CHAPTER 1

Accelerating growth

Digital technology creates opportunities to accelerate growth, but these are often missed because firms in sectors where technology's impact is greatest are frequently protected from innovative competitors. Firms that face more competition use digital technology more intensively and effectively—it enables them to reduce their costs to outperform their competitors. But firms in developing countries do not necessarily have the incentive to adopt new technologies to increase their cost effectiveness because they are often protected from domestic or foreign competition. And it is precisely in protected sectors such as retail and wholesale trade, finance, transport, or public utilities where digital technology can increase productivity the most. Harnessing those opportunities thus requires policies that lower the barriers to competition and market entry, in addition to investments in infrastructure and skills. Only then will firms use new digital technologies more intensively and effectively—and only then will countries avoid falling behind.

Firms across the world are becoming more connected. For instance, the share of firms with at least five employees using broadband internet in lower-middle-income countries rose from 39 percent to 68 percent from 2006–09 to 2010–14. And the growth rates and valuations of internet firms across the world are surging. Less visibly, but more importantly, digital technologies have transformed traditional production structures, facilitating new, more cost-effective processes. Indeed, the vast majority of efficiency gains emerge outside the information and communication technology (ICT) sector, where firms use the internet to sell and market their products online or share real-time information with suppliers to minimize their inventory and with customers to optimize their services.

The impact of digital technology on economic growth is mediated through three mechanisms—inclusion, efficiency, and innovation. It promotes the inclusion of firms in the world economy by enabling more firms to trade new products to new destinations. For instance, firms selling their goods online through Alibaba, China's leading e-commerce company, are smaller and younger and export more products to different destinations than firms selling offline. It raises efficiency by allowing firms to make better use of their capital and labor. For instance, real-time data help equipment manufacturers in China turn over their inventory stocks five times faster than suppliers not connected to the internet. It enhances innovation by enabling firms to exploit scale effects through online platforms and services that compete with conventional business models in retail, transport, lodging, and banking, to name a few. These three mechanisms thus boost growth by expanding trade, increasing capital and labor utilization, and intensifying competition (figure 1.1).[1]

But the benefits are neither automatic nor assured. Despite great opportunities, firms' use of digital technologies differs substantially across countries due to variations in skills and infrastructure and in barriers to competition and market entry. Competition from China induced firms in member-countries of the Organisation for Economic Co-operation and Development (OECD) to adopt new technologies to escape the competition from low-cost producers, accounting for 15 percent of their investment from 2000–07. Manufacturing firms in Mexico responded to higher competition from low-cost Chinese producers in the domestic and the U.S. (export) market by using digital technologies more intensively and productively. Manufacturing firms in Brazil facing an increase in competition are more likely to invest in e-commerce systems. Firms in Africa facing an increase in competition are more likely to use the internet to market their products or to manage their inventories. Firms' use of digital technology also

varies with barriers to competition across sectors in the same country. Business process outsourcing in the Philippines has few entry barriers, and firms use digital technology intensively—the retail sector on the other hand faces substantial restrictions to entry and is dominated by incumbent firms, with few of them offering e-commerce.

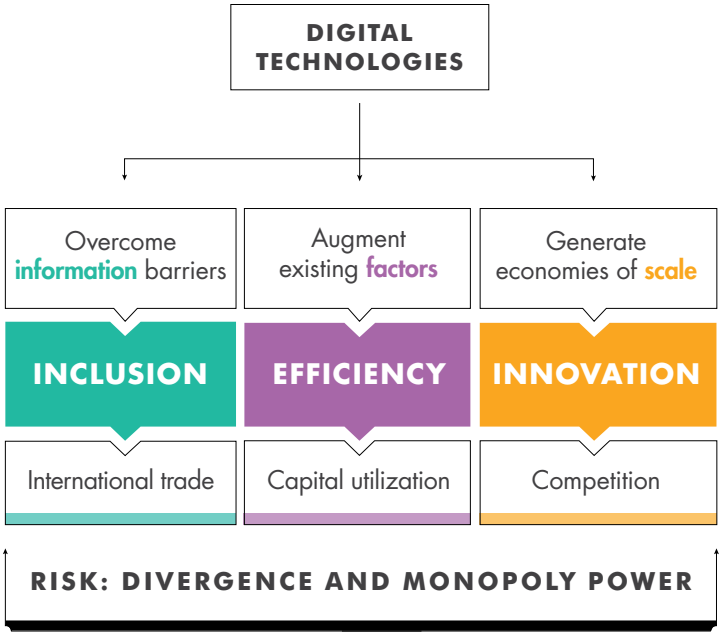
Harnessing the full growth potential of digital technology is thus predicated not just on investments in skills (chapter 2) and infrastructure (chapter 4) but also on reforming regulatory barriers by overcoming vested interests to encourage all firms to compete by investing in these new technologies (chapter 5). This also involves overhauling regulatory regimes in the digital economy, especially in sectors where online and offline firms increasingly compete, such as retail, transportation, printing and publishing, lodging, and finance. The initial entry of internet firms into these sectors promotes competition and can disrupt traditional monopolies. But internet firms can be prone to anticompetitive behaviors by exploiting scale and network effects. So the regulators need to level the regulatory regime to guarantee free market entry and prevent market shares from becoming too concentrated. The greater digital adoption therefore needs to be accompanied by unified standards, full interoperability, and competition across platforms and contracts.

The goal is to have firms' use of the internet promote competition, which encourages more firms to use the internet. But that will not happen if vested interest groups are strong enough to capture regulators and create new barriers to competition and technology adoption. A level playing field for business was always important—digital technologies have made it an imperative.

Connected businesses

The adoption of broadband internet has increased for firms in all country income groups. Almost all firms in high-income OECD countries (with at least five employees) used a broadband internet connection between 2010 and 2014, with usage rising from 79 percent in 2006–09 to 92 percent in 2010–14 (figure 1.2, panel a). The increase between the two periods was even stronger for lower-income countries. The share of firms in lower-middle-income countries using broadband internet rose from 39 percent in 2006–09 to 68 percent in 2010–14. The share in low-income countries in 2010–14 is still fairly low (38 percent), but with some notable exceptions.

Figure 1.1 A framework for the internet and economic growth



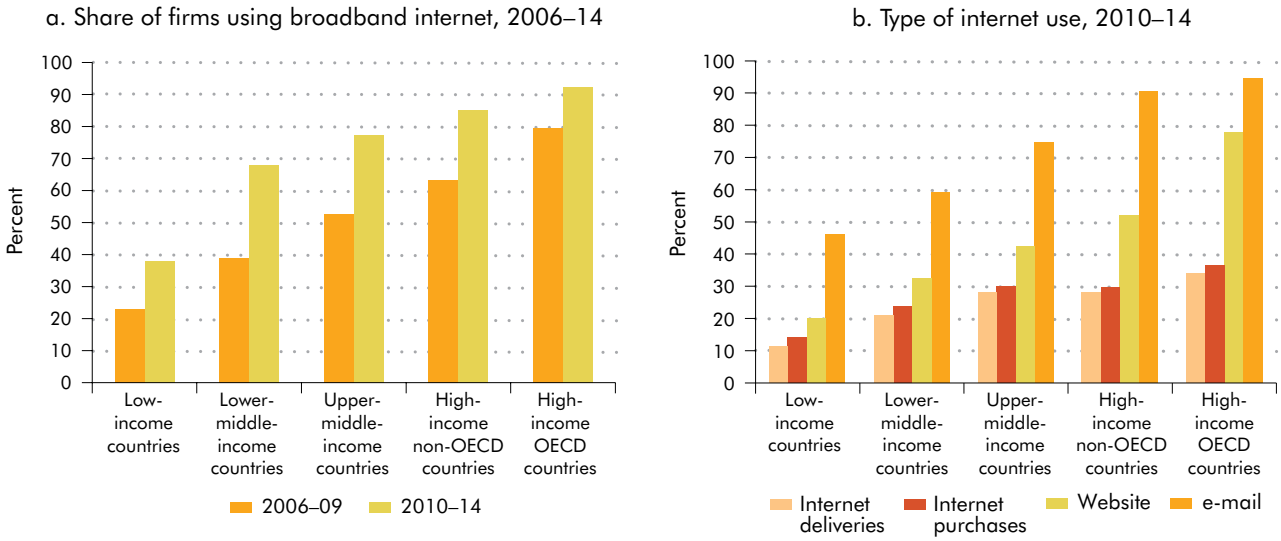
Source: WDR 2016 team.

More than 90 percent of firms in high-income countries, and 46 percent in low-income countries, used electronic mail (e-mail) to communicate with clients between 2010 and 2014 (figure 1.2, panel b). The differences are greater when the internet is used for more demanding business activities. For instance, 42 percent of firms in upper-middle-income countries had a website, and 30 percent purchased goods or services online. Only 14 percent of firms in low-income countries purchased goods or services online, and only 11 percent delivered them online.

Developing countries such as Vietnam have invested heavily in the rollout of (broadband) internet infrastructure in recent years. As a result, the share of manufacturing and service firms in Vietnam using the internet for business activities rose to 71 percent in 2007 and 86 percent in 2011. Internet access was up almost uniformly across all provinces (map 1.1).[2]

But many advanced digital technologies have not yet diffused widely, even in high-income countries. Almost all European firms with at least 10 employees use a personal computer (PC) and broadband internet. About 80 percent have a website, and 60 percent use supply chain management software that is integrated with the ICT systems of customers or suppliers outside of the firm (figure 1.3). But less than 20 percent

Figure 1.2 More firms are using broadband internet



Source: Hussain (2015) based on World Bank Enterprise Surveys, various years. Data at http://bit.do/WDR2016-Fig1_2.

Note: The data cover firms with at least five employees. Panel a is based on 10,161 firms in 100 countries (2006–09) and 33,467 firms in 88 countries (2010–14). The survey question is, "Does this establishment have a high-speed, broadband internet connection on its premises?" Panel b is based on 100 countries in 2010–14 with 45,892 firms (e-mail), 45,872 firms (website), 20,480 firms (internet purchases), and 17,099 firms (internet deliveries). OECD = Organisation for Economic Co-operation and Development.

of European firms purchase or sell goods or services online and use any cloud computing services. Only 8 percent use cloud computing services to acquire management software and computing power. And only 3 percent use radio frequency identification devices, which are wireless microchips used to connect machines with one another (the "internet of things").

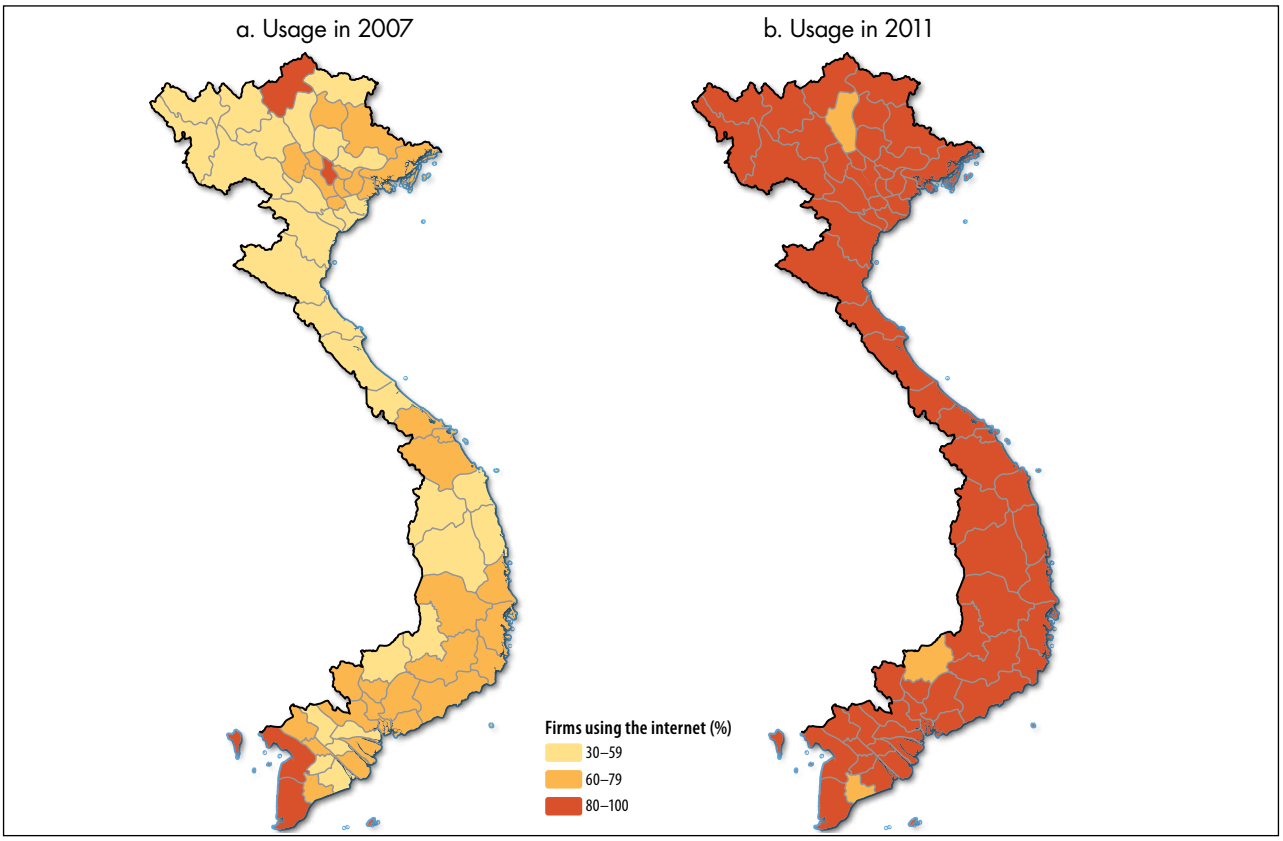
The use of digital technologies is still basic in most developing countries. In Vietnam, only 2.2 percent of all firms sold their goods or services online in 2011 (up from 0.6 percent in 2007). In Turkey, 92 percent of all firms with at least 10 employees had internet access in 2012, but only 71 percent used it for banking; 55 percent had a website; and 10 percent made orders or reservations online. In Mexico, 84 percent of firms with at least 10 employees used the internet in 2012, but only 26 percent of employees had internet access; and only 13 percent of firms used e-commerce for purchases, and 9 percent for sales. In Brazil, 63 percent of all manufacturing firms with at least 10 employees bought or sold products online, but only 28 percent provide an online catalogue or feature online orders on their website; and only 6 percent allow online payments. And less than half the manufacturing firms in Brazil have an information technology (IT) department or use software supporting management, either for resource planning or customer relations.[3]

More productive firms are early adopters of the internet

More productive firms are more likely to adopt the internet and use it more intensively. The percentage of firms having a website and selling or buying goods or services online tends to increase with firm productivity in all country income groups (figure 1.4).[4] Firms in the most productive quintile are most likely to have a website or use broadband internet.[5] The correlation between firm productivity and e-commerce is stronger in upper-middle-income countries. In lower-middle-income countries, less than 13 percent of the most productive firms sold or bought goods or services online. The results suggest that only the more productive firms in developing countries overcome (unobservable) barriers to using the internet more effectively.

African firms using the internet have on average 3.7 times higher labor productivity than nonusers and 35 percent higher total factor productivity (TFP) (figure 1.5). But the most productive firms that do not use the internet have TFPs comparable to high-productivity internet users. The differences are also found to be larger for labor productivity than for TFP, implying that African firms using the internet are not only more productive but also more capital intensive.[6]

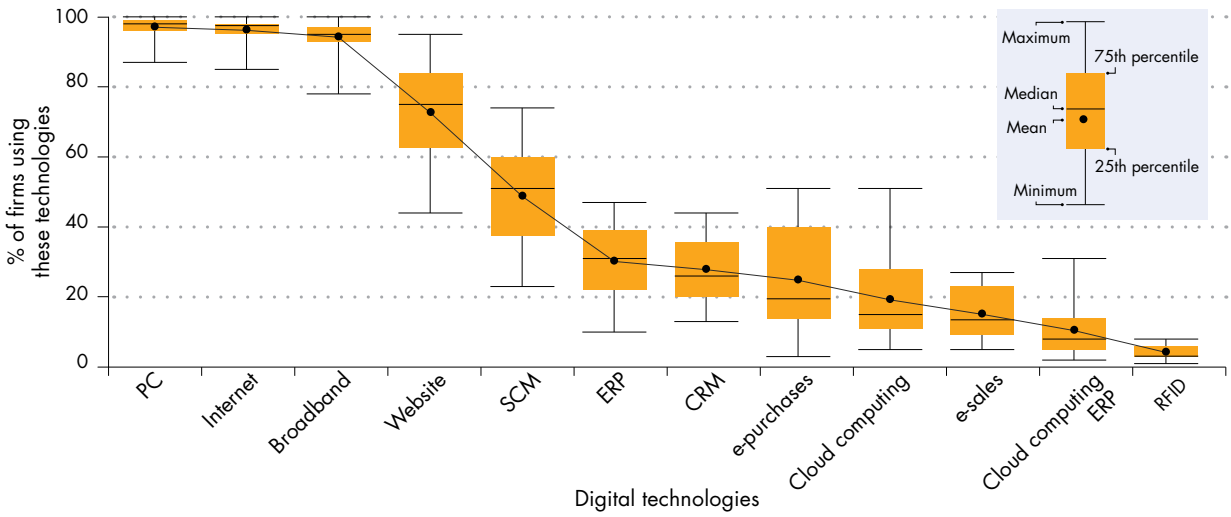
Map 1.1 Many more firms are using the internet in Vietnam



Source: Nguyen and Schiffbauer 2015. Data at http://bit.do/WDR2016-Map1_1.

Note: The census of Vietnamese firms includes more than 300,000 observations each year.

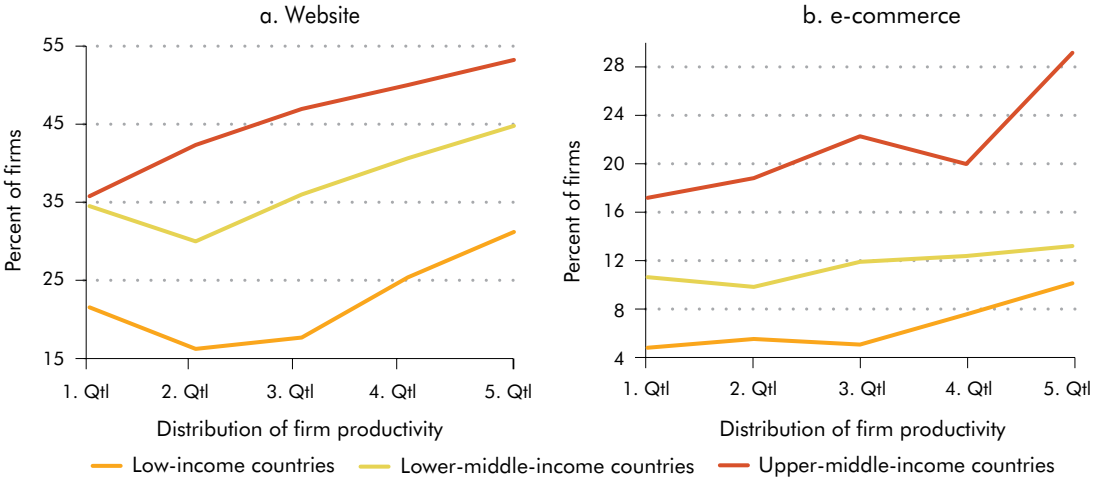
Figure 1.3 Many advanced digital technologies have not yet diffused across firms in high-income countries, 2014



Source: Eurostat, circa 2014 (EC, various years). Data at http://bit.do/WDR2016-Fig1_3.

Note: For each technology, the chart shows the distribution across 32 high-income countries of the share of firms (with at least 10 employees) that use that technology. Data are for 2014 or the last available year. CRM = customer relationship management software; ERP = economic resource planning software; PC = personal computer; RFID = radio frequency identification technologies; SCM = supply chain management software.

Figure 1.4 Higher-productivity firms are more likely to use the internet, 2010–14

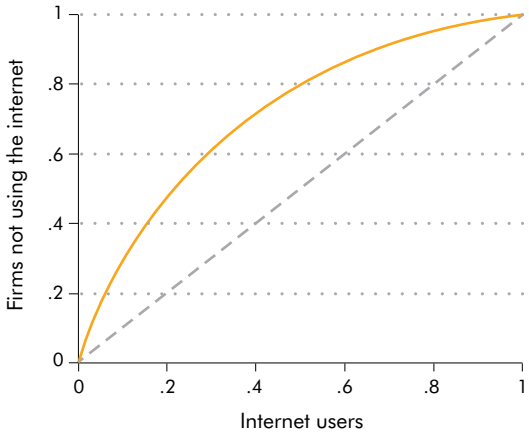


Source: Hussain (2015) based on World Bank Enterprise Surveys, various years. Data at http://bit.do/WDR2016-Fig1_4.

Note: The figures show the share of firms that have a website or use e-commerce among the different labor productivity quintiles across country income groups. "Qtl" refers to log labor productivity quintiles. The data, pooled for all years between 2006 and 2014, cover firms with at least five employees.

Figure 1.5 African firms using the internet are more productive, 2014

Distribution of sales per worker



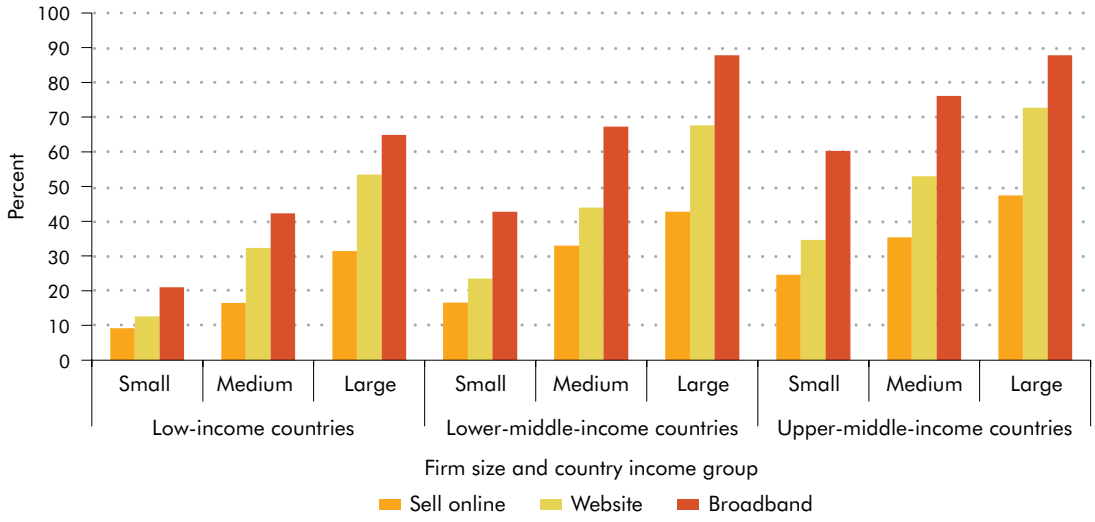
Source: Cirera, Lage, and Sabetti 2015. Data at http://bit.do/WDR2016-Fig1_5.

Note: The figure shows the relative distribution of productivity for firms that use the internet and firms that do not. Productivity is measured by sales per worker, estimated at the sector level. Results are similar using value added instead of sales. Observations on the 45-degree line indicate that firms in both groups have the same productivity. Firms not using the internet are less productive (above the 45-degree line) throughout the distribution of labor productivity. For instance, the median productivity firm among nonusers has about the same productivity as the 20th percentile firm of the productivity distribution among internet users. The surveys are representative of all firms with at least five employees in six African countries: the Democratic Republic of Congo, Ghana, Kenya, Tanzania, Uganda, and Zambia.

Firms that use digital technologies intensively also share other characteristics of high-productivity firms. They tend to be larger, fast-growing, skill-intensive, export-intensive, and located in the capital city.[7] Larger firms use the internet more intensively across all country income groups (figure 1.6), and 65 percent of large firms but only 21 percent of small firms use broadband internet in low-income countries. The differences are comparable for firms that use the internet for more demanding business activities: 17 percent of small firms deliver goods or services using the internet in lower-middle-income countries, compared with 43 percent of large firms.

Census and detailed survey data from Mexico, Turkey, and Vietnam confirm the positive correlation between internet use and the characteristics of high-productivity firms. Firms in Turkey using the web for online orders or reservations are 11 percent more productive, 25 percent larger, and twice as likely to export.[8] Those having a website are twice as productive, twice as large, and more than twice as likely to export as firms that do not have a website. In Mexico and Vietnam, firms are more productive if they have more computers per worker, conduct e-commerce, or have a higher share of workers using the internet.[9]

Figure 1.6 Larger firms use the internet more intensively across all income groups, 2006–14



Source: Hussain (2015) based on World Bank Enterprise Surveys, various years. Data at http://bit.do/WDR2016-Fig1_6.

Note: The figure shows the percentage of manufacturing and service firms that deliver orders over the internet, have a website, and use broadband internet by firm size across low-income, lower-middle-income, and upper-middle-income country groups. The data, pooled for all years between 2006 and 2014, cover only firms with at least five employees. Small firms have between 5 and 19, medium firms between 20 and 99, and large firms more than 100 employees. The statistics are based on about 100 countries (some countries being surveyed twice) and 27,035 firms selling online, 94,083 with a website, and 43,628 using broadband.

More trade, higher productivity, and greater competition

Digital technologies raise growth, but quantifying their aggregate impact is difficult

The accumulation of ICT capital accounted for almost 20 percent of global growth between 1995 and 2014, growth accounting approaches suggest. However, the results need to be regarded with some caution, as the approach involves some severe measurement problems (box 1.1). The impact was largest between 2005 and 2009, when it raised aggregate annual growth by 1.3 percentage points a year in developing countries, out of a total of 6.6 percent among these countries, or 19 percent (figure 1.7). And among high-income countries, it contributed 0.4 percentage points out of 1.2 percent, or 38 percent.[10]

Digital technologies accounted for a higher share of aggregate growth in high-income countries, pointing to greater digital use. The accumulation of ICT capital accounted on average for 27 percent of aggregate growth (2.1 percent) from 1995 to 2014 in high-income countries and 14 percent of aggregate growth (5.4 percent) in developing countries, consistent with their less intensive use of ICTs. Firms in developing countries have considerable room to adopt digital solutions that have led to growth in high-income countries, such as using the internet for e-commerce or inventory management.

The true contribution to growth can be larger if ICT complements other production factors, but also smaller if it substitutes for them. Productivity externalities beyond measured production factors are ascribed to the residual TFP growth. A necessary (but not sufficient) condition to accurately measure productivity externalities is analysis at the firm level.

Assessing the growth opportunities of the internet warrants more detailed analysis of the mechanisms for it to affect growth. Against this background, it is instructive to draw insights from the economics of the internet as well as from the past industrial revolutions (see box 1.2). The internet reduces transaction costs, allowing firms to enter new markets, enhance their efficiency, and exploit economies of scale, leading to innovation. It does this by reducing information frictions, search costs, and the costs to communicate. The decline can be dramatic if firms adapt their business models to automate data-intensive transactions, generating economies of scale.

Box 1.1 Tracing back growth to a single, new technology suffers from severe measurement problems

My view is that pinpointing precisely which (explanatory) variables matter for growth is impossible.
—Robert Barro, 2015

The limited number of observations relative to the seemingly open-ended list of other potential growth correlates at the country level makes it almost impossible to reject alternative interpretations of the same macroeconomic correlation. Faster-growing countries, for instance, have more resources and economic opportunities available to invest in information and communication technology (ICT) infrastructure; thus, the direction of causality may run from growth to ICT rather than the other way around. Moreover, there are severe endogeneity issues, since differences in the provision of ICT infrastructure across countries are likely to be positively correlated with (time-varying) unobservable, country-specific GDP correlates such as government accountability and other institutional factors, leading to an upward bias in ICT-growth elasticity estimates.

Cross-country growth regressions are not an appropriate tool to draw inference on the impact of ICT on growth. Numerous studies find a positive correlation between GDP growth and (lagged) values of different forms of ICT capital stocks based on cross-country growth regressions.[a] It is tempting to take the estimated ICT-growth elasticities at face value to quantify the impact of digital technologies on growth. But this approach has serious shortcomings. Most important, compared to the seemingly open-ended list of potential growth correlates, the sample sizes in cross-country growth regressions are fairly small due to the finite number of countries and the typically limited low-frequency time-series variation in the data.[b]

Growth accounting provides a less ambitious approach; it decomposes aggregate growth into the contribution of each production factor without getting to the issue of causality. But its precision also hinges on the ability to compute ICT capital stocks, which requires measuring depreciation rates and price indexes for digital technologies that appropriately reflect quality changes.[c] The approach also assumes that the contribution of each factor of production to output is proportional to the corresponding share in total input costs. So, the true contribution to growth can be larger or smaller.

Firm-level studies comprise large sample sizes and allow comparisons of the performance among firms operating in similar institutional environments. ICT investment is a firm's decision—still it is not plausible to assume that it is independent of performance. A positive productivity correlation in the data might simply capture that more productive firms use digital technology more effectively, indicating that other potentially unobservable firm-specific factors explain the positive correlation between digital technologies and firm productivity. In fact, many firm-level studies claiming to find productivity externalities still suffer from measurement and reversed causality problems.[d,e]

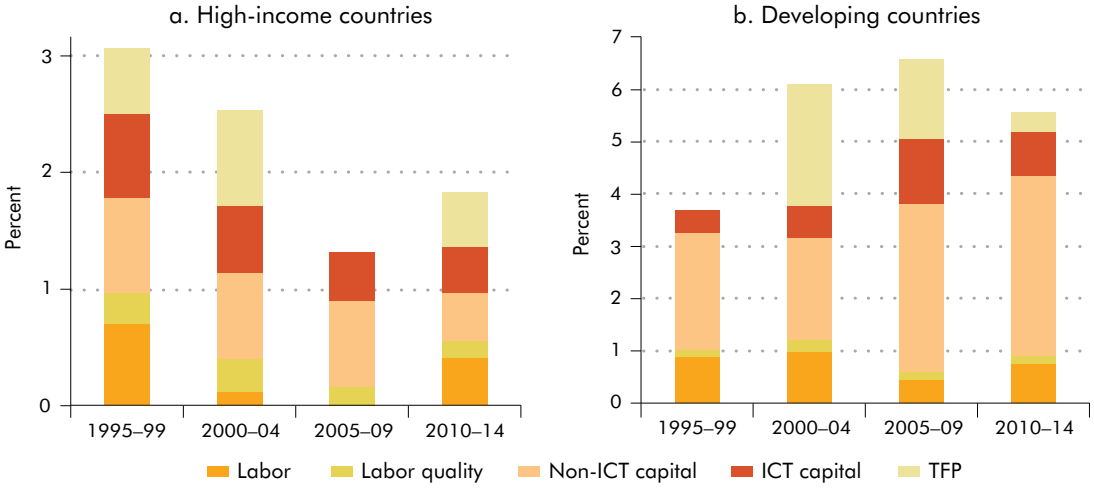
a. See Czernich and others (2009), Koutroumpis (2009), or Niebel (2014) for more recent contributions using cross-country regressions to assess the impact of broadband infrastructure on GDP growth. Qiang, Rossotto, and Kimura (2009); Cardona, Kretschmer, and Strobel (2013); and Minges (2015) provide surveys of the literature using cross-country regressions to assess the correlation between ICT capital and broadband internet on GDP growth, respectively.
b. Several researchers use methodologies, such as generalized method of moments (GMM) panel estimators, to address the endogeneity issue in cross-country growth regressions, but the results are typically not robust to small variations in the included countries, time periods, or control variables due to the large number of necessary country-level control variables, given the open-endedness of potential factors correlated with growth and ICT capital investments (Hauk and Wiczarg 2009).
c. But the acceleration in computing power (Moore's observation) involves a severe measurement problem, as conventional price indexes do not capture changes in quality of hardware or software. Jorgenson (2001) addresses this problem for hardware by constructing a constant quality index of computer prices using hedonic techniques. The Conference Board (2015) uses the World KLEMS data following this methodology, harmonizing the most recent techniques across countries.
d. See, for example, Gordon (2010, 2014) or Acemoglu and others (2014).
e. For instance, Draca, Sadun, and Van Reenen (2007) argue that causality has not yet been convincingly demonstrated.

The reduction in transaction costs thus increases inclusion (market access), efficiency, and scale, which translate into economic growth primarily through the three channels of trade, capital utilization, and competition.

Inclusion—facilitating international trade

Online marketplaces can reduce differences in the information available to buyers and sellers (for example, information asymmetries), enabling more firms in developing countries to engage in international

Figure 1.7 ICT capital accounted for nearly one-fifth of global growth, 1995–2014



Source: Conference Board 2015. Data at http://bit.do/WDR2016-Fig1_7.

Note: The figure shows the average contribution of factor inputs and TFP to aggregate growth for 39 high-income countries and 91 emerging economies. ICT = information and communication technology; TFP = total factor productivity.

Box 1.2 Is this time different? Predicting labor productivity growth at the technological frontier based on lessons from past industrial revolutions

History shows that productivity growth driven by general purpose technologies can arrive in multiple waves; it need not simply arrive, give what it has, and fade away forever thereafter.
—Chad Syverson, 2014

It is easy to find echoes of today's debates about the internet in the history of the industrial revolution. Each technological breakthrough comes with its own idiosyncratic variations, but much can be learned by studying the deliberations and experiences of the past.

Technological revolutions often take a long time to have significant impacts. The maximum impact of steam power on British productivity growth was not felt until the third quarter of the 19th century, nearly 100 years after James Watt's patent.[a] The benefits of railroads were fairly small initially, but grew as railroad productivity improved and rail output rose as a share of economic activity.[b] Similarly, investments in electrical capital equipment did not have important spillovers until the 1920s.[c] Initially, factory owners simply replaced large steam engines with large electric ones. It took nearly 40 years after electricity was widely available in the United States for organizational methods to catch up and develop more efficient decentralized production lines.

How do information and communication technologies (ICTs) stack up with past major general-purpose technologies? For instance, electricity led to the invention of air conditioning, elevators, and home appliances half a century later. Arguably, the internet can be regarded as a major follow-up invention from the computer (or microchip), just as the internal combustion engine led to the interstate highway system in the United States 60 years later. The internet boosts the productivity of computers and mobile phones in the same way that highways boosted the productivity of cars and trucks.

U.S. data show that labor productivity increased on average by 2.4 percent annually after the inventions of the internal combustion engine, electricity, and running water between 1891 and 1972. Then it slowed, averaging only 1.4 percent annually between 1973 and 1996. Between 1996 and 2004, it surged again, growing 2.5 percent annually, which scholars ascribe to the fast spread of the internet.[d]

(Box continues next page)

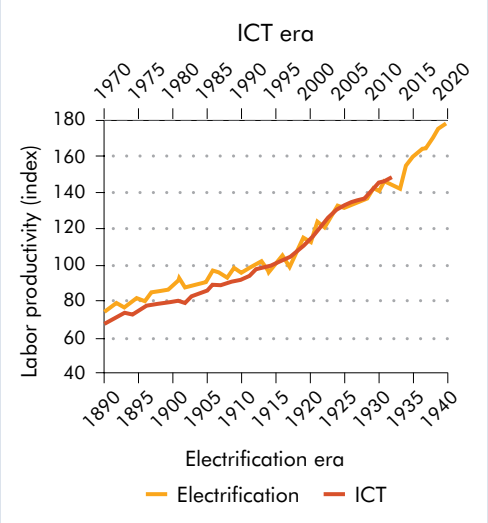
Box 1.2 Is this time different? Predicting labor productivity growth at the technological frontier based on lessons from past industrial revolutions *(continued)*

Since 2004 aggregate productivity growth has returned to its pre-1996 level, averaging 1.3 percent annually.

Does the 2004–13 productivity slowdown in the United States reflect a petering out of the ICT revolution? Gordon interprets this as a sign that the IT (or internet) revolution does not have the same lasting impact as previous industrial revolutions triggered by the internal combustion engine or electricity.[e] But the difficulty of tracing a country's growth performance to a single new technology, given severe measurement and endogeneity problems, allows alternative interpretations of the same recent historical trend.

Syverson overlays U.S. labor productivity in the electrification era and the ICT era to show that productivity growth in both eras has exhibited remarkably common patterns so far (figure B1.2.1).[f] During the electrification era, labor productivity growth over the first 25 years was relatively slow, just as it was in the ICT era from 1970 to 1995. Then both eras saw decade-long accelerations in productivity growth, spanning 1915–24 for electrification and 1995–2004 for IT. Analogous to the 2004–12 slowdown, labor productivity growth slowed again in the electrification era in 1924–32. Then labor productivity growth in the electrification era sped up again, averaging 2.7 percent annually in 1932–40. This does not necessarily suggest that labor productivity in the United States will pick up again in coming years.

Figure B1.2.1 U.S. labor productivity during the electrification era (1890–1940) shares remarkably common patterns with the ICT era (1970–2012)



Sources: Syverson 2013; Crafts 2015.

Note: ICT series years are labeled on the upper horizontal axis; the series is indexed to a value of 100 in 1995. Electrification series years are labeled on the lower horizontal axis; the series is indexed to 100 in 1915. ICT = information and communication technology.

a. Von Tunzelmann 1978.
b. Fogel 1965.
c. David 1990.
d. Gordon 2014; Syverson 2013.
e. Gordon 2010, 2014. Byrne, Oliner, and Sichel (2013) use a growth decomposition of long-term time-series data and come to a similar conclusion.
f. Syverson 2013.

trade (box 1.3). To purchase any product, the buyer must find a seller, make a payment before receiving the goods, and trust that the seller will deliver the correct amount and quality on time. As a result of these information asymmetries, only the most productive firms export—typically the larger and older firms.[11] Online marketplaces help solve all three problems. They provide an organized marketplace for firms to advertise their products and find buyers in overseas markets.[12] They thus reduce the costs of trade by enabling firms to avoid intermediaries to establish trade connections or participate in costly trade fairs to market their products. Online marketplaces that operate internationally, like eBay, Amazon, and Alibaba, operate websites in local languages. Online marketplaces also include rating systems, allowing the buyer and seller to assess each other's performance. The ratings and individual comments, visible to anyone, build trust for future transactions and encourage more responsible behavior. Many online marketplaces also provide payment and delivery services to reduce the cost of e-commerce. Digital technologies also lower communication costs facilitating the unbundling of tasks, allowing firms to offshore production processes and services to developing countries at lower costs.

Box 1.3 Is the internet reshaping economic geography? Not yet.

Fifteen years ago, a widely read study pronounced the death of distance and concluded that, with better and cheaper communication technology, geography will no longer influence individuals and firms. It argued that the internet is making it easier and cheaper to communicate over long distances. Goods and services, increasingly virtual and weightless, can be delivered over the internet. That makes location irrelevant to what an individual consumes, to where an individual works, or to where the firm establishes its business.[a]

Even though the internet has reduced the economic distance between countries, geography still determines flows of goods and services. Bilateral trade between countries is still negatively related to the distance between them after controlling for the effects of the internet.[b] And online transactions are still negatively related to distance: transaction values on online market platforms like eBay in the United States and MercadoLibre in Latin America decline when the distance between buyers and sellers increases.[c] Internet websites hosted in countries closer to the United States receive more visits by U.S. consumers.[d] More generally, the number of online transactions globally declines when the bilateral distance between buyers and sellers increases.[e] Even so, the relationship between trade flows and geography is weaker for online transactions than for offline transactions.

The impact of distance on digital goods may at first seem counterintuitive, given that they are weightless and delivered over the internet. But distance might be capturing taste preferences that can influence online activities. The effects of distance are not uniform across all website visits. Instead, websites selling digital goods that are differentiated and dependent on taste (music and games) are affected by distance, but more standard digital goods (software and financial information) are not.[f] The effect of distance on online transactions also differs across product categories, where goods that appeal to a local market (tickets and sports memorabilia) are most affected by distance.[g]

The impact of the internet on the location decisions of firms and the geography of jobs is less clear. The internet facilitates the dispersion of firms by allowing better communication between workers performing complex tasks and greater disintermediation of production processes. And it enables the dispersion of jobs, as individuals find work regardless of their location through online labor exchanges (chapter 2). But it also opens locations previously considered economically unfeasible and allows firms to cluster in locations to take advantage of comparative advantage, further enabled by better communication technology.[h] Jobs are clustered in these locations because the firms want to access the dense labor market and specialized inputs suppliers. The equilibrium effect of the internet on the location of firms and jobs is difficult to determine, but the final global pattern of firm location could be many clusters connected by the internet.[i]

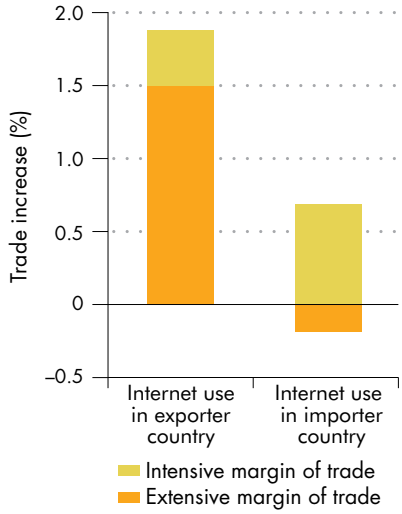
a. Cairncross 2001.
b. Freund and Weinhold 2004.
c. Hortaçsu, Martínez-Jerez, and Douglas 2009; Lendle and others 2012.
d. Blum and Goldfarb 2006.
e. Cowgill and Dorobantu 2014.
f. Blum and Goldfarb 2006.
g. Hortaçsu, Martínez-Jerez, and Douglas 2009.
h. Leamer and Storper 2001.
i. Venables 2001.

More internet use in a country is positively related to the growth of bilateral exports of goods and services.[13, 14] The relationship tends to depend on country income. Higher internet use in a developing country is related to higher exports to high-income countries, but not necessarily to other developing countries. Higher internet use in developed countries, in turn, has no effect on their exports. The similarities in internet use between trading partners can also affect how the internet affects trade. The trade between two countries is 25 percent higher if both countries have high internet use and 31 percent higher if the exporter has high internet use and the importer has low internet use, relative to two countries with low internet use.[15]

Enabling more firms to reach new markets

The internet makes it easier to reach new markets and thereby increases the extensive margin of trade—more firms start to export and more products get exported. A 10-percent increase in internet use in an exporting country increases the number of products traded between two countries by 1.5 percent; this increase in the extensive margin can account for as much as 78 percent of the total effect of the internet

Figure 1.8 The internet enables more firms to reach new markets, 2001–12



Source: Osnago and Tan 2015. Data at http://bit.do/WDR2016-Fig1_8.

Note: Extensive margin of trade: more firms start to export and more products get exported; *intensive margin of trade:* exporters increase the amount of their exports for the same products.

on trade (figure 1.8). The impact of the internet is largest if both countries have high internet use.[16]

Online platforms allow smaller firms to become exporters. The firms selling on eBay in Chile, Jordan, Peru, and South Africa are younger and have smaller market shares than firms in the offline markets.[17] The Alibaba platform has a larger fraction of small firms than the offline market.[18] Firms exporting through Alibaba also sell more products per firm.[19]

Online platforms enable firms to reach new export destinations, changing trade patterns. Marketing goods globally on the internet is cheaper, and customizing the marketing information to suit the local context and language is easier. So, firms trading through online platforms can reach more destinations than their offline peers. Chinese companies selling on Alibaba reach an average of 3 and a maximum of 98 export destinations,[20] up from an average of one and a maximum of 50 export destinations for the offline firms.[21] The set of export destinations also differs for firms exporting online or offline in China. And a larger share of the online exports reach emerging markets such as Brazil, Colombia, India, Nigeria, the Russian Federation, and Ukraine, compared with exporting offline, which is more intensive in low-income countries or traditional high-income markets such as Germany, Japan, and the United States (map 1.2).

Looking forward, the rise of online marketplaces can accelerate the integration of developing countries into world markets, opening substantial opportunities for trade and future growth. In China, Alibaba already enables smaller and younger firms to sell more products and reach more new consumers or businesses in foreign countries. Online marketplaces also emerged in other developing regions, but so far only on a (much) smaller scale or for market niches. The Moroccan online platform Anou enables artisans in rural areas to directly export their products online, cutting out traditional middlemen.[22] The Kenyan online platform iProcure prescreens its vendors to provide reliable local procurement services connecting agricultural businesses and institutional buyers.[23] So, e-commerce platforms should have substantial growth effects if they achieve sufficient scale in developing regions (see box 1.4).

Increasing the volumes of exported products

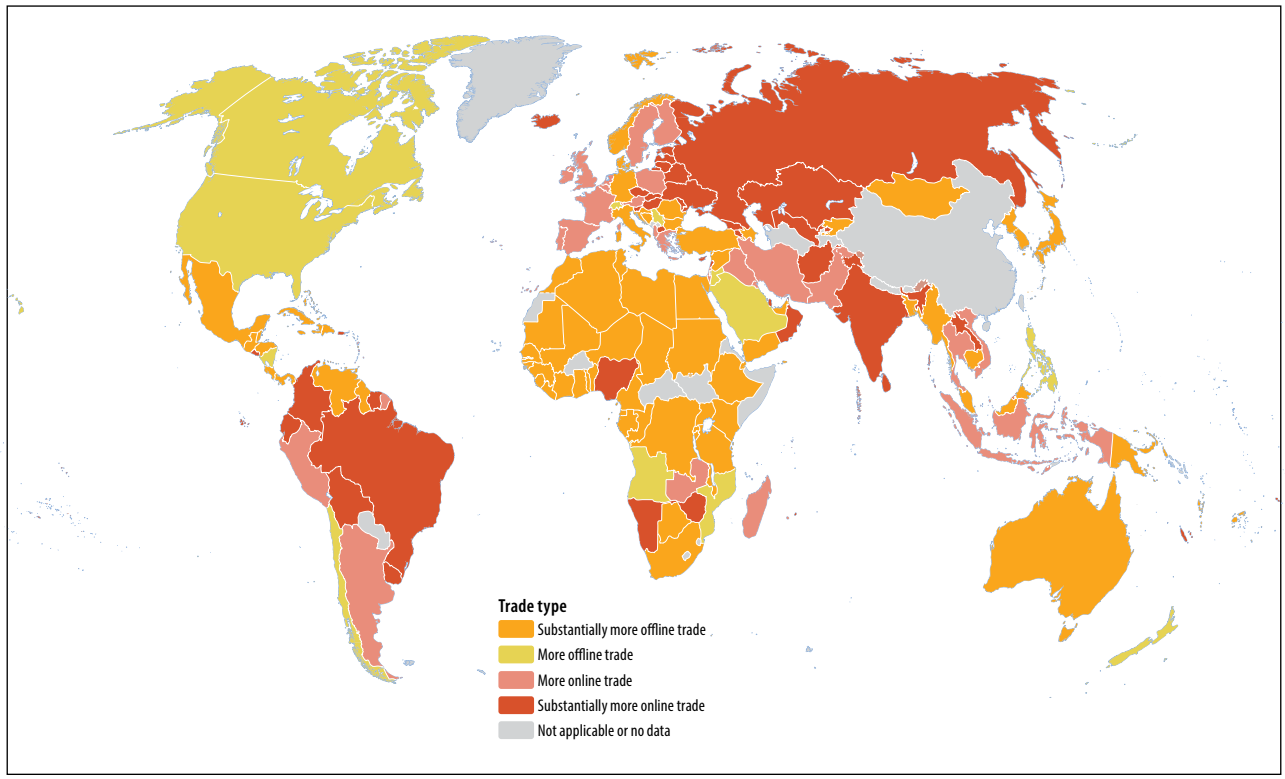
The intensive margin of trade—defined as the average trade per firm or product—increases with the internet penetration of countries. A 10-percent increase in the internet use of a country pair increases the average bilateral trade value per product by 0.6 percent. More specifically, the average export value per firm increases by 1 percent if internet use increases by 10 percent in the exporting country; it increases by 0.5 percent if internet use increases by 10 percent in the importing country.[24]

The rollout of broadband infrastructure boosted exports and labor productivity in China even in the era before Alibaba, from 1999 to 2007. The number of internet users increased across all provinces between 1997 and 2007, though it was stronger in coastal areas in the earlier years and in several inland provinces in later years.[25] The value of real exports seems to have followed a similar pattern.[26] The increase in internet domains and users per capita had a positive impact on firms' manufacturing exports in ICT-intensive sectors.[27] It raised the number of firms that export, the firms' share of export in total sales, and the real value of firms' exports. The higher share of internet domains and users also increased firms' real output and labor productivity.

Facilitating the unbundling of tasks

Better communication technologies have facilitated the unbundling of tasks, the "second unbundling" of international trade.[28] Businesses can locate different stages of their production in different host

Map 1.2 China's export destinations differ for firms using online platforms, 2006 and 2014



Source: Chen and Xu 2015. Data at http://bit.do/WDR2016-Map1_2.

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Note: Countries are grouped according to their share of total revenue in online trade relative to offline trade. Online trade is measured by Alibaba platform transaction data, and offline trade by customs data. *Substantially more offline trade* is a ratio below 0.5 for the share of a country's online exports in world online exports divided by the share of its offline exports in world offline exports. *More offline trade* is a ratio between 0.5 and 1. *More online trade* is a ratio between 1 and 4.75 (75th percentile). *Substantially more online trade* is a ratio above 4.75.

Box 1.4 Successful online platforms account for local context and institutions

Successful online platforms cannot necessarily be transplanted to a foreign country without adapting to the local market and local institutions. The entry of eBay into China illustrates this. Both eBay and Taobao, Alibaba's consumer-to-consumer (C2C) platform, entered the Chinese market in 2003. eBay immediately established its dominant market share of 85 percent by acquiring the Chinese market leader, EachNet.[a] Taobao, however, quickly assumed a dominant position. By 2014, it accounted for over 80 percent of the Chinese C2C market (eBay exited the Chinese market in 2006).

Alibaba's success can be explained (at least in part) by its ability to adapt to local market conditions and culture to remove the information asymmetries unique to the Chinese C2C market. The Taobao website, for instance, indicates whether sellers are online and allows buyers to communicate instantly with the sellers through an online messaging system.[b] Alibaba further guarantees foreign buyers in-time delivery of their money and implemented a system to verify sellers on its website for business-to-business (B2B) transactions. Firms can buy a gold supplier status to have a third-party verification company conduct on-site quality control.

a. Wulf 2010.
b. Ou and Davidson (2009) note that Chinese consumers want to be able to communicate with their sellers and solve any problems relating to the transaction immediately.

countries to achieve greater efficiency in each stage. This unbundling of tasks allows firms to outsource production processes and services to developing countries at lower cost, which in turn increases trade in intermediate goods and places more importance on global supply chains. This trend has, for example, enabled the strong growth in business process outsourcing in Eastern Europe, India, and the Philippines. The foreign value added content of exports increased substantially along all major trade routes over the past 20 years, particularly among Asian economies.

Digital technologies reduce the costs of offshoring, especially when the host country has significant human capital. So, production structures become more globalized, and more firms choose to offshore different stages of their production. Higher use of ICTs by firms allows headquarters to manage increasingly complex functions, enabling them to confidently send these functions overseas.[29] As communication costs decline, exports of headquarter services to foreign affiliates, such as professional and technical services, increase.[30] These functions are, however, complex, implying that firms select host countries based on their human capital.[31]

Better use of digital technology in a country encourages multinational firms to locate their subsidiaries there. Many foreign subsidiaries are in countries with high business use of the internet, and the entry of a multinational into a foreign market is positively correlated with business use.[32] And the provision of digital technology in the host country has a stronger effect on the entry of multinational firms when the firm is in an industry that uses communication technology more intensively and has fewer routine tasks.

The unbundling of tasks has driven the tripling of service trade over the past 15 years, particularly for business, professional, and technical services such as legal, advertising, consulting, and accounting. The internet makes it easier for headquarters to transmit information, supervise their factories, and coordinate the supply chain across borders, encouraging firms to outsource not only manufacturing but also service tasks. Trade in education and professional services has also increased.[33] Trade in education services prior to the internet was conducted through correspondence courses, with textbooks and course materials mailed between instructors and students. Now websites provide massive open online courses, known as MOOCs, with video and other materials over the internet. They also connect health service providers enabling the spatial unbundling of health services, such as radiology. Similarly, professional and technical services can be supplied internationally over the internet. Online platforms like Upwork (formerly Elance-oDesk) create marketplaces for freelancers to provide these services (see chapter 2).

Efficiency—raising firms' utilization of capital and labor

Digital technologies help firms save costs by automating data-intensive production processes and reorganizing their business models, increasing their productive use of capital and labor.[34] Computers and software allow firms to routinize processes, increasing management efficiency and replacing personnel with, for instance, human resource or supply chain management software. The internet further increases the opportunities for cost saving by connecting machines, suppliers, and clients, so that firms can manage their supply chains and inventory more effectively in real time. The extent to which digital technologies raise labor productivity depends on firms' activities, but examples abound across countries and economic sectors.

The vast majority of efficiency gains emerge outside the ICT sector, where firms use the internet to sell and market their products online or share real-time information with suppliers to minimize their inventory and with customers to optimize their services. The digital economy accounts for about 6 percent of GDP in OECD countries (box 1.5). Less visible but more important for growth, incumbent firms in traditional sectors invest in digital technologies to save costs by optimizing their production and management processes. Retail companies such as Walmart, for instance, have integrated (global) supply chains to minimize their inventory holdings by linking electronic cash registers at retail outlets and business-to-business ordering systems with order dispatch and transportation scheduling at remote factories. So far, the largest efficiency gains from firms using digital technologies have been found in wholesale and retail trade, business services, insurance, finance, and selected manufacturing sectors. The following section highlights selected illustrations of how digital applications boost firms' efficiency.

Increasing management efficiency

Crowdsourcing information through mobile phone applications is helping farmers in Tanzania to prevent the outbreak of diseases. In Tanzania's Lake Zone, 60 groups of farmers from 10 districts belonging to the Digital Early Warning Network prevent the outbreak of the cassava disease by crowdsourcing

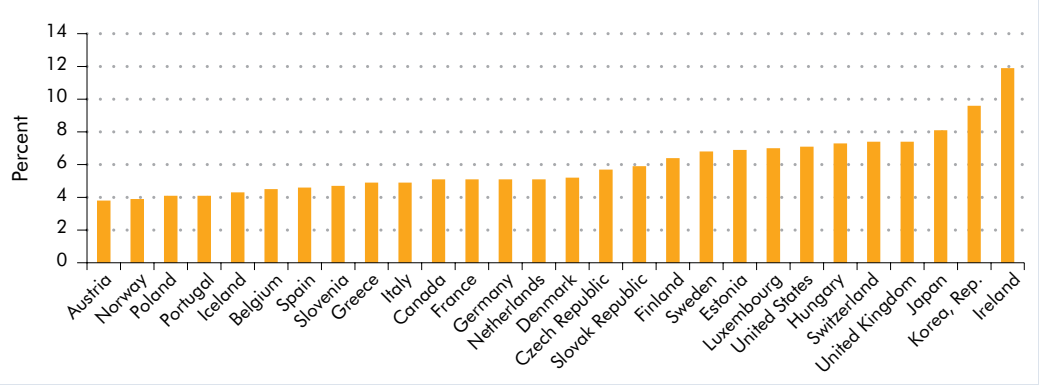
Box 1.5 The growth impact is largest when firms in traditional sectors use digital technologies to modernize their business

The digital economy accounts for about 6 percent of gross domestic product (GDP) in OECD (Organisation for Economic Co-operation and Development) countries (figure B1.5.1).[a] In the United States, which hosts some of the biggest tech companies, the value added of information and communication technology sectors in GDP is 7 percent, compared with 13 percent in real estate, renting, and leasing; 12 percent in wholesale and retail trade; and 8 percent in finance and insurance or health and social services.[b] The value added of information and communication technology (ICT) sectors in GDP is the highest in Ireland (12 percent), thanks to large inflows of foreign direct investment. In Kenya, which hosts one of the largest ICT sectors among African countries, the value added share of ICT services in GDP was 3.4 percent in 2013; that includes telecommunications (and thus mobile money).[c]

Despite the strong growth and high market valuations of internet firms offering conventional services, their market shares in these traditional sectors to date have been relatively small. Consider Amazon. In the United States, its home market, Amazon accounted for only 1.7 percent of the retail market in 2014; e-commerce accounted for about 7 percent of the U.S. retail market in 2015. By contrast, offline sales accounted for more than 99 percent of all sales of food and beverages; 84 percent of clothing and furniture; and 59 percent of books, magazines, and music.[d]

Less visible but more important for growth, incumbent firms in traditional sectors invest in digital technologies to save costs by optimizing their production and management processes. The McKinsey Global Institute estimates that 75 percent of the economic impact of the internet in 12 large developing and developed countries originates in firms in traditional sectors—firms that would exist without the internet but that use it to increase their cost-effectiveness.[e] The findings are consistent with studies showing that the bulk of U.S. productivity growth over the past 15 years originated in ICT-using, not-producing sectors.[f]

Figure B1.5.1 The ICT sector accounts for 4–7 percent of GDP in most OECD countries, 2011



Source: OECD 2015. Data at http://bit.do/WDR2016-FigB1_5_1.

Note: ICT value added is the difference between the ICT sector's gross output and intermediate consumption. The data are from 2011. The aggregate of information industries here includes ISIC rev. 4 division 26 (manufacture of computer, electronic and optical products) and section J (information and communication), which in turn comprises divisions 58–60 (publishing and broadcasting industries), 61 (telecommunications), and 62–63 (computer programming, and information service activities). ICT industries are broadly defined, as they include publishing and broadcasting, trade and repair activities, and media and content industries (Division 63.9).

a. The McKinsey Global Institute (Manyika and others 2011) used a different approach to compute the contribution of the internet to GDP. It computes the total value of three main activities based on the internet: activities using the internet as support (e-commerce, online content, or advertising); internet service providers; and software and internet service activities such as IT consulting, hardware manufacturers (computers, smartphones, or hardware equipment). They find that these activities account on average for 3.4 percent of GDP among the G-8 countries, Brazil, China, India, the Republic of Korea, and Sweden in 2009. The impact is largest among the developed countries. The shares include publishing and broadcasting activities and media and content industries.
b. The classification includes internet firms such as search engines, but not online retailers. The market share of online retailers is, however, still relatively small: Amazon accounted for only 1.7 percent of the retail market in the United States in 2014; see http://www.bea.gov/.
c. World Bank 2015.
d. *Economist* 2014, 2015b.
e. McKinsey Global Institute (Manyika and others 2011). The results are based on a survey of 4,800 small and medium enterprises in the following 12 countries: Canada, China, France, Germany, India, Italy, Japan, the Republic of Korea, the Russian Federation, Sweden, the United Kingdom, and the United States.
f. See, for example, Jorgenson 2001, 2011.

information.[35] Each farmer has a topped-up phone card and has been trained to recognize early symptoms of cassava mosaic disease and brown streak disease. The farmers use the mobile phones to send monthly text messages to researchers about disease incidence. In return, they receive advice on disease control, and disease experts visit the area when more than 10 percent of the members of a group report the disease. The network, part of the Great Lakes Cassava Initiative, supports more than 1 million farmers in six countries.

Digital technologies help farmers in Botswana meet quality and traceability requirements for beef exports to the European Union. The farmers use the Livestock Identification Trace-Back System, based on transponders inserted into each animal, transmitting information automatically to databases in 46 district offices. The centrally stored data allow exporters to trace beef to the individual cattle and their owners, necessary to meet traceability requirements for imports into the European Union. The technology also helps improve veterinary services and save costs by optimizing feeding schedules.

Digital interventions in agriculture seem to work best when the information provided to farmers is simple, such as real-time prices or weather forecasts. Based on simple mobile phone applications or internet kiosks, real-time data improve farmers' access to prices, local weather forecasts, and more detailed advice on agricultural practices and input use (see sector focus 1).

Real-time data help equipment manufacturers in China turn over their inventory stocks five times faster than suppliers not connected to the internet. Supply chains and logistics operations account for 10–20 percent of Chinese equipment manufacturers' costs, so companies using real-time data to optimize inventories and transportation routes can achieve substantial efficiency gains. Anji Logistics, a wholly owned subsidiary of Shanghai Automotive Industry Corporation, connects its IT systems with dozens of Chinese equipment manufacturers to manage logistics. General Motors China has cut costs and improved customer satisfaction by building internet connectivity into cars, so that dealers can check faults remotely and send maintenance alerts to owners. With only 20–25 percent of small manufacturing firms in China estimated to have used the internet in 2013, there clearly is more scope to improve manufacturing efficiency.[36]

The Egyptian logistics firm RW uses the online platform En2ly to optimize supply chains, shortening the time to deliver goods. The platform ensures more efficient real-time communication and coordination with clients and gives RW access to a large pool of independent carrier trucks. Each truck has a global positioning system (GPS), so RW can track shipments in real time and be notified once the shipment is delivered. The technology shortens the supply chain gap between shipment and delivery in the domestic market, allowing RW to provide superior transport services at more competitive rates.

Connected water metering systems help municipalities identify leaks or changes in water use, reducing water losses by up to 10 percent. At its research center in France, U.S. manufacturer Itron developed water metering systems with wireless devices allowing remote reading over large distances, so that municipalities can reorganize maintenance and respond immediately to water waste or losses in the distribution network. The data also improve water consumption analysis to optimize client service and tariff structures. Itron's production of communication devices has increased fifteenfold since 2000, and its production of water meters threefold. Such connected metering systems have great potential to save drinking water—more than 30 percent of the drinking water produced worldwide never reaches the customer (often due to leaks).[37]

Looking forward, the internet of things should further increase the labor productivity of firms, implying substantial opportunities for more efficient business models and thus future growth (see spotlight 6). For instance, the German truck body and trailer manufacturer Schmitz Cargobull uses telematics (the integrated application of telecommunications and data) in its trailers for real-time sharing of data with drivers, freight agents, and customers on maintenance, loaded weights, cargo temperatures, and truck locations. The company adjusted its organizational structure and management practices to maximize efficiency gains and escape competition from low-wage countries. As a result, the firm's production pace necessary to meet customer demand fell by 90 percent, internal failures decreased by 92 percent, and yearly accidents declined by 95 percent between 2000 and 2013, as its market share for refrigerated trailers in Europe rose to 50 percent.[38]

Enabling online marketing and distribution

Firms are finding new and more efficient ways to market and distribute their products online. Carmakers represented on the internet in China can attend to about 10 million searches each day on Baidu, reducing their marketing and sales costs relative to nonconnected manufacturers. Volkswagen, for instance,

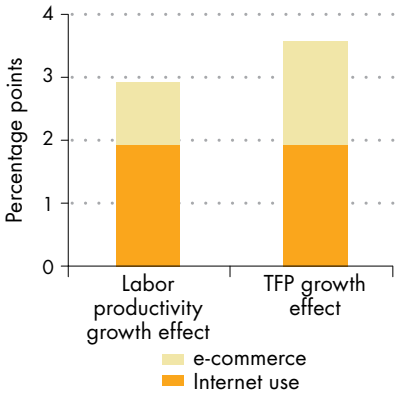
is selling cars online to Chinese customers through its own website and on the e-commerce site Tmall.[39] Other manufacturers in China have been working with search engines to gain deeper insights into customer preferences to incorporate them in product development.

Vietnamese firms using the internet for e-commerce had 3.6 percentage point higher productivity growth in subsequent years. The rollout of broadband internet infrastructure in Vietnam (see map 1.1) is positively correlated with firm productivity growth. Using the internet increased TFP growth by 1.9 percentage point; firms also doing e-commerce increased TFP growth by an additional 1.7 percentage point (figure 1.9). The effect of e-commerce is larger in sectors that use ICT more intensively, consistent with a causal impact on productivity growth (see box 1.6).[40]

Innovation—intensifying competition and creating new business models

Online services and platforms eliminate search and communication costs, increasing price transparency and lowering the fixed costs to start a business. Lower fixed and marginal costs enable new startups to exploit scale economies from the beginning, supporting their rapid growth. The transaction costs for each new customer is almost zero for some services,

Figure 1.9 Vietnamese firms using e-commerce have higher TFP growth, 2007–12



Source: Nguyen and Schiffbauer 2015 for the 2016 WDR. Data at http://bit.do/WDR2016-Fig1_9.

Note: Results are based on a regression of TFP or labor productivity growth on the one-year lag of a dummy if the firm used the internet and the one-year lag of a dummy if the firm also conducts e-commerce. The regressions control for year fixed effects, province fixed effects, industry fixed effects, firm age, firm size, foreign ownership, exports status, state ownership, and the share of workforce with a secondary schooling degree. The internet or e-commerce effects are significantly larger in ICT-intensive industries, measured by World KLEMS two-digit sector-level data for Japan or the United States; two-digit sector-level data on telecommunication expenses in China; or four-digit sector-level data from a Vietnamese firm census, 2007–12, with more than 300,000 observations each year. ICT = information and communication technology; TFP = total factor productivity.

Box 1.6 Do digital technologies embed productivity externalities?

Firms' total factor productivity (TFP) growth in high-income countries is often positively associated with information and communication technology (ICT) capital accumulation.[a] The relation has been stronger in the United States relative to the European Union, particularly in ICT-using sectors, such as retail and wholesale trade, finance, and other business services.[b] The few studies for developing countries show that the correlations between firms' ICT capital stock and TFP growth in Brazil and India are comparable to those estimated for high-income countries.[c] A few recent studies focus on the impact of rolling out broadband infrastructure on firm productivity growth, but the results are ambiguous.[d]

Knowledge spillovers?

Some recent studies suggest a causal impact of firms' use of digital technologies on their TFP growth.[e] Identifying a causal impact requires that the spatial sequencing of ICT infrastructure rollout must be independent from productivity growth in the different locations. Such a case is arguably provided by the limited funding of a public program rolling out broadband internet access points in Norway in the early 2000s; the expansion of broadband increased firms' productivity.[f] Another study shows that establishments owned by U.S. multinational companies in the United Kingdom use their ICT capital stock more productively (after takeovers) relative to domestic firms and establishments owned by multinationals from other countries. This productivity differential is highest in exactly the same sectors that were responsible for the U.S. productivity surge from ICT investments in the 2000s, pointing to a causal impact of ICT on firm productivity among U.S. firms in these sectors.[g]

Foreign direct investment spillovers?

Foreign direct investment (FDI) in Jordan's ICT sector did not lead to growth spillovers among domestic firms

(Box continues next page)

Box 1.6 Do digital technologies embed productivity externalities? *(continued)*

interacting with the foreign tech companies. Neither domestic firms supplying goods or services to foreign tech companies (backward linkages) nor domestic firms consuming their services (forward linkages) grew as results of such linkages. The lack of measurable growth spillovers could be due to the relatively small number of foreign multinationals in the ICT sector (8 in ICT-producing sectors, and 160 in ICT-using sectors). And there are still relatively few domestic ICT companies in Jordan, such as software programmers, which are expected to benefit most from linkages with foreign tech companies. Furthermore, foreign firms like Microsoft or Oracle might use Jordan primarily as a hub to support regional activities involving few linkages to the domestic economy. The lack of spillovers to ICT-using sectors in Jordan suggests that Jordanian firms import ICT services rather than depend on the presence of foreign tech companies in the country.[h]

Producing new products and processes?

Broadband internet increases innovation. A study of German firms shows that broadband (DSL) infrastructure rollout between 2001 and 2003 increased firms' process and product innovation once broadband internet was available within their districts (measured by the postal code).[i] A study of six African countries finds that more intensive use of computers or the internet enabled more product and process innovation in 2014.[j]

Production technologies differ in whether they are more or less widely applicable across products or industries. That is, some knowledge can be more readily adapted for use in related production processes while other knowledge is limited in its application. So, products or industries embodying more applicable technologies also have more scope for technology externalities. A recent study uses patent citation data from the U.S. Patent and Trademark Office to trace the bilateral direction and intensity of knowledge flows between technologies. It finds that digital technologies typically are more widely applicable in driving the discovery of new technologies.[k]

Increasing international technology diffusion?

The internet reduces geographic distances, which are the main predictor of international technology diffusion. Technology spillovers provide an indirect channel for digital technologies to boost efficiency and thus firm productivity growth beyond firms' measured ICT capital stocks. For instance, the internet might facilitate the (international) diffusion of technologies by providing access to relevant information or inducing knowledge spillovers between users. The literature suggests that geographic distances are barriers to international technology diffusion.[l] Likewise, several studies find that bilateral trade flows embed learning externalities, spurring the diffusion of technologies. This Report provides evidence that the internet enhances trade and reduces distance, suggesting that the internet facilitates the international diffusion of technologies, even though the growth contribution of this channel is difficult to verify empirically.

a. Cardona, Kretschmer, and Strobel 2013.
b. See, for example, Inklaar, Timmer, and van Ark 2008; Schiffbauer, Serafini, and Strauch 2011; Bloom, Sadun, and Van Reenen 2012.
c. Commander, Harrison, and Menezes-Filho 2011.
d. Haller and Lyons (2015); Colombo, Croce, and Grilli (2013); and Bertschek, Cerquerab, and Kleinc (2013) do not find a significant impact of the rollout of broadband infrastructure on firm productivity in Ireland, Italy, and Germany, respectively. By contrast, Grimes, Ren, and Stevens (2012) and Akerman, Gaarder, and Mogstad (2015) find a positive impact in New Zealand and Norway, respectively. The results might suggest that moving from basic internet access to broadband leads to only marginal productivity improvements. However, it might also be too early to measure the effect of high-speed internet in firm-level data, since firms' use of the internet is often still relatively basic.
e. Most studies attempt to address the endogeneity problem by using lagged ICT or human capital variables as instruments. However, unobserved transitory shocks (or unobservable firm-specific factors) lead to serial correlation in ICT and productivity measures that make these types of instrumental variables invalid.
f. Akerman, Gaarder, and Mogstad 2015.
g. Bloom, Sadun, and Van Reenen 2012.
h. See Lamla and Schiffbauer 2015.
i. See Bertschek, Cerquerab, and Kleinc (2013). The authors analyze the impact of DSL infrastructure rollout in Germany in an early phase, when about 60 percent of German firms already used broadband internet.
j. Cirera, Lage, and Sabetti 2015.
k. Cai and Li 2015.
l. See Keller 2002; Keller and Yeaple 2013.

enabling scale effects and increasing the profits from innovation. Such scale effects inspire new business models based on the internet in services ranging from retail trade, transport, and logistics to tourism and finance. Innovations include mobile money, digital marketplaces, price comparator websites, online media, and the sharing economy. The substantial scale effects for some activities have also led to digital

goods trading exclusively online, as for e-books, online search, and streaming music and videos—making transport, storage, and distribution obsolete.

Intensifying competition

Price comparator websites enhance transparency in prices and result in lower and less dispersed prices for consumers. Consider term-life insurance, where average prices have fallen up to 15 percent in the United States after the introduction of comparator sites.[41] These websites emerged in 1996 and eliminated the previously high markups. The potential customer fills out a medical questionnaire online, and the sites report quotes from companies that offer a suitable policy. In almost all cases, the individual does not buy the product directly online but gets connected instead to the offline seller. Comparator sites essentially provide an information platform between the consumer and the life insurance company that formerly was available only to brokers. In contrast, the prices of whole-life insurance, which were not covered by these sites, were not affected—whole-life insurance is a more complex product including built-in saving components, leaving more room for asymmetric information across buyers and sellers; a decline in search costs is thus less relevant.

Online registration systems can lower the cost of entry for new players, increasing competitive pressure for incumbents. The number of newly registered limited liability firms has increased, on average, 56 percent after the introduction of online registration systems (from 2.7 per 1,000 working-age population in years before the reform to 4.2 in the years after).[42] But this positive average impact masks heterogeneity across countries (figure 1.10). Thirty-three countries introduced online registration systems for firms between 2006 and 2012. The entry density declined somewhat in 8 of the 33 countries.

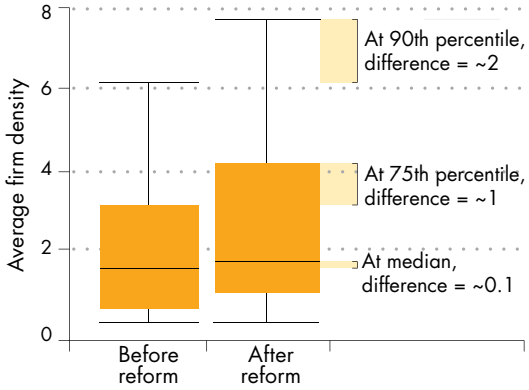
Two out of three firms experience moderate or severe competition from digital innovations. The share of firms reporting competitive pressure from traditional competitors is somewhat higher than the share of firms reporting competitive pressure from digital technology startups (figure 1.11). Firms in traditional sectors using digital technologies to modernize their business are thus an important source of competition (see also box 1.5).[43]

Bringing competition to incumbent firms

The internet has created new types of startups that base their business model entirely on the web but offer traditional services such as retail trade, finance, transport, logistics, tourism, media, publishing, and advertising. These new business models dissolve the boundaries between the online and offline economies and can help break existing regulatory barriers to entry in sectors that are often protected from competition.

Mobile money spurs competition in finance. Safaricom, the leading telecom firm in Kenya, launched the mobile money service M-Pesa in 2007, allowing users to transfer money through a simple text-based menu

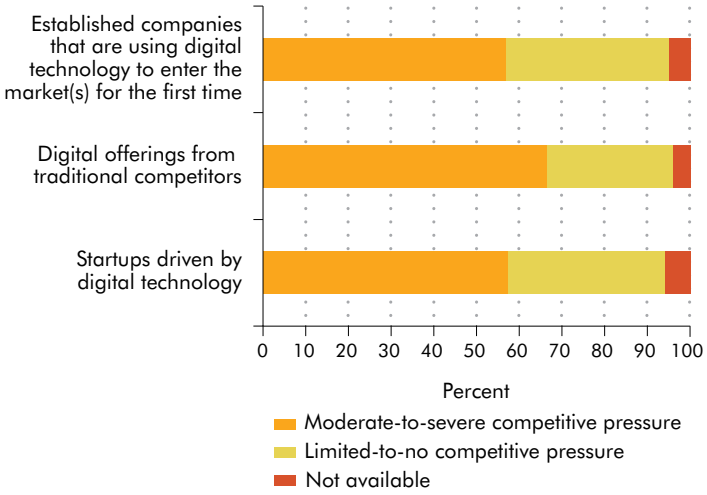
Figure 1.10 Firm entry rates rose after countries introduced online registration systems, 2006–12



Sources: World Bank Doing Business database, 2007–12; World Bank Entrepreneurship Database, 2006–12. Data at http://bit.do/WDR2016-Fig1_10.

Note: The entry densities are based on regression coefficients using the reform years in the Doing Business database. The reform year is either the year when the online business registration was introduced or when significant digital measures were undertaken to make the online registry more effective.

Figure 1.11 Two out of three firms report competitive pressure from digital innovations, 2014



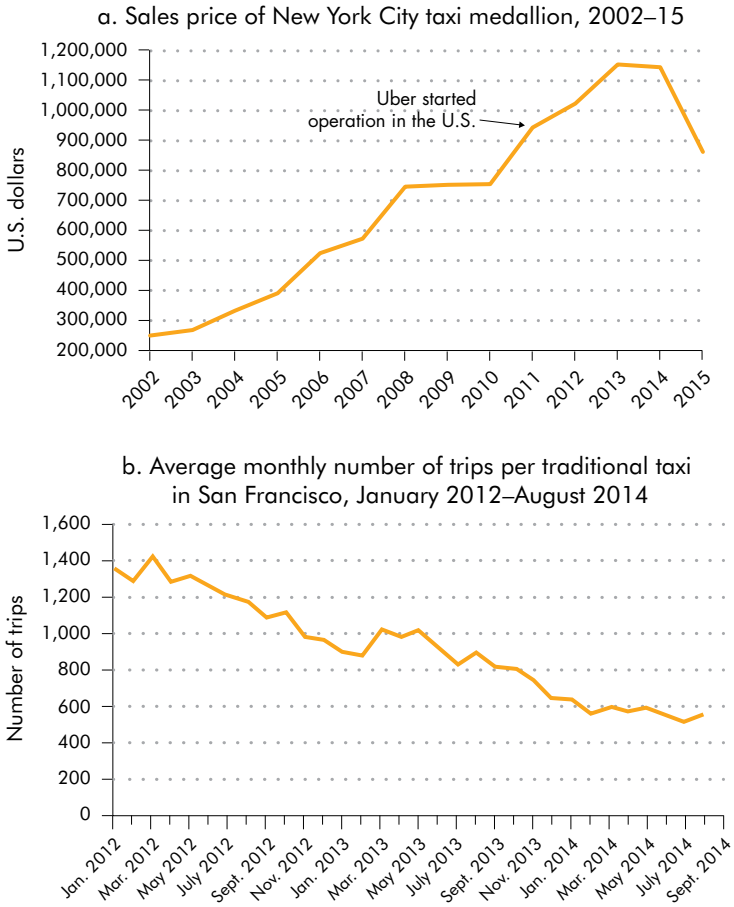
Source: Economist 2015a. Data at http://bit.do/WDR2016-Fig1_11.

Note: The data are based on a global survey with 561 respondents.

available on the most basic mobile phone. By the end of 2013, 17 million Kenyans, or more than two-thirds of the adult population, were using the service to pay for taxi rides, electricity bills, or daily supermarket purchases. M-Pesa also created new opportunities for innovation. Kopo Kopo partnered with Safaricom to offer mobile money services to businesses. One of the key factors underpinning M-Pesa's success in Kenya was the regulator's decision to permit the scheme to proceed as an experiment without formal approval: similar schemes in other countries have typically been held up by opposition from banks and regulators. Firm-level data show that M-Pesa reduces the prices of competing services in the financial sector.[44]

Internet startups offering financing based on "big data" analysis to target unbanked customers increase the competitive pressure for traditional banking services. For example, in China, regulations in the financial sector have been restrictive, with deposit interest rates partially liberalized only recently. In contrast, internet platforms for businesses are often loosely regulated, allowing them to offer financial services that bypass regulations in the financial sector.[45] Yu'E Bao, Tencent's online bank, and WeBank, for instance, offer online banking services in China. They collect deposits from households and lend money using big data analytics to assess the creditworthiness of potential borrowers. Yu'E Bao had 150 million subscribers by the end of 2014. These internet firms threaten the profitability of traditional banks, increasing competitive pressure. Similar startups have emerged in other countries. ZestFinance, LendUp, and Wonga currently target unbanked subprime customers in Canada, Europe, South Africa, and the United States. German startup Kreditech and Hong Kong SAR, China, startup Lenddo use information from social media profiles and networks to determine the creditworthiness of potential customers. Lenddo targets the thriving middle class in developing countries, which often lacks access to local financial services. Ghanaian startup Cignifi uses borrowers' mobile phone records to judge their creditworthiness.

Figure 1.12 Prices of taxi medallions have started to decline following the entry of on-demand services and reduced demand for traditional taxis



Sources: Wei and Mozur 2014; Metropolitan Transportation Agency (New York), http://www.mta.info/; Golovin 2014. Data at http://bit.do/WDR2016-Fig1_12a.

Online marketplaces exert competitive pressure on brick-and-mortar retailers to innovate. The most prominent are online retailers and wholesalers such as Amazon and eBay in the United States, Alibaba in China, Flipkart and Snapdeal in India, Ozon in Russia, Jumia and Konga in Nigeria, and Takealot and Kalahari in South Africa. In the United States, online sales accounted for 25 percent of all retail sales for computers, electronics, and appliances in 2013. The competition from online retailers has led many large traditional retailers in the United States to combine digital and physical consumer experiences by offering online orders and in-store pickup services to improve their efficiency. And some online retailers such as Amazon started to open brick-and-mortar stores to enjoy potential (marketing) advantages of traditional retailers.

Ride sharing services enhance competition and the efficiency of transport services. Many cities around the world require drivers to hold a license to operate a taxi; entering the market is often associated with high fixed costs since licenses are issued rarely and must be bought from current owners. The licensing system, together with growing urban populations, has led prices for taxi medallions to skyrocket in large cities worldwide; in New York City, the cost of a single-taxi medallion increased from about US$400,000 in 2004 to more than US$1,100,000 in the beginning of 2013 (figure 1.12, panel a). But the new

competition from ride sharing services reversed the trend. In San Francisco, the home city of these companies, taxi use fell 65 percent (figure 1.12, panel b). After decades of steady increases, single-taxi medallion prices in New York City started to slump, falling to about US$800,000 by the end of 2014 (the trend is similar in other cities).[46] The new competition also forces taxi companies around the world to reduce their prices or improve their services. Taxi companies in various cities have begun to develop joint smartphone applications enabling online payment, rating, and vehicle tracking in real time to compete with the ride sharing services. The trend is not confined to high-income countries. While Uber operates in more than 57 countries and 300 cities, regional competitors have emerged, such as Lyft and Sidecar in the United States, Hailo and BlaBlaCar in Europe, Kuaidi-Didi Taxi in China, Olacabs in India, and Easy Taxi in Nigeria.

Digital innovations increase welfare in many ways that are not necessarily captured by GDP statistics. These welfare gains are even more difficult to quantify, but a growing literature is shedding more light to these "unmeasured benefits" of the internet (box 1.7).

Internet platforms also reduce the entry costs in other service sectors contesting conventional business models. Airbnb operated in more than 40 countries in 2014, enabling owners to let their homes for short-term rents. This puts competitive pressure on the hotel and tourism industry, which has frequently enjoyed high rents due to local market segmentation or exclusive contracts in developing countries. The Estonian startup TransferWise and the U.S. startup Xoom match requests for international currency transfers online, saving direct and indirect transaction fees by clearing reciprocal currency transfer requests. The startups reduce regulatory rents by reducing the prices of international currency transfers by up to 90 percent. Postmates and Parcel provide local logistics services in U.S. urban centers and are starting to compete with traditional service providers such as Federal Express, but also with existing e-commerce platforms by matching customers demanding any type of locally available goods with a pool of couriers. And Kenyan startup Sendy provides a platform accessible by simple mobile phones connecting customers with motorcycle couriers to offer delivery services payable with mobile money.[47] Upwork (formerly Elance-oDesk) matches firms in high-income countries with freelancers offering professional service tasks in developing countries. The Ugandan internet platform eKeebo connects

Box 1.7 Much of the benefit from the internet is unmeasured

The internet offers many benefits to individuals that are not captured in the gross domestic product (GDP) statistics. Countries compute GDP based on activities measured in monetary terms and exclude activities that do not generate monetary transactions. But many online activities generate substantial benefits for the individual, such as time saved, consumer convenience, expanded choice, better quality leisure time, and access to more knowledge. These benefits can be understood as the consumer surplus: the difference between the price individuals are willing to pay and the actual price for the product or service, which is often free on the internet.

Economists are developing new techniques and collecting new data to present a more accurate estimate of the consumer surplus from the internet. One method is to analyze the price and quality outcomes of using the internet in a sector. A recent study compares the online and offline prices of used books, finding that online prices are lower than the prices in brick-and-mortar bookstores. It infers that the buyers and sellers are better matched online.[a] This stylized fact is an example of the "Long Tail" argument, which notes that online stores provide a larger variety of products and can sell niche products to more consumers.[b] The same study also estimates that the consumer surplus is higher when consumers shift to purchasing used books online.[c] A study of the music industry finds that variety and diversity have improved since 2000, mostly because independent labels and musicians can operate online and release their music digitally.[d]

Another way to calculate the consumer surplus from the internet is to directly measure individuals' willingness to pay for the internet (online products and services are often free and funded through advertisements). A McKinsey survey of consumers in France, Germany, the Russian Federation, Spain, the United Kingdom, and the United States in 2010 found that an average household would be willing to pay approximately €38 a month for internet services that it

(Box continues next page)

Box 1.7 Much of the benefit from the internet is unmeasured *(continued)*

currently receives for free.[e] Similarly, an examination of time-use data estimates that the median individual gains more than US$3,000 annually from the internet.[f]

A study comparing the outcomes of online searches to offline searches in a library finds that the average online search tends to be faster by 15 minutes, the results are more accurate and relevant, and the experience is more enjoyable than the offline search.[g] Also attempting to measure consumer surplus, another study finds that users of Google obtain a surplus of US$500 a year, on average, or a total of US$150 billion for a 300-million user base.[h]

The increase in time saved and in quality—and thus the productivity of work from using the internet—can indirectly increase GDP statistics. Conversely, the internet has also reduced productivity by providing an easy way to procrastinate and distract oneself with social networking sites and cute animal videos. The aggregate effects of the internet use of individuals are difficult to determine—an interesting avenue for further research.

But all this is not new. The initial gains from past technological change were also undercounted in GDP. For example, the cost savings from railroads made up about three-fourths of the total gains in GDP in the mid-19th century; by the early 20th century, this had fallen to about one-fourth. Time saving became by far the more important benefit as commute times shortened and the leisure time of working-class customers increased. Similarly, U.S. national accounts did not reflect the output from automobiles for nearly 15 years after the Ford Model T, the first mass-produced car, was available.

Source: Crafts 2015.

a. Ellison and Fisher Ellison 2014.
b. See Anderson 2006.
c. Ellison and Fisher Ellison 2014.
d. Waldfogel 2013.
e. McKinsey Global Institute (Manyika and others 2011).
f. Goolsbee and Klenow 2006.
g. Chen, Jeon, and Kim 2014.
h. Varian 2011.

individuals who want an authentic home-cooked meal with independent or amateur chefs, circumventing restaurant licensing, which can be a source of rent-seeking in developing countries.

Cloud computing can reduce the costs of entry in developing countries, implying substantial opportunities for innovation and competition and thus future growth.[48] It provides computing infrastructure (processing, memory, and storage of data), platform applications, and software services for firms with access to the internet. Firms can use these services, for a fee, without investing in the underlying hardware or software infrastructure. Cloud computing has significantly reduced the fixed costs of starting a business in the last decade. Startups can use the latest computing infrastructure, video conferencing services, or online payment systems at much lower cost. The reduction in entry costs has so far materialized mainly in high-income countries. Although local providers have emerged in developing regions, such as Angani in Kenya and Data Park in Oman, these have not yet achieved sufficient scale.

Digital technologies can lead firms and countries to diverge

Divergence—with benefits short of expectations

Despite the opportunities, firms' use of digital technologies differs substantially across sectors and countries; the differences prevail when comparing the ICT intensities of the same sectors across countries with a similar GDP per capita. The share of firms that used the internet for banking in 2012, for example, was below 20 percent in several middle-income countries, but more than 80 percent in others (figure 1.13).

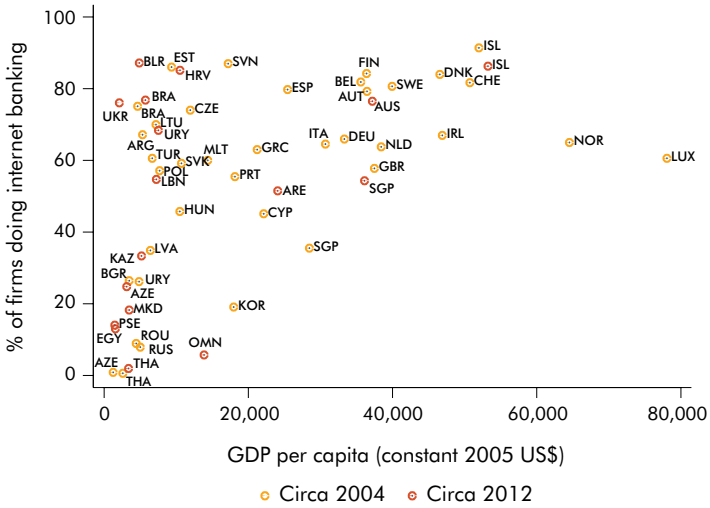
This divergence in the intensity of internet use for firms in the same sector is confirmed by more detailed survey data from six African countries in 2014. The share of manufacturing and service firms with at least five employees using the internet ranged from 22 percent in Tanzania to 73 percent in Kenya. Of manufacturing firms in Kenya, 41 percent used

it to manage their inventories, compared with 27 percent in Zambia and only 6 percent in Uganda (figure 1.14). Of service firms in Kenya, 41 percent used the internet to manage their inventories, compared with 15 percent in Zambia, 12 percent in Uganda, and only 8 percent in the Democratic Republic of Congo and Tanzania. The divergence in the shares of manufacturing or service firms that sell goods online or use the internet for marketing was comparably large across these six countries.[49]

The share of retail firms that sell their products online varies substantially across Latin American countries with a similar GDP per capita. In Bolivia, 52 percent of all firms with at least five employees in the retail sector sold their products online in 2010 (figure 1.15). Peru had a slightly higher GDP per capita in 2010, but only 14 percent of retail firms with at least five employees sold online. Only 18 percent of retail firms in Brazil sold online in 2010, and only 27 percent in Panama. In Mexico and Uruguay, about half of all retail firms sold online; in Argentina 62 percent. Variations in the share of retail firms that do e-commerce are comparably large in the other developing regions.

The share of firms that use connected customer relationship management (CRM) platforms to facilitate sales, customer support, and related interactions with customers or other businesses varies substantially across sectors and countries in Europe (figure 1.16). In Austria, 60 percent of retail and wholesale firms use integrated CRM systems, but only 28 percent do in the United Kingdom. Half of all manufacturing firms in Germany use these systems,

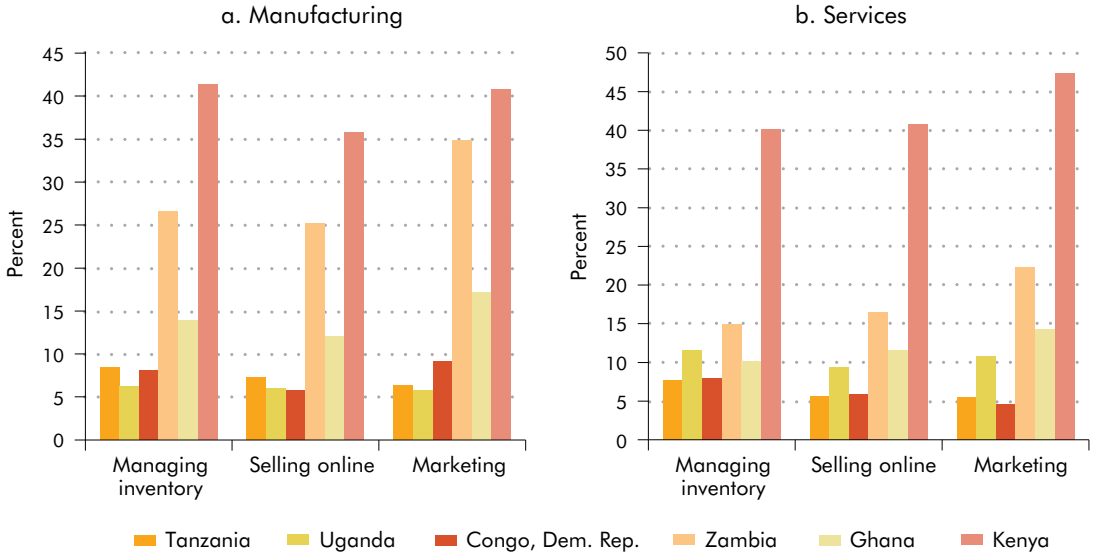
Figure 1.13 Firms' use of online banking varies substantially across countries at comparable incomes, 2003–06 and 2008–13



Source: UNCTAD, http://unctad.org/en/Pages/Statistics.aspx. Data at http://bit.do/WDR2016-Fig1_13.

Note: The figure shows all countries with available data for the latest year with available data from 2003–06 and 2008–13.

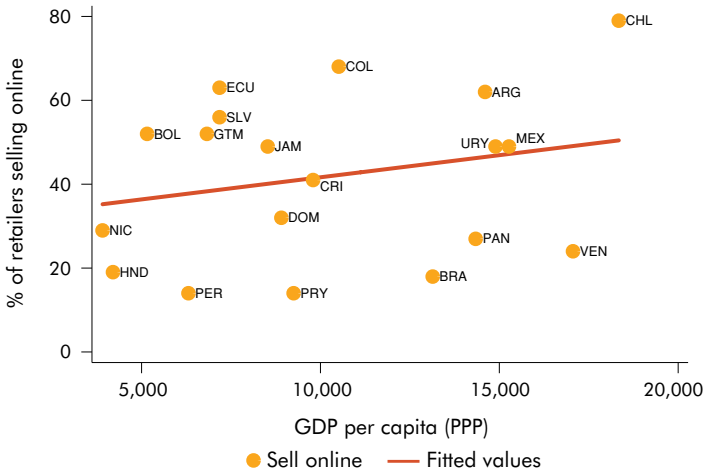
Figure 1.14 Firms' use of the internet varies among six African countries, 2014



Source: Cirera, Lage, and Sabetti 2015. Data at http://bit.do/WDR2016-Fig1_14.

Note: The figures show the shares of firms in the manufacturing and services sectors that use the internet to manage their inventory, sell their goods or services, and do marketing. The results are based on 2,843 firms (1,458 manufacturing and 1,385 service firms) in these six African countries in 2014.

Figure 1.15 The share of firms in the retail sector that sell their products online varies substantially among Latin American countries, 2010



Source: World Bank Enterprise Surveys data 2010. Data at http://bit.do/WDR2016-Fig1_15.

Note: GDP = gross domestic product; PPP = purchasing power parity.

compared to only 32 percent in Norway, 20 percent in Poland, 18 percent in Estonia, and 12 percent in Croatia. In Finland, 25 percent of professional service firms sourced CRM software from the cloud in 2014, but only 5 percent did in France or Lithuania.

These findings are consistent with previous studies showing that digital technologies diffuse much more slowly within developing countries than previous major technologies (for example, electricity or the steam engine).[50] This lack of internet penetration in developing countries contributes to cross-country divergence in incomes.

Why are the differences so large? In most countries, the physical infrastructure barriers to internet use are fairly small for most firms in urban areas. Differences in the affordability of the internet across countries have been an important factor (see chapter 4). But equally important are other structural barriers that limit firms' ability or incentives to use the internet more intensively. That three-fourths of all retail firms in Panama do not conduct e-commerce, for instance, might be related to a regulatory barrier protecting domestic retailers: foreign-owned firms are not allowed to operate in Panama's retail sector, reducing competitive pressure among domestic firms to increase their efficiency (see figure 1.15). By contrast, there are no restrictions to foreign entry into the retail sectors in Argentina, Mexico, and Uruguay—where retailers use e-commerce more extensively.

Market power—scale and network effects can lead to anticompetitive behavior

The digital economy can be highly concentrated. Facebook is the leading social network. Amazon sold 40 percent of all e-books in 2014. Google is the dominant search engine in most countries: it accounted for about 25 percent of the display-ad market, while Yahoo and Facebook accounted for about 10 percent each.[51] And while the sharing economy is increasing the number of market players in various services, Airbnb and Uber are its major platforms so far.

Figure 1.16 The share of firms using integrated customer relationship management platforms varies substantially among sectors and countries in Europe, 2014

Source: Eurostat (EC, various years). Data at http://bit.do/WDR2016-Fig1_16.

Note: The figure shows the shares of European firms in manufacturing, wholesale and retail, and professional services that used integrated customer relationship management software in 2014. Customer relationship management systems allow firms to track, record, and store data to facilitate sales, customer support, and related interactions with customers or with other businesses.

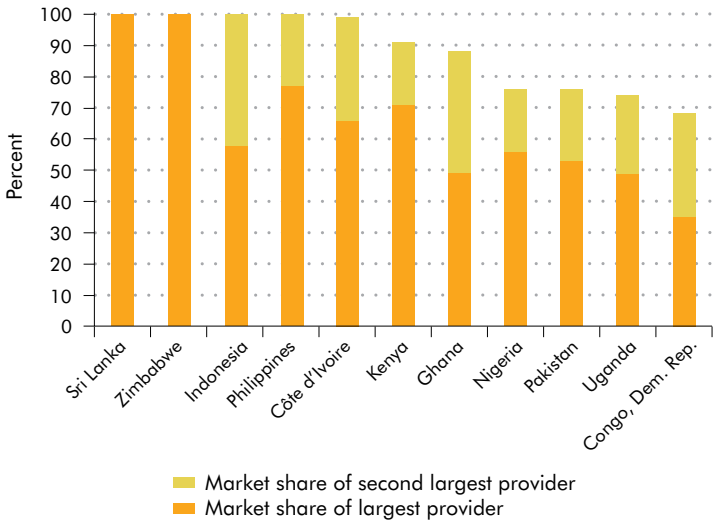
Domestic mobile money markets are often controlled by one or two operators. Safaricom, creator of the mobile money service M-Pesa, controls more than two-thirds of the mobile money market in Kenya (figure 1.17). The mobile money market in the Philippines is a duopoly, with the largest operator controlling 77 percent of the market.

What matters for antitrust regulators, however, is not the concentration of a sector per se, but the entry costs for new entrants or switching costs for consumers.[52] The concentration of various markets in the digital economy—often two-sided markets in which platforms match service providers or sellers with users or buyers[53]—is not surprising. When the transaction costs to serve additional customers are close to zero, the most innovative firm—say, the one with the best search algorithm or online platform—will be frequented by the most customers. As long as the fixed entry costs are low, the industry remains dynamic, in the sense that entrepreneurs programming more efficient search engines or applying superior business models will be able to enter and disrupt the existing incumbent (through creative destruction). AltaVista, for instance, was once the most popular search engine, but it lost ground in 2001 to new market entrant Google, which provided more efficient services.

Network effects or anticompetitive behavior can, however, create barriers for startups. For instance, the more people who use Facebook, the higher the value for users to create content on its website. Similar network effects (or switching costs) might exist for other online services. Google has been accused of using its dominant position in the market for online display advertising to curb competition and push companies toward its other services. Several Google competitors, including Microsoft and Yelp, had argued that Google unfairly demoted rivals in its search engine results to direct users toward its services. Similarly, Amazon has been accused of abusing its market power by delaying the shipping times of products from publishers that did not agree with its pricing mechanism.

The room for anticompetitive behavior varies among digital products and services. Network effects and switching costs appear to be large for search engines, allowing them to create barriers to scale for new firms offering this service. By contrast, programming ride sharing platforms can be imitated fairly easily, and drivers can use more than one platform at the same time in the absence of exclusivity contracts. Indeed, multiple ride sharing platforms competing with each other have emerged. And traditional taxi companies have also started to use the technology.

Figure 1.17 Mobile money markets are often controlled by one or two operators, 2014



Source: Evans 2015. Data at http://bit.do/WDR2016-Fig1_17.

New digital solutions can also raise fixed costs and thus lower competition in sectors such as manufacturing due to high up-front costs of software, data storage, analytics, and security.

Safeguarding a level playing field for business can thus also involve overhauling the regulatory regimes in the digital economy, including sectors in which technology is dissolving the boundaries between online and offline firms. The initial entry of internet firms into these sectors can disrupt monopolies, but regulators need to level the regulatory regime and prevent market shares from becoming excessively concentrated.

The nexus of technology and regulation

The potential impact of the internet on firm productivity is highest for activities where the internet can achieve large-scale effects and where contracts are easier to enforce—and thus can be automated. Economic activities can be classified by the degree of their amenability to the internet, based on:

- *Contract complexity.* Some goods and services are contract-intensive, because they embody a higher share of intermediate inputs that require relationship-specific investments that are more difficult to enforce by written contracts.[54] The less complex that goods or services are, the easier it is to enforce contracts and use internet platforms to

Table 1.1 The internet impact is highest for data-intensive activities that involve easy-to-enforce contracts

Data-intensive activities	More scalable	Less scalable
Less complex products (contracts easier to enforce)	Retail and wholesale trade, transport, insurance, banking	Legal services
More complex products (contracts more difficult to enforce)	Agriculture, education, health care, hotels and restaurants, manufacturing, real estate, utilities	Construction

Source: WDR 2016 team.

Note: The approximate grouping of sectors is based on the literature; among others, on Bloom, Sadun, and Van Reenen (2012).

market these products and match buyers and sellers (table 1.1).[55]

- *Scale effects*. The impact of the internet is larger if the internet can help achieve scale effects. For instance, longer value chains require more intensive real-time communication or sharing of large amounts of data between different stages of production or with suppliers and clients. The internet reduces these transaction costs, enabling scale effects and increasing management efficiency.[56]

Firms using digital technologies need to invest in skills and reorganization

As for any new technology, integrating digital solutions into firms' business models can be risky and lead to costly failures. Digital technologies have often been called on to help meet supply chain needs, but not all have brought the expected widespread benefits. Five or ten years ago, radio frequency identification tags for tracking individual goods were considered the major source for efficiency gains. U.S. retailer Walmart required its biggest suppliers to use the tags, but their use has not taken off in the extended supply chain.

The successful use of digital technologies depends on firms' complementary investments in skills and organizational restructuring. That more productive firms use digital technologies (more intensively) suggests that there are barriers to firms using them more effectively. Two such barriers for firms are the skills of the workforce and the ability to reorganize management processes to make better use of the efficiency gains that digital technologies can provide. There is even evidence that investing in ICTs without business process reorganization can reduce firms' productivity growth.[57]

The correlation between firm productivity and ICT capital stocks among firms in India and Brazil increases significantly after firms have reorganized their production structures or hired more skilled labor. Firms in Vietnam with a more educated workforce or a higher share of managers relative to total staff had a stronger correlation between firms' use of the internet (such as selling products online) and TFP growth in subsequent years.[58]

The majority of firms in Eastern Europe and Central Asia that use broadband internet have not reorganized their businesses, pointing to potential inefficiencies in the way it is deployed. Only one-fourth of firms using ICTs have adjusted their organizational structures or management practices (table 1.2).

The differences in these complementary investments help explain the heterogeneity in the use and impact of digital technologies. For instance, firms' investments in computerized information (digital technologies) are comparable among firms in the United States and Brazil (figure 1.18). But U.S. firms

Table 1.2 Many firms use the internet without changing their organizational structures, limiting its impact, 2010–14

percentage of firms

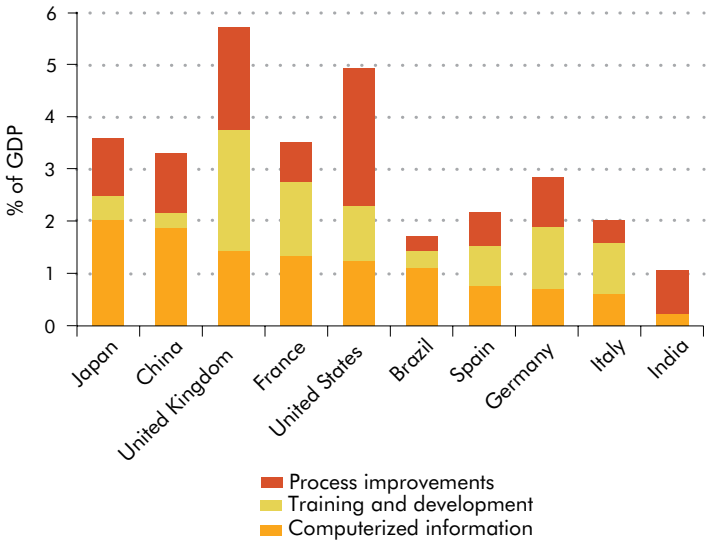
Did your firm introduce new or improved organizational structures or management practices?	Firms that use broadband		Firms that use e-mail		Firms that have a website	
	Yes	No	Yes	No	Yes	No
Yes	23	10	22	7	26	12
No	77	90	78	93	74	88

Source: Hussain (2015) based on World Bank Enterprise Surveys, various years.

invest substantially more in training and development (skills) and in business process improvements (reorganization), explaining why the impact of digital technologies on firm productivity is higher for U.S. firms. Similarly, firms in Japan and China had the highest investments in digital technologies, but they invested less in skills than France, Germany, the United Kