representatives stated that there has been positive feedback from U.S. businesses regarding the use of recently established IP courts in China, although it is too early to tell if the courts will be effective in the long term.¹¹⁰⁵

According to one industry representative, China's tolerance for digital piracy has affected digital content industries by keeping revenues far below their potential.¹¹⁰⁶ China was included in USTR's 2015 Notorious Markets Report, in part for the sale of physical counterfeits through websites such as Alibaba and Taobao.com, and in part for sales of pirated e-books, magazines, and other digital media through Ebookee.org.¹¹⁰⁷ The Association of American Publishers (AAP) recently stated to the Commission that it had pursued a website called KJ Med that pirated published material for a decade, but the Chinese government failed to prosecute the entity. The association contends that the online piracy situation in China "continues to grow worse" due to a lack of deterrence. It states that services similar to KJ Med have emerged that continue the same infringing practices to the detriment of U.S. publishers, who are unable to receive licensing revenue or compensation for the use of the pirated articles.¹¹⁰⁸

¹¹⁰¹ Acharya, "China Closes Down 290 Websites," December 25, 2016.

¹¹⁰² IIPA, written submission to the USITC, March 22, 2017; Abrams, "China Cracks Down on Set-Top Box Market," November 18, 2015.

¹¹⁰³ USITC, hearing transcript, April 4, 2017, 126–27 (testimony of Kevin Rosenbaum, International Intellectual Property Alliance).

¹¹⁰⁴ USTR, "2017 National Trade Estimate Report on Foreign Trade Barriers," 2017, 79.

¹¹⁰⁵ Industry representative, interview by USITC staff, Washington, DC, March 7, 2017.

¹¹⁰⁶ USITC, hearing transcript, April 4, 2017, 30 (testimony of Kevin Rosenbaum, International Intellectual Property Alliance).

¹¹⁰⁷ USTR, *2015 Out of Cycle Review of Notorious Markets*, December 2015, 7, 13.

¹¹⁰⁸ Association of American Publishers, written submission to the USITC, April 18, 2017.

India

Amendments to India's Copyright Act of 2012 contain provisions that make unauthorized reproductions and broadcast of digital content illegal.¹¹⁰⁹ These amendments were passed to curb digital piracy and facilitate India's accession to the WIPO Copyright Treaty. Section 65A of the amendments outlines the technological protection measures used by copyright holders to protect their work from piracy; any person circumventing these measures faces imprisonment for up to two years, as well as possible fines. Section 65B also imposes criminal penalties on a person who removes rights management information and who distributes or broadcasts digital content to the public without authorization from the copyright holder.¹¹¹⁰ India also provides for civil remedies for digital piracy through injunctions, damages, or other means.¹¹¹¹

Although BSA notes that India has adequate domestic copyright measures, it adds that enforcement of these measures is weak, resulting in widespread digital piracy of movies, TV shows, and unlicensed software.¹¹¹² USTR has placed India on its Priority Watch List, and notes in its 2016 Special 301 Report that losses from piracy of music and movies in India total about \$4 billion per year, with the commercial value of unlicensed software estimated at about \$3 billion.¹¹¹³ BSA claims that 58 percent of the software in use in India is unlicensed, and has ranked India near the bottom of BSA's Global Cloud Computing Scorecard for its inadequate protection of IPR.¹¹¹⁴ Legitimate online platforms like Netflix and iTunes exist in India, but the IIPA states that "torrent" sites—websites that host peer-to-peer file sharing such as torrentz2.eu, extratorrent.cc, extra.to, yts.ag, rarbg.to, torrentproject.se and thepiratebay.org—were viewed 59 million times in one month for access to film and TV content.¹¹¹⁵ IIPA also asserts that India's weak IPR legal and enforcement regime allows content to be pirated through video streaming sites, mobile downloading on memory cards and mobile apps, and stream-ripping services—the latter is a major problem in India. Camcording of films is pervasive as well. Music is also heavily pirated in India; USTR's Notorious Market Report notes that MP3VA.com, an illegal downloading website for music based in Russia and the Ukraine, is popular in India.¹¹¹⁶

¹¹⁰⁹ BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

¹¹¹⁰ Singh, "Online Piracy in India," July 29, 2016.

¹¹¹¹ BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

¹¹¹² BSA, written submission to USTR's 2017 Special 301 Report, February 9, 2017.

¹¹¹³ USTR, "2016 Special 301 Report," April 2016, 40.

¹¹¹⁴ BSA, written submission to USTR's Special 301 Report, February 10, 2017.

¹¹¹⁵ IIPA, written submission to USTR's 2017 Special 301 Report, February 9, 2017.

¹¹¹⁶ USTR, *2016 Out-of-Cycle Notorious Markets Report*, December 2016.

India has been trying to tackle various forms of digital piracy through legislation and specific law enforcement efforts. To combat film piracy, an anti-camcording bill was circulated among Indian Parliament members in early 2016 and is expected to be passed.¹¹¹⁷

Furthermore, the Indian government has been fighting against cable piracy through operator raids.¹¹¹⁸ In August 2016, the Indian government banned torrent sites and downloading or viewing a file from a host that has been banned in India; those guilty of viewing, downloading, or duplicating the illegal content could face three years in jail or a fine. For users that are trying to access such content, a warning pops up on the screen stating that the website has been blocked due to government instructions or a court order.¹¹¹⁹ IIPA recently stated that India's legal system is slow in giving relief to copyright holders, but that there has been some progress through John Doe (i.e., "cease and desist") court orders that allow copyright-infringing websites to be taken down more rapidly than through traditional court cases.¹¹²⁰

Indonesia

Indonesia has recently enacted regulatory measures to decrease online piracy of content. Indonesia is a member of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS agreement) and the WIPO Copyright Treaty, and has implemented many of the key provisions of the WIPO Copyright Treaty in its domestic legislation.¹¹²¹ Indonesia's Copyright Law, enacted in 2014, includes criminal sanctions and severe fines for organized commercial piracy.¹¹²² In July 2015, the Indonesian government implemented a law allowing a copyright holder to report websites that are infringing on IP rights. The law also includes procedures to block such websites.¹¹²³

IIPA has noted, however, that Indonesia's Copyright Law provides a broad exception under Article 43(d) that allows "making and disseminating copyright content through information and communication technology media that is non-commercial and/or non-profit in its effect on the author or related parties, or in which the author has expressed no objection to such making or disseminating."¹¹²⁴ IIPA argues that this provision violates the TRIPS Agreement and other

¹¹¹⁷ USDOC, ITA, "India: Protecting Intellectual Property," November 3, 2016.

¹¹¹⁸ U.S.-India Business Council, written submission to USTR's 2017 Special 301 report, February 9, 2017.

¹¹¹⁹ Anand, "You May Face up to 3 Years," August 22, 2016.

¹¹²⁰ IIPA, written submission to the USITC, March 22, 2017.

¹¹²¹ BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

¹¹²² Ibid.

¹¹²³ USDOC, ITA, "Indonesia's Protection of Property Rights," February 22, 2017.

¹¹²⁴ IIPA, written submission to the USITC, March 22, 2017.

international treaties protecting IPRs because copyright holders would lack the manner and means to authorize digital dissemination of their content.¹¹²⁵

Moreover, as Indonesia's broadband connection penetration has increased; online piracy has become rampant domestically.¹¹²⁶ Indonesia's piracy problem is targeted at both pirated physical goods, such as CDs, DVDs, and software, and illegal downloading and streaming of books, films, music, software, and video games. Legitimate providers of digital content such as Netflix, iFlix, and iTunes are beginning to penetrate the Indonesian market. However, piracy websites continue to harm such providers by inhibiting the growth of legal distribution of digital content.¹¹²⁷

Several reports attest to the pervasiveness of the problem. IIPA estimates that 90 percent of physical CDs, DVDs and software sold physically in Indonesia are pirated.¹¹²⁸ USTR's Notorious Markets Report notes that Harco Glodok (based in Jakarta) is Indonesia's largest trade center for electronics and related goods, and also serves as the retail distribution point for pirated products.¹¹²⁹ The Indonesian Association of Artists, Singers, Composers and Recording Businessmen (PAPPRI) estimates that pirated music costs the industry \$291 million annually.¹¹³⁰ BSA stated that the use of unlicensed software in Indonesia is very high, affecting the legitimate market and increasing security vulnerabilities and malware.¹¹³¹

In August 2015, an Indonesian government task force called the Creative Economy Agency launched an anti-piracy task force to work with law enforcement to eradicate digital piracy.¹¹³² In an effort to respond to piracy, the government blocked or closed 324 websites in response to complaints from the Indonesian Film Producers Association.¹¹³³ However, BSA states that the government has not imposed criminal sanctions for digital piracy, and IP property enforcement remains difficult.¹¹³⁴

Russia

In the last five years, Russia has enacted several laws aimed at combating digital piracy. In 2013, for example, Russia updated its copyright law through Federal Law No. 187, which gave Russian

¹¹²⁵ IIPA, written submission to the USITC, March 22, 2017.

¹¹²⁶ *Jakarta Globe*, "Now Playing" (accessed April 19, 2017).

¹¹²⁷ IIPA, written submission to the USITC, March 22, 2017.

¹¹²⁸ *Jakarta Globe*, "Now Playing" (accessed April 19, 2017).

¹¹²⁹ USTR, *2016 Out of Cycle Review of Notorious Markets*, December 2016.

¹¹³⁰ IIPA, written submission to USTR's 2016 Special 301 Report, February 5, 2016.

¹¹³¹ BSA, written submission to USTR's 2017 Special 301 Report, February 9, 2017, 20.

¹¹³² USDOC, ITA, "Indonesia's Protection of Property Rights," February 22, 2017.

¹¹³³ Yasmine, "Film Producers Association Launches Anti-Piracy Campaign," March 15, 2017.

¹¹³⁴ BSA, "2016 BSA Global Cloud Computing Scorecard," 2016.

authorities the power to tell Internet providers to cut off access to websites that pirate digital content relating to movies and TV shows. In 2014, Russia broadened the scope of the law to apply to websites that share links to pirated music, books, and software. Russia's updated laws stipulated that accused digital pirates would have 72 hours to respond to a complaint by a copyright holder before a permanent ban would be placed on the website. The law also stated that a court order would not be required for a website to be shut down by Russian authorities.¹¹³⁵

Although Russia has been attempting to address digital piracy through legislative measures, its enforcement of IP rights in cyberspace has not been highly effective.¹¹³⁶ After Russia imposed stronger legislative reforms for online digital piracy in 2014, Russian authorities blocked just 12 websites that infringed on copyrighted material that same year, although 175 websites were reported to Russian authorities as infringing on digital content.¹¹³⁷ In 2016, the Russian government blocked access to its most popular torrent website, ruTracker.org, but this website remains accessible within Russia through the anonymizing tools and other websites that circumvent the ban.¹¹³⁸ Industry experts claim that Russian Internet users can unblock banned content through special browser plugins, virtual private network services, or distributed networks such as TOR, I2P, and ONION. These experts claim that some banned websites advertise how to access their webpage using these mechanisms.¹¹³⁹ Moreover, digital content that is blocked on one website often appears on another site very quickly.¹¹⁴⁰ BSA claims that Russian law enforcement is reluctant to pursue copyright infringement crimes against large-scale entities that are using unlicensed software or engaging in digital piracy.¹¹⁴¹

USTR's 2017 National Trade Estimate Report notes that Russia's failure to allocate resources to enforcing measures against IP violations, including digital piracy, is a significant trade barrier for U.S. stakeholders.¹¹⁴² According to a press report, two-thirds of Russians admitted in an online poll to accessing file-sharing platforms, and more than half said films, music, and books should be available on the web for free.¹¹⁴³ A website based in Russia and Ukraine, MP3VA.org, was cited in USTR's Notorious Market Report for unauthorized sale of U.S. music, as was Libgen.io, an unauthorized Russia-based website which has millions of books and other publications

¹¹³⁵ BBC, "Russia Beefs Up Anti-piracy Laws," May 1, 2015; Kozlov, "Russia Enters Brave New World," April 30, 2015.

¹¹³⁶ Trademark and Brands Online, "Russia Shuts Down Popular Torrent Site," January 26, 2016.

¹¹³⁷ BBC, "Russia Beefs Up Anti-piracy Laws," May 1, 2015.

¹¹³⁸ Trademark and Brands Online, "Russia Shuts Down Popular Torrent Site," January 26, 2016; USTR, *2017 National Trade Estimate Report on Foreign Trade Barriers*, April 2017, 379.

¹¹³⁹ East West Digital News, "Russian Lawmakers Increase Pressure on Internet Providers," February 16, 2017.

¹¹⁴⁰ Shevchenko, "Is Russia Losing the Battle Online?" February 19, 2016.

¹¹⁴¹ BSA, written submission to USTR's 2017 Special 301 Report, February 9, 2017.

¹¹⁴² USTR, "2017 National Trade Estimate Report on Foreign Trade Barriers," April 2017, 379.

¹¹⁴³ Shevchenko, "Is Russia Losing the Battle Online?" February 19, 2016.

Appendix F: Regulatory Developments related to Digital Piracy

available for download.¹¹⁴⁴ According to the Association of American Publishers, publishers continue to face significant online piracy problems in Russia, especially on websites hosted by Russian residents. The association noted that Sci-hub.io (a Libgen.io-related website operated by a Russian resident) obtains unauthorized access to publisher databases through compromised login credentials issued by academic institutions to their students, faculty, and university personnel and makes this content available for free on content-hosting sites such as Libgen.io.¹¹⁴⁵

On a positive note, according to IIPA, the motion picture industry recently reported that the number of users in Russia accessing legal content has increased significantly in recent years.¹¹⁴⁶ Moreover, IIPA said that about 2,500 civil court claims involving copyright and related rights were filed in Russia in the first half of 2016, with 1,809 cases resolved by the Russian courts.¹¹⁴⁷

¹¹⁴⁴ USTR, “2016 Out of Cycle Review of Notorious Markets,” December 2016.

¹¹⁴⁵ Association of American Publishers, written testimony to the USITC, April 18, 2017.

¹¹⁴⁶ IIPA, written testimony to USITC, March 22, 2017.

¹¹⁴⁷ Ibid.

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Appendix G

Data Tables for Figures

Table G.1: Global data center traffic, 2011–16 (millions workloads^a)

Year	Traditional data center workloads	Cloud data center workloads
2011	49.8	21.3
2012	53.1	33.5
2013	58.3	49.7
2014	63.7	67.9
2015	44.9	136
2016	45.1	189.8

Source: Cisco, *Cisco Global Cloud Index*, 2016; Cisco, *Cisco Global Cloud Index*, 2012.

Note: This data corresponds to [fig. ES.1](#) and [fig. 3.2](#).

^a “A server workload is defined as a virtual or physical set of computer resources, including storage, that are assigned to run a specific application or provide computing services for one to many users. For the purposes of quantification, we consider each workload as being equal to a virtual machine or a container.” Cisco, *Cisco Global Cloud Index*, 2016, 8.

Table G.2: Digital content industry global market size, 2016 (billion \$)

Digital content industry	Market size (billion \$)
Video games	48.9
VoD	16.2
E-publishing	15.3
Digital music	9.1

Sources: Statista, “Digital Media,” 2016; IFPI, *Global Music Report*, 2016, 8–13.

Note: This data corresponds to [fig. ES.3](#).

Table G.3: Fixed and mobile broadband subscriptions per 100 people, 2010–16

Year	Mobile Broadband	Fixed broadband
2010	11.5	7.6
2011	16.7	8.4
2012	21.7	9.0
2013	27.3	9.9
2014	36.7	10.1
2015	44.2	11.2
2016	49.4	11.9

Source: Source: ITU, “ICT Facts and Figures 2016,” 2016.

Note: This data corresponds to [fig. 2.1](#).

Table G.4: Cloud data center workloads, 2015

Country	Share of total cloud data center workloads, 2015
North America	40.7
Asia-Pacific	27.2
Western Europe	19.7
Latin America	6.8
Rest of the world	5.6

Source: Cisco, *Cisco Global Cloud Index*, 2016.

Note: This data corresponds to [fig. 3.3](#).

Appendix G. Data Tables for Figures

Table G.5: Total cloud spending by country, 2015 (million \$)

	United States	EU	China	Brazil	India	Indonesia	Russia
2015	44105.9	14507.0	1275.8	969.5	391.9	74.1	317.1

Source: IDC, "IDC Version 4-Cloud Services,," March 2017.

Note: This data corresponds to [fig. 3.4](#).

Table G.6: Public cloud spending (SaaS, IaaS, and PaaS) per 100 people, 2012-16 (\$)

Year	China	India	Indonesia	Russia	Brazil
2012	30.8	11.9	7.6	88.3	16.6
2013	41.6	20.2	14.2	76.7	78.3
2014	69.5	27.5	19.6	128.7	146.4
2015	110.8	39.8	30.9	216.9	278.7
2016	167.3	50.0	41.0	270.0	407.1

Source: USITC staff calculations using data from IDC, "IDC Pivot Table, Q1 2015 Final," July 2015; and World Bank World Development Indicators (accessed April 4, 2017).

Note: This data corresponds to [fig. 3.5](#).

Table G.7: Global digital content revenues, by sector, 2016

Digital content industry	Market size (million \$)
Pay-per-view	3,211
Streaming	9,679
Downloads	3,273
Video on demand total	16,163
Downloads	3,551
Streaming	5,594
Digital music total	9,144
Download games	10,518
Mobile games	25,647
Online games	12,762
Video games total	50,521
e-Books	10,812
e-Magazines	1,449
e-Newspapers	3,013
e-Publishing total	15,274
Total	91,102

Source: Statista, "Digital Media," 2016.

Note: Totals may not add due to rounding. This data corresponds to [fig. 4.1](#).

Table G.8: Global streaming VoD revenue, by company, 2016

Company	Revenue, %
YouTube	16.0
Netflix	15.2
Facebook	7.2
Amazon Prime	3.6
Hulu	2.8
HBO Now	0.4
Other	54.8

Source: Arthofer et al., “The Future of Television,” 2016, 14–15.

Note: These company-level revenue totals will not match country-level estimates noted earlier, due to sources' differing accounting methodologies. This data corresponds to [fig. 4.3](#).

Table G.9: Global music revenue, by segment, 2015

Segment	Percentage
Physical	39
Digital-downloads	26
Download-streaming	19
Performance rights	14
Synchronisation	2

Source: IFPI, Global Music Report, 2016, 9, 15.

Note: Synchronization is the licensing of artistic material to other media outlets for royalty payments (e.g., using copyrighted music for a TV commercial or a video game). IBISWorld, “Global Music Production and Distribution,” January 2017, 12. This data corresponds to [fig. 4.4](#).

Table G.10: Global streaming music subscriptions, by company, December 2016

Company	Percentage
Spotify (Sweden)	44
Apple Music (U.S.)	21
Deezer (France)	7
Napster (U.S.)	5
Tidal (Sweden)	1
Other	22
Total global subscribers	100.4 million

Source: Mulligan, “Music Subscriptions Passed 100 Million in December,” January 6, 2017.

Note: This data corresponds to [fig. 4.5](#).

Appendix G. Data Tables for Figures

Table G.11: Top e-book companies, by U.S. revenue, 2016^a

Company	Percentage
Amazon (U.S.)	65
Apple (U.S.)	13
Barnes & Noble (U.S.)	9
Kobo (Japan/Canada)	5
Google (U.S.)	2
Other	7
Total revenue	\$3.9 billion

Source: McGinley, “Bookworms,” December 2016, 17.

Note: This data corresponds to [fig. 4.6](#).

^a Company-level revenue totals will not match country-level estimates noted earlier, due to differing accounting methodologies by the sources.

Table G.12: U.S. Business-to-business (B2B) e-commerce sales volume, 2013–17 (billion dollars)

Year	Sales volume (billion \$)
2013	559
2014	692
2015	780
2016	855
2017	928

Source: Statista, “Projected B2B E-commerce Volume in the United States from 2014 to 2020,” 2014 (accessed July 11, 2017, fee required) (Forrester data estimates); Hoar, “U.S. B2B E-commerce Sales,” October 18, 2012.

Note: This data corresponds to [fig. 5.1](#).

Table G.13: Number of noncash payments per person, 2011–15

Country	2011	2012	2013	2014	2015
Brazil	107.8993	116.6019	126.8613	133.1045	139.5629
China	6.273426	8.2941	11.42024	16.78671	26.10063
France	266.8956	273.7353	272.7411	285.6842	296.3252
Germany	220.9742	226.4285	242.9109	223.0877	240.4928
India	6.161229	6.77166	7.60876	8.787597	10.31776
Russia	31.96609	40.85776	56.21402	74.74569	95.2748
UK	281.3026	290.4821	307.5401	329.1234	354.9747
United States	365.3353	374.363	389.1613	402.3274	421.4013

Source: BIS, “Statistics on Payment, Clearing and Settlement Systems in the CPMI Countries—Figures for 2015,” country tables (table 7 for each country in the figure), December 2016; World Bank, World Development Indicators, “Population” (accessed April 12, 2017). Noncash payments include credit transfers, direct debits, checks, e-money, and payments by credit and debit card.

Note: This data correspond to [fig. 5.2](#).

Table G.14: Actively used fleet-management (FM) systems, million units, 2015

Country	Million units
North America	5.8
Latin America	2.3
Europe	5.3
Russia	1.9
China	2.1

Source: Berg Insight, *Fleet Management in the Americas*, July 2016, 2; Berg Insight, *Fleet Management in Europe*, August 2016, 2; Berg Insight, *Fleet Management in Russia/CIS and Eastern Europe*, March 2016, 2; Berg Insight, *Fleet Management in China* (Executive Summary), January 2015, 1.

Note: This data correspond to [fig. 6.2](#).

Table G.15: Worldwide robotics sales, by destination market, 2015

Country	Percent	Units
China	27	68,556
Europe	20	50,073
South Korea	15	38,285
Japan	14	35,023
United States	11	27,504
All others	14	34,559
Total		254,000

Source: International Federation of Robotics, (IFR), "World Robotics 2016," September 29, 2016.

Note: This data corresponds to [fig.6.3](#).

Table G.16: Worldwide sales of 3-D printers, by exporter, 2015

Country	Percent	Units
Israel	41.1	5,166
Europe	31.7	3,981
United States	16.7	2,097
China	4.3	534
Others	6.2	780
Brazil		3
Total		12,558

Source: Wohlers Associates, *Wohlers Report 2016: 3-D Printing*, 2016.

Note: This data corresponds to [fig. 6.4](#).

Table G.17: Increase in the number of data localization measures (1960–2015)

Year	Increase in data localization measures
1960	1
1961	2
1962	2
1963	2
1964	2
1965	2
1966	2
1967	2
1968	2
1969	2
1970	2
1971	2
1972	3
1973	3
1974	3
1975	3
1976	3
1977	3
1978	3
1979	3
1980	3
1981	3
1982	3
1983	3
1984	3
1985	3
1986	3
1987	3
1988	4
1989	6
1990	6
1991	6
1992	7
1993	8
1994	8
1995	10
1996	11
1997	12
1998	13
1999	14
2000	19
2001	21
2002	22
2003	23
2004	24
2005	27
2006	31
2007	32

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Year	Increase in data localization measures
2008	38
2009	39
2010	40
2011	45
2012	51
2013	64
2014	70
2015	79
2016	84

Source: ECIPE Digital Trade Estimates database.

Notes: The database includes data localization measures of 65 countries, worldwide. The graph does not include one measure for which the date of entry into force is unknown. This data corresponds to [fig. ES.1](#) and [fig. 8.1](#).

Appendix H

Content Industry Snapshots by Country

This appendix provides brief summaries of the digital video game, video on demand, digital music, and e-book industries for Brazil, China, Europe, India, Indonesia, and Russia. The snapshots include market data information, industry players/competitive conditions, and policies and regulatory measures (where reported) for each country/region.

Digital Video Game Industry Snapshots by Country

Brazil

Brazil's digital video game industry was valued at about \$417 million in 2016. The largest subsector was mobile games, valued at about \$253 million.¹¹⁴⁸ In recent years, mobile gaming has seen rapid adoption and growth in Brazil, largely driven by reductions in the sales prices of smartphones and tablets as well as by the growing number of “freemium”¹¹⁴⁹ game options for users. In 2016, it was estimated that most mobile gamers in Brazil—51.4 million—played via their smartphones, while 22.8 million gamers were tablet users.¹¹⁵⁰

Mobile gaming is one of the most popular smartphone activities in Brazil. In an April 2015 study by Opinion Box, a Brazilian market research firm, a majority (56.8 percent) of smartphone owners in the country said they played games on such devices. Females were more likely than males to use smartphone gaming apps, at 59.7 percent versus 53.6 percent.¹¹⁵¹

China

China's digital video game industry was valued at about \$10.7 billion in 2016, with the largest subsector being mobile games, valued at about \$7.1 billion.¹¹⁵² Tencent, China's leading social media conglomerate and the world's largest video game company by revenue, earned about \$10.2 billion from games in 2016, an increase of 17 percent over the previous year. Tencent's gaming revenues have largely been driven by its popular smartphone games, such as Honor of

¹¹⁴⁸ Statista, “Digital Media: Video Games,” 2016.

¹¹⁴⁹ “Freemium” games are initially free to download, but offer optional game enhancements (in-app purchases), such as buying virtual goods or accessing new game levels.

¹¹⁵⁰ Teixeira, “The Market for Video Games in Brazil,” October 2, 2015; eMarketer, “Smartphones Drive Mobile Gaming Revenues in Brazil,” May 28, 2015.

¹¹⁵¹ eMarketer, “Smartphones Drive Mobile Gaming Revenues in Brazil,” May 28, 2015.

¹¹⁵² Statista, “Digital Media: Video Games,” 2016.

Kings, Cross Fire Mobile, and JX Mobile, which consistently dominate that country's gaming charts.¹¹⁵³

Tencent paid \$8.6 billion in 2016 for a majority stake in the world's leading mobile games developer, Supercell (Finland). Douyu TV, a leading Chinese online platform for the streaming of live video game-related content (e.g., e-sports), drew \$100 million in one investment round, with funding led by Tencent. Industry analysts viewed this move as a way for Tencent to maintain its dominant position in China's online games market as competition from domestic rivals grows. In particular, an estimated 100 million Chinese watch or engage in e-sports (competitive video game tournaments).¹¹⁵⁴

Europe

Europe's digital video game industry was valued at about \$8.7 billion in 2016. The largest subsector was mobile games, valued at about \$3.6 billion.¹¹⁵⁵ European mobile app developers have become world leaders. More than 90 percent of the revenues from these games come from “freemium” titles. Major European mobile gaming companies include King (United Kingdom/Sweden/Spain/United States), Supercell (Finland/China), Wooga (Germany), and Gameloft (France).¹¹⁵⁶ In 2015, of the top 10 mobile game apps in both the Apple App Store and Google Play Store, 6 were made by companies headquartered in Europe.¹¹⁵⁷

Mobile games are popular among Europeans. According to a survey commissioned by Deloitte, there were more than 21 million players of mobile games in France, Germany, Spain, and the UK alone. Together it is estimated that the freemium model supports 21,000 full-time jobs throughout the EU—with smaller, independent game makers in Europe driving growth.¹¹⁵⁸ In 2014, European mobile game developers generated over 35 percent of their revenues outside of the EU. Consumers in the United States, China, and Japan were the three markets that generated the highest app revenues for European game makers.¹¹⁵⁹

¹¹⁵³ Newzoo, “Top 25 Companies Game Revenues,” December 2016; Lucas, “Smart Phone Gaming Drives Tencent Revenues,” March 22, 2017.

¹¹⁵⁴ Lucas, “Smart Phone Gaming Drives Tencent Revenues,” March 22, 2017; Huifeng, “Era of E-sports,” March 16, 2016; Hanson, “China (and Asia) Are Driving,” May 9, 2016.

¹¹⁵⁵ Statista, “Digital Media: Video Games,” 2016.

¹¹⁵⁶ Deloitte, *Mobile Games in Europe*, September 2015, 3, 8.

¹¹⁵⁷ Ibid.

¹¹⁵⁸ Deloitte, *Mobile Games in Europe*, September 2015, 13.

¹¹⁵⁹ Ibid., 9, 17.

India

India's digital video game industry was valued at about \$681 million in 2016, with the largest subsector being mobile games, valued at about \$466 million.¹¹⁶⁰ As of 2016, India is reportedly the fifth-largest mobile gaming market in the world behind China, the United States, Brazil, and Russia.¹¹⁶¹

App store revenue from games was estimated at \$16 million in 2016, up from \$12 million the previous year. This increase (from a relatively small base) can be attributed to rising smartphone use and Google Play's rollout of direct carrier billing (an online payment method that allows users to make purchases by charging payments to their mobile phone bill). Google has also introduced prepaid vouchers and lowered the floor for apps and in-app purchases from Rs 50 to Rs 10 (or from about 80¢ to 15¢ in U.S. currency). In 2016, companies creating cash-based strategy card games saw 20–25 percent increases in the number of monthly spends (expenditures) over the previous year, though spending on apps was still low by world standards.¹¹⁶²

India's digital video game industry faces major challenges. One of the most pressing is a lack of funding or direct investment to allow game developers in India to adequately compete with international developers. Moreover, the relatively small revenue generated from app purchases reflects the severity of problems Indian game makers face in attempting to make money from their products. An important reason for this is the difficulty consumers have in actually paying for apps; for example, there is no universal implementation of direct carrier billing. Offering alternative forms of payment has therefore become increasingly popular.¹¹⁶³

Indonesia

Indonesia's digital video game industry was valued at about \$678 million in 2016. The largest subsector was mobile games, which was valued at about \$514 million.¹¹⁶⁴ In 2014, there were approximately 34 million mobile game users in Indonesia, with 49 percent of these users

¹¹⁶⁰ Statista, "Digital Media: Video Games," 2016.

¹¹⁶¹ Shankar, "India Reaches Level 5 in the Mobile Gaming Market," November 23, 2016.

¹¹⁶² Ibid.

¹¹⁶³ Alam, "In 2016, Indian Gaming Industry Reached Global Top 5," December 23, 2016; Shankar, "India Reaches Level 5 in the Mobile Gaming Market," November 23, 2016.

¹¹⁶⁴ Statista, "Digital Media: Video Games," 2016.

spending money on mobile games (tying Thailand for the highest spending rate in Southeast Asia).¹¹⁶⁵

In 2015, about half of the top-grossing mobile games in Indonesia were Western titles (based on the number of top-grossing apps from Western companies listed on Apple’s App Store and Google Play for Indonesia). Local developers accounted for only about 1.2 percent of the online games played in Indonesia.¹¹⁶⁶

The sale of pirated video games in Indonesia is reportedly widespread and, in part, has helped establish the “gamer culture” in the country. Pirates will go online and download a hacked version of popular video games and then create DVDs to sell in mid-market malls for as low as \$1.50 (by comparison, the retail price of some imported games can be as high as \$51). The enforcement of copyright measures is reportedly inadequate, since unlike computer software or Hollywood movies, video games in Indonesia are subject to a unique legal loophole that makes game piracy illegal, but unlikely to be prosecuted—as nascent domestic video companies are generally unwilling to file the costly legal paperwork to file official complaints.¹¹⁶⁷

Russia

Russia’s digital video game industry was valued at about \$651 million in 2016, with the largest subsector being online games, valued at about \$382 million.¹¹⁶⁸ There are 72 million gamers in Russia, representing 65 percent of the online population. Desktop and laptop computers remain the dominant gaming platform, with 44 percent of the total games market. A typical Russian online gamer spends \$40.95 per year on online gaming; this sum includes games, accessories, and in-app purchases.¹¹⁶⁹

¹¹⁶⁵ Casual Games Association/Newzoo, *Southeast Asia Games Market 2015*, 4–6.

¹¹⁶⁶ Casual Games Association/Newzoo, *Southeast Asia Games Market 2015*, 4–6; Indonesia Investments, “Indonesia’s Online Gaming Industry,” January 25, 2016.

¹¹⁶⁷ Janottama, “Video Game Pirates,” March 31, 2017.

¹¹⁶⁸ Statista, “Digital Media: Video Games,” 2016. Online/browser games are defined as massive multiplayer online games (MMOG) as well as casual and social games, which can be played directly in the Internet browser and do not require an installation.

¹¹⁶⁹ Newzoo, “The Russian Games Market 2016,” September 23, 2016; Russian Search Marketing, “Russian Video Game Revenues,” November 21, 2016.

Approximately 34 percent of Russian video game revenues come from mobile devices. There are more mobile games installed on Android devices than on iOS devices in Russia, largely due to Android devices being more affordable in Russia.¹¹⁷⁰

Digital Video on Demand Industry Snapshots by Country

Brazil

Brazil's video on demand (VoD) industry was valued at about \$204 million in 2016. The largest subsector was subscription streaming VoD services, valued at about \$124 million.¹¹⁷¹

According to comScore, Inc., a cross-platform media measurement and analytics company, Brazil has the largest online video viewing population in Latin America. In December 2014, 65.5 million unique online video viewers ages 6 and older lived in Brazil, translating to 86.5 percent of Internet users in the country.¹¹⁷²

Netflix, which entered the Brazil market in 2011, has a commanding presence in the digital video market space. Analysts estimate that Netflix has 4 to 5 million subscribers in the country, which trails only the United States and the UK in total Netflix subscribership.¹¹⁷³ However, Netflix is facing increasing competition from Brazilian competitors, particularly Globo, Brazil's largest TV network. Globo introduced a digital streaming service in 2015 called Globo Play to attract younger audiences. Globo Play offers most of the network's programming on demand at a lower price than Netflix.¹¹⁷⁴

China

China's VoD industry was valued at about \$934 million in 2016. According to the China Internet Network Information Center, as of June 2016 China had 514 million online video viewers, representing over 70 percent of total Chinese Internet users. Mobile video streaming users

¹¹⁷⁰ Russian Search Marketing, "Russian Video Game Revenues," November 21, 2016.

¹¹⁷¹ Statista, "Digital Media: Video on demand," 2016.

¹¹⁷² eMarketer, "Brazil Stands Out for Digital Video Viewing," February 11, 2015.

¹¹⁷³ Shaw, "Netflix Wants the World to Binge-Watch," January 12, 2017.

¹¹⁷⁴ Ibid.

reached around 440 million.¹¹⁷⁵ The online video market in China is highly fragmented, with many sites trying to differentiate themselves in terms of quality, content, and price.¹¹⁷⁶

As domestic competition over streaming video services grows more intense, China's three largest technology companies—Baidu, Alibaba, and Tencent, collectively known as BAT—have made major investments in sports, blockbuster movies, popular foreign TV programs, etc., to bolster their video content offerings. For instance, Tencent has exclusive coverage of NBA and NCAA basketball games in China through a partnership with U.S.-sports network ESPN, and Alibaba completed the acquisition of a major Chinese streaming video site, Youku Tudou, for about \$4 billion (net cash) in 2015. Industry analysts saw this acquisition as a way for Alibaba to better compete with other domestic online video streaming platforms, including Tencent Video and Baidu's iQiyi, which is China's leading VoD streaming site.¹¹⁷⁷

China's largest online video platforms, over time, have become similar in both content and business model. The majority of their revenues come from advertising, with lesser but increasing contributions from premium subscription fees and other smaller sources such as online video games. However, as competition continues to intensify among the largest domestic players, the cost of acquiring the rights to video content, particularly original productions, has gone up. Consequently, VoD companies such as iQiyi have been increasing investments in their own original content, as well as focusing on attracting and retaining more paid subscribers.¹¹⁷⁸

Europe

Europe's VoD industry was valued at about \$3.5 billion in 2016.¹¹⁷⁹ VoD revenue remains the smallest subsector of the European audiovisual services market, but it is also the fastest growing. European VoD revenue reached just under 1 billion euros (about \$1.07 billion) in 2010 and grew to 2.5 billion euros (about \$2.68 billion) in 2015, recording a compound annual growth rate of 28.4 percent from 2010 to 2015. Demand for streaming video services,

¹¹⁷⁵ Statista, "Digital Media: Video on demand," 2016; Xiang, "The Dilemma of Chinese Online Video Sites," September 4, 2016.

¹¹⁷⁶ Carlson, "China Shifts to Digital," June 22, 2016.

¹¹⁷⁷ Lucas, "Smart Phone Gaming Drives Tencent Revenues," March 22, 2017; Chen and Katz, "Alibaba Buys Youku," November 6, 2015; Xiang, "The Dilemma of Chinese Online Video Sites," September 4, 2016; Melvin, "Tencent Joins Hands with ESPN," February 2, 2016.

¹¹⁷⁸ Xiang, "The Dilemma of Chinese Online Video Sites," September 4, 2016.

¹¹⁷⁹ Statista, "Digital Media: Video on demand," 2016.

particularly in Western European markets, has been the primary driver of growth for the subsector.¹¹⁸⁰

Global video streaming companies Netflix and Amazon are active in nearly all European markets. In each country, they are usually competing against a handful of pan-European providers of streaming VoD and two or three national providers, as well as niche video streaming providers. One well-known pan-European provider is the UK-based Sky Group's Sky Now TV and Sky Online/Ticket services in the UK, Germany, Italy, and Austria. National providers are often owned and operated by domestic broadcasters, telecom providers, or Internet service providers (e.g., BBC iPlayer).¹¹⁸¹

Increasingly, Netflix and Amazon are investing in the production of local content in order to better compete with European content providers. Likewise, European streaming VoD services have started to invest more in original digital productions. However, these national service providers are often at a disadvantage in terms of production funding compared to the global companies. To illustrate, a study by IHS Markit showed that in 2015, Amazon and Netflix had already spent more on German programming (\$7.5 billion) than all German audiovisual services providers combined that year.¹¹⁸²

As Netflix and Amazon's video streaming market share expands on the continent, several European policymakers and regulators are considering domestic-market content quotas for subscription video streaming providers to promote and protect European audiovisual services productions—quotas could be up to 20 percent of content for global providers. A European Audiovisual Observatory study by the Council of Europe examined the national origin of films offered on European video streaming services. The study found that, on average, European films accounted for less than a third (32 percent) of the catalogs of the 16 streaming VoD services analyzed, versus 60 percent for U.S. films and 8 percent for other international films.¹¹⁸³

India

India's VoD industry was valued at about \$49 million in 2016.¹¹⁸⁴ User-generated video content is the most popular, with YouTube, the market leader, accounting for more than 50 percent of

¹¹⁸⁰ Blázquez et al., *VOD, Platforms and OTT*, 2016, 11.

¹¹⁸¹ *Ibid.*, 16.

¹¹⁸² *Ibid.*, 17.

¹¹⁸³ Blázquez et al., *VOD, Platforms and OTT*, 2016, 16–17; Arthofer and Rose, "The Future of Television," September 2016, 28–30.

¹¹⁸⁴ Statista, "Digital Media: Video on demand," 2016.

all videos watched online in India. Other digital video providers include Netflix (as of January 2016), Amazon (as of December 2016), and more domestically focused providers such as HotStar (owned by Fox), Airtel Movies, and Voot, to name a few.¹¹⁸⁵

Videos are expected to account for 72 percent of all Internet traffic in India by 2018, up from 45 percent in 2013. As India is the second-largest global market for smartphones, the growth of its digital video market is being driven by increasing consumption of mobile video content, particularly among younger audiences.¹¹⁸⁶

International digital video providers have pushed to develop or acquire more local content in order to better compete with established Indian content creators and Bollywood. Amazon, for example, has set aside \$300 million for investment in Indian video content of all genres.¹¹⁸⁷

Slower-than-average Internet speeds (when compared to most developed countries) are reported to be the primary barrier to industry growth. In response, Google has introduced the YouTube Go app (currently in beta form). The app addresses India's inadequate mobile network coverage by allowing customers to find and preview videos with minimal data and to save video content so they can watch it offline.¹¹⁸⁸

Indonesia

Indonesia's VoD industry was valued at about \$152 million in 2016. The largest subsector was subscription streaming VoD services, valued at about \$92 million.¹¹⁸⁹

Competition among online video streaming services in Indonesia is intensifying, largely due to the country's rapidly growing Internet population. U.S.-based Netflix became available in Indonesia in January 2016 and Amazon Prime Video in December 2016. Another prominent foreign video streaming service provider is HOOQ (Singapore), a joint venture between Singapore Telecommunications, Sony Pictures (Japan/United States), and Warner Brothers

¹¹⁸⁵ Deloitte, *Digital Media: Rise of On-demand Content*, 2015, 19, 32; Gadgets 360, "Our 5 Favourite TV and Movie Streaming Services in India," November 10, 2015.

¹¹⁸⁶ Deloitte, *Digital Media: Rise of On-demand Content*, 2015, 28–29, 32.

¹¹⁸⁷ Laghate, "Amazon Starts Prime Video Service in India," December 14, 2016.

¹¹⁸⁸ Deloitte, *Digital Media: Rise of On-demand Content*, 2015, 29; Lui, "YouTube Launches a Mobile App In India," April 5, 2017.

¹¹⁸⁹ Statista, "Digital Media: Video on demand," 2016.

(United States). HOOQ entered the country in April 2016 and Malaysia’s iFlix, backed by PLDT, Inc. (formerly known as Philippine Long Distance Telephone), entered in June 2016.¹¹⁹⁰

A March 2016 circular from Indonesia’s Communications and Information Technology Ministry stated that foreign providers of digital content services (including video and music streaming services) entering Indonesia must either establish local entities or forge partnerships with local players. Since the circular appeared, most foreign providers have secured partnerships with local labels and film-production houses in order to access local content that may better appeal to the Indonesian public. HOOQ, for example, set up local offices to support its streaming video services. Due to Indonesia’s relatively weak broadband network, some foreign providers have also partnered with local telecom companies to bolster distribution networks and increase promotion. One example is VIU (Hong Kong), a streaming service that offers video content exclusively from South Korea, India, Thailand, and Indonesia; VIU has partnered with IndiHome, Telkom Indonesia’s Internet option.¹¹⁹¹

Censorship has become an issue for some foreign digital video providers. Indonesia’s national censorship board can block content that it deems not “healthy” for society, and the national parliament passed a broad anti-pornography bill in 2008 prohibiting adult and sexual content. Since its launch in January 2016, state-owned Telekom Indonesia, the country’s largest Internet service provider, has completely blocked Netflix on Telekom Indonesia’s networks due to censorship issues (as of April 2017). While Netflix is accessible on other telecom networks and carriers in Indonesia, Telekom Indonesia has about 174 million customers on its cellular network, or about 70 percent of the total Indonesian population.¹¹⁹²

Russia

Russia’s VoD industry was valued at about \$93 million in 2016. The largest subsector was subscription streaming VoD services, valued at about \$49 million.¹¹⁹³

The Russian digital video market is very fragmented. The top three providers—YouTube, ivi.ru, and Rostelecom—account for less than half the market. Although Netflix is available in Russia,

¹¹⁹⁰ Amirio, “A Host of New Music, Video Services,” May 27, 2016; Suzuki, “HOOQ Enters Indonesia’s Busy Online Video Market,” April 14, 2016; *Digital TV Europe*, “Amazon Takes On Netflix,” December 14, 2016; Freischlad, “Netflix Competitor iFlix,” June 16, 2016.

¹¹⁹¹ Amirio, “A Host of New Music, Video Services,” May 27, 2016; Suzuki, “HOOQ Enters Indonesia’s Busy Online Video Market,” April 14, 2016.

¹¹⁹² Elder and Gallagher, “Netflix in Talks with Indonesian Telco,” April 18, 2017; Suzuki, “HOOQ Enters Indonesia’s Busy Online Video Market,” April 14, 2016.

¹¹⁹³ Statista, “Digital Media: Video on demand,” 2016.

its penetration is too small to be counted, and many of the other Russian VoD services struggle to differentiate themselves as they offer similar content.¹¹⁹⁴

Content piracy is rampant in Russia. For example, it is reported that 80 percent of all online video consumed is pirated content.¹¹⁹⁵

Digital Music Industry Snapshots by Country

Brazil

Brazil's digital music industry was valued at about \$123 million in 2016. The largest subsector, music streaming, was valued at about \$101 million.¹¹⁹⁶ In fact, in 2015, music streaming represented the majority (51 percent) of digital music sales in Brazil. Google Play was reported to have a "built-in" advantage, as almost all local smartphones contain Android operating systems (over 90 percent of tablets and smartphones in Brazil use Android systems). Deezer (France), Napster (U.S.), and Spotify (Sweden) are leading streaming music providers in the country.¹¹⁹⁷

Bundling streaming services with smartphone service payment plans has been an increasingly successful way for content providers to reach out to casual music listeners who might not sign up for a stand-alone music streaming subscription. In 2015, Deezer collaborated with Brazilian Internet service provider and portal Universo Online (UOL) to launch UOL Musica Deezer. UOL Musica Deezer became an on-demand music platform that replaced Radio UOL, one of the country's streaming music pioneers.¹¹⁹⁸

China

China's digital music industry was valued at about \$390 million in 2016. The largest subsector was music streaming, which was valued at about \$360 million.¹¹⁹⁹ The Chinese music streaming sector is dominated by QQ Music, owned by social media conglomerate Tencent. QQ Music has about 200 million monthly active users and over 15 million paying music subscribers. Its share of the digital music market in China is estimated at over 77 percent. Tencent also has exclusive

¹¹⁹⁴ Dixon, "Winning in the Low ARPU," November 9, 2016.

¹¹⁹⁵ Ibid.

¹¹⁹⁶ Statista, "Digital Media: Digital Music," 2016.

¹¹⁹⁷ Gonzaga, "In Brazil, Music Consumers Choose Streaming," April 22, 2015; Knopper, "Streaming Music Companies Battle," February 26, 2015; Dyson, *Brazil Music Industry Report*, July 4, 2016; Wischenbart et al., *Global eBook*, 2016, 91.

¹¹⁹⁸ Washenko, "Deezer to Launch Streaming Service," August 11, 2015.

¹¹⁹⁹ Statista, "Digital Media: Digital Music," 2016.

digital distributor rights in China to the catalogs of Warner Music, Sony Music, and South Korea's YG Entertainment. Although Nokia and Microsoft have online radio service in China, every other Western service remains shut out, including Apple's iTunes.¹²⁰⁰

The prevalence of intellectual property piracy in the region has driven down the prices of subscription streaming services because bootlegging has entrenched the expectation that digital content should be free or priced very low. According to the International Federation of the Phonographic Industry (IFPI), China's annual per capita spending on recorded music was only 10¢ in 2015.¹²⁰¹

Europe

Europe's digital music industry was valued at about \$2.8 billion in 2016. The largest subsector was music streaming, valued at about \$1.9 billion.¹²⁰² Europe remains a highly diverse region, with markets adopting new formats and channels at different rates. In Sweden, Spotify's home market, music streaming accounted for about 67 percent of the market in 2015. In Germany, by contrast, CDs accounted for 60 percent of record company trade revenues that year. Overall, however, revenue from music streaming in Europe increased by about 43 percent from 2014 to 2015.¹²⁰³

In a 2016 study conducted by the EU Intellectual Property Office, it was estimated that about €113 million (about \$121 million) in revenue was lost due to digital music piracy in 19 EU countries in 2014.¹²⁰⁴ The UK accumulated the highest losses, accounting for one-third of total lost digital music sales (€36.3 million, or about \$38.9 million), followed by Germany, at 18 percent of total lost digital music sales (€20.0 million, or about \$21.5 million).¹²⁰⁵

India

India's digital music industry was valued at about \$58 million in 2015 and grew at an annual average rate of 4.6 percent from 2011 to 2015. In 2014, the digital music segment accounted

¹²⁰⁰ Jones, "Here's Why Spotify and Apple Music Will Struggle," January 27, 2017; Frater, "China's Tencent and Weiyang Take \$85 Million Stake," May 31, 2016; Knopper, "Streaming Music Companies Battle," February 26, 2015.

¹²⁰¹ McKinsey, *The Beat of Progress*, November 2016, 12–14; Jones, "Here's Why Spotify and Apple Music Will Struggle," January 27, 2017.

¹²⁰² Statista, "Digital Media: Digital Music," 2016.

¹²⁰³ IFPI, *Global Music Report*, 2016, 11.

¹²⁰⁴ Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Spain, Sweden, Slovakia, and the United Kingdom.

¹²⁰⁵ EU, EUIPO, *The Economic Cost of IPR Infringement*, May 2016, 19.

for about 55 percent of overall Indian music industry revenues, and its contribution is expected to increase to 72 percent by 2017.¹²⁰⁶

There were an estimated 27 million online music users in India in March 2015—a number expected to grow more than 10-fold to 273 million online music listeners by March 2020. Most of this growth is expected to be driven by Indians aged 18 to 35 years, almost 85 percent of whom will access the music through connected mobile devices.¹²⁰⁷

Less than 1 percent of all online music listeners subscribe to music service platforms (as opposed to free, ad-supported content). However, music subscription levels are expected to increase as demand for premium services rises and access to various payment mechanisms improves.¹²⁰⁸

The growth in music streaming's popularity has also prompted telecom operators to set up their own music streaming services or partner with existing ones. For example, Bharti Airtel (an Indian telecom firm) set up its own online streaming app Wynk in 2014, while Vodafone (a British telecom firm) established a partnership with Hungama, an Indian music streaming service, a year earlier. Other major Indian music streaming platforms such as Gaana and Saavn have attracted increased investments and also forged partnerships with leading e-commerce companies.¹²⁰⁹

Piracy has hindered Indian customers' willingness to pay for music, partly hindering the growth of India's nascent digital music streaming industry. However, the negative effects have been somewhat muted with the growing popularity of legitimate music streaming services, which provide superior content across mobile devices, often for free.¹²¹⁰

Indonesia

Indonesia's digital music industry was valued at about \$21 million in 2015, growing at an average annual rate of 7.5 percent from 2011 to 2015.¹²¹¹ Demand for streaming music services in Indonesia is rising as the country's Internet population continues to grow. Major foreign

¹²⁰⁶ McKinsey, *The Beat of Progress*, November 2016, 3; Deloitte, *Digital Media*, 2015, 25.

¹²⁰⁷ Deloitte, *Digital Media*, 2015, 23.

¹²⁰⁸ *Ibid.*, 24.

¹²⁰⁹ Deloitte, *Digital Media*, 2015, 26; Satpathy, "Vodafone Music Service Launched," December 23, 2013.

¹²¹⁰ Deloitte, *Digital Media*, 2015, 26.

¹²¹¹ McKinsey, *The Beat of Progress*, November 2016, 3.

players operating in Indonesia include U.S.-based Apple Music and Yonder Music, Spotify (Sweden), Deezer (France), Guvera (Australia), and JOOX, a Chinese firm owned by Tencent.¹²¹²

JOOX, which also operates in Hong Kong, Malaysia, and Thailand, is Indonesia's and the region's most popular music streaming service. During 2015–16, the JOOX app was downloaded more than 50 million times, collectively equating to more than 50 percent of all music streaming app downloads in the four Asian markets JOOX operates in.¹²¹³

As noted earlier, in March 2016 Indonesia's Communications and Information Technology Ministry stipulated in a circular that foreign digital content service providers (including video and music streaming services) entering Indonesia must either establish local entities or forge partnerships with local firms. As a result, Guvera and Yonder Music, among others, have set up local offices to support their operations in Indonesia. Most foreign providers have secured partnerships with local labels and film-production houses in order to access local content that may better appeal to the Indonesian public. Due to Indonesia's relatively weak broadband network, some foreign providers have also partnered with local telecom companies to bolster distribution networks and increase promotion. For example, Spotify, which launched in Indonesia in March 2016, entered into a partnership with local telecom Indosat Ooredoo. Through its partnership, usage of Spotify's services would not be counted against Indosat users' data limits.¹²¹⁴

Challenges to music streaming providers in Indonesia include a lack of affordable mobile data. Further, the prevalence of low-end smartphones that provide less-than-optimal streaming functionality limits the adoption of music streaming apps (a low-end smartphone can cost as little as \$75 per device in Indonesia). Also, while companies such as Spotify are diversifying payment options in Indonesia, many unbanked Indonesian users are still unaware of such electronic services. Hence, Spotify also allows for bank transfers, phone credits, and transactions through local markets.¹²¹⁵

¹²¹² Amirio, "A Host of New Music, Video Services," May 27, 2016.

¹²¹³ McKinsey, *The Beat of Progress*, November 2016, 6.

¹²¹⁴ Amirio, "A Host of New Music, Video Services," May 27, 2016.

¹²¹⁵ McKinsey, *The Beat of Progress*, November 2016, 12–14; Amirio, "Spotify Having Good First Five Months," September 8, 2016.

Russia

Russia's digital music industry was valued at about \$28 million in 2016. The largest subsectors were music streaming and downloads, which evenly split the first rank with a value of about \$14 million each.¹²¹⁶

Russia's music streaming industry has been growing; Yandex.Music (owned by Russian technology/search company Yandex) became Russia's second-largest music streaming service in 2016 when it reported that their subscription numbers had tripled from the previous year to reach 250,000 paid subscribers. Apple Music is Russia's market leader, with an estimated 600,000 streaming subscribers, and Google Play Music is third with 100,000 subscribers. Zvooq, Russia's other leading domestic music streaming provider, is reported to be fourth largest.¹²¹⁷

Intellectual property piracy in Russia's digital music sector is reported to be a major barrier. Some of the more well-known MP3 pirating sites have originated in Russia (e.g., ALLOfMP3.com).¹²¹⁸

E-book Industry Snapshots by Country

Brazil

Brazil's e-book industry was valued at about \$74 million in 2016.¹²¹⁹ U.S.-based Amazon, Apple, and Google have been present in the Brazilian market since 2012, as has the Japanese-Canadian e-book publisher Kobo. Apple started selling e-books in Brazil in October of that year, while the other three e-book providers started up in December 2012. Due to the large installed base of tablets and smartphones in the country, Apple and Google had an initial advantage. However, by 2015, Amazon had about a 60 percent market share of the Brazilian e-book market, followed by Apple (15 percent), Saraiva (Brazil) (10 percent), Google (10 percent), and Kobo (5 percent).¹²²⁰

¹²¹⁶ Statista, "Digital Media," 2016.

¹²¹⁷ Kozlov, "Yandex.Music, Russian-Owned Streaming Service," January 24, 2017; Kozlov, "Russia's Zvooq Streaming Service," June 8, 2016.

¹²¹⁸ Knopper, "Streaming Music Companies Battle," February 26, 2015.

¹²¹⁹ Statista, "Digital Media: ePublishing," 2016.

¹²²⁰ Wischenbart et al., *Global eBook*, 2016, 90.

Although there are no official data available for digital self-publishers in Brazil, industry observers estimate the self/independent e-book catalog in Brazil at about 15,000 to 20,000 titles. In 2015, 4.3 percent of all trade titles were being sold as e-books.¹²²¹

Digital self-publishing, according to some industry observers, has great potential in Brazil as publishers are offering more digital editions of their titles. Also, Brazilian publishing leader Saraiva has made a commitment to digital by launching its own e-book reading device, LEV, in 2014. Yet it is noted that the Brazilian e-book industry continues to face many challenges, including updating an inefficient digital value chain.¹²²² Moreover, the country still needs to emerge from recent economic and political crises.¹²²³

China

China's e-book industry was valued at about \$933 million in 2016.¹²²⁴ The country's leading e-book distributors include China Reading Limited, owned by Tencent; Migu Digital Media, owned by China's leading mobile telecom provider, China Mobile; and the Kindle e-book platform Amazon China, as well as domestic platforms such as Zhangyue's iReader and ChineseAll. In addition, Apple's iBook was launched in China in 2015; however, sales to date reportedly have been limited.¹²²⁵

According to the 2014 11th annual nationwide reading survey from the Chinese Academy of Press and Publication, 57.8 percent of China's adult population reads books. Of those, 50.1 percent read books digitally (this figure includes adults who read books in a variety of formats, including computers, tablets, mobile phones, and e-readers). With the increasing popularity of mobile phones, dedicated e-readers have lost market share. Most mobile phone users install at least one e-reading app on their phones and some mobile carriers offer phones with such apps pre-installed.¹²²⁶

E-book publishers in China have stayed cautious in previous years due to privacy/censorship concerns, as well as challenges in obtaining copyright permissions for digital editions. As a consequence, well-edited e-books of originally printed works have occupied only a small part of the digital publishing market until recently.¹²²⁷

¹²²¹ Ibid., 96, 98.

¹²²² Problems include technical platforms that are still not compatible with the best overseas digital distributors.

¹²²³ Wischenbart et al., *Global eBook*, 2016, 96, 98.

¹²²⁴ Statista, "Digital Media: ePublishing," 2016.

¹²²⁵ Wischenbart et al., *Global eBook*, 2016, 102–6.

¹²²⁶ Yeyang, "China at BEA 2015," May 22, 2015.

¹²²⁷ Wischenbart et al., *Global eBook*, 2016, 103.

Most of China’s traditional book publishers now publish new consumer titles in both print and digital formats (often simultaneously). They have also used online platforms to develop successful tie-ins with movies, TV series, other print books, and online games.¹²²⁸ Since March 2013, with increased government oversight and active participation of intellectual property rights alliances, China’s e-book market has reportedly been able to strengthen copyright protection technology as more major domestic companies are offering exclusive access to hundreds of thousands of copyrighted works through their own e-book platforms (e.g., mobile apps, e-readers). Overall, increasing attention on copyright infringement issues has encouraged both Chinese e-book companies and consumers to acquire e-publications through proper channels.¹²²⁹

Europe

Europe’s e-book industry was valued at about \$2.3 billion in 2016.¹²³⁰ The evolution of e-books in non-English-language European book markets is highly diverse in terms of both market penetration and overall market contexts.¹²³¹ While industry observers can identify and discuss differences within these markets qualitatively, market data for these countries are often inconsistent with no clear definitions of parameters. Also, with few exceptions (such as Germany), these data are collected only once per year.¹²³²

In major non-English-speaking countries (including Germany, France, Spain, Italy, the Netherlands, and Sweden), the market share of e-books within the trade segment of the book market is below 10 percent, and more often below 5 percent.¹²³³

A major barrier to e-book trade in Europe involves differing tax treatment across countries. In contrast to print books, e-books cannot benefit from a reduced value-added tax (VAT, or sales tax) since they are classified as “electronically supplied services.” While the average VAT rate

¹²²⁸ Ibid.

¹²²⁹ Yeyang, “China at BEA 2015,” May 22, 2015.

¹²³⁰ Statista, “Digital Media: ePublishing,” 2016.

¹²³¹ The UK [and Irish] e-book markets are facing similar slowdowns in e-book industry revenues as the United States. As most global e-books are in English and consumed in primarily English-speaking countries, global e-book trending data generally follows these markets. Cain, “Ebook Sales Continue To Fall As Younger Generations Drive Appetite For Print,” March 14, 2017.

¹²³² Wischenbart et al., *Global eBook*, 2016, 35.

¹²³³ Ibid., 35–83.

for print books across the EU is 7.6 percent, the corresponding rate for e-books stands at 19.9 percent, thus placing them at a disadvantage.¹²³⁴

India

India's e-book industry was valued at about \$85 million in 2016.¹²³⁵ It was reported that Flipkart, India's leading e-commerce firm, holds a 75 percent share of the e-book market in India (but this figure cannot be verified as of April 2017). Flipkart has expanded through international partnerships, including with leading independent e-book publisher Smashwords (U.S.) and Publish on Demand Global (U.S.). However, Amazon, which started operations in India in 2013, has carved out a steady and growing presence in the Indian e-book market with its Kindle e-reading device, its India Kindle Store (which offers a global list of e-books), and its Kindle Direct Publishing platform intended to attract self-publishers of e-books.

Japanese/Canadian e-book distributor Kobo also has a (smaller) presence in the Indian market.¹²³⁶

E-books in Indian languages are reportedly picking up slowly, but technological challenges remain. In particular, the lack of support for Indic scripts by reading devices such as those produced by Amazon and Apple is said to be a hindrance to the distribution of Indian-language e-books.¹²³⁷

Investment from both federal and state governments for e-books is growing, including support for India's National Digital Library.¹²³⁸

Indonesia

Indonesia's e-book industry was valued at about \$17 million in 2016.¹²³⁹ E-book consumption remains limited in Indonesia. However, the UK-based subscription e-book service Bookmate entered the Indonesian market in 2015 via a partnership with telecom company Indosat. They will compete with a long-standing local player in digital publishing, SCOOP.¹²⁴⁰

¹²³⁴ Wischenbart et al., *Global eBook*, 2016, 36; EU, EPRS, *E-Books: Evolving Markets and New Challenges*, February 2016, 6–8.

¹²³⁵ Statista, "Digital Media: ePublishing," 2016.

¹²³⁶ Wischenbart et al., *Global eBook*, 2016, 107.

¹²³⁷ *Ibid.*, 107–8.

¹²³⁸ *Ibid.*, 107–9.

¹²³⁹ Statista, "Digital Media: ePublishing," 2016.

¹²⁴⁰ Digital Book World, "Bookmate Expands Mobile Reading Service," August 24, 2015; Ahmadi, "Why Ebooks Aren't Taking Off in Indonesia," October 21, 2015.

Russia

Russia's e-book industry was valued at about \$49 million in 2016.¹²⁴¹ Russia's leading e-book consumer platform Litres claims to own around 80 percent of the legal e-book market (however, this figure cannot be verified as of April 2017). Litres is a subdivision of leading Russian publisher EKSMO. Other providers include UK-based Bookmate, which has offered a subscription e-book service since 2010, and Amazon's Kindle. Kindle has been available in Russia since 2013 though it only launched a dedicated Russian-language e-books section in 2015.¹²⁴²

According to a 2013 survey by Russian newspaper RBTH, 70 percent of Russian readers read e-books. However, 92 percent of these readers also admitted to getting their books "from the Internet" for free. The major threat of intellectual property piracy has triggered several legal actions by the Russian government, notably by extending a measure for blocking websites with pirated movies to cover pirated books as well, effective 2014. Nevertheless, piracy remains a major market barrier.¹²⁴³

¹²⁴¹ Statista, "Digital Media: ePublishing," 2016.

¹²⁴² Wischenbart et al., *Global eBook*, 2016, 124.

¹²⁴³ Russo, "E-books in Russia," June 28, 2013; Wischenbart et al., *Global eBook*, 2016, 124–25.

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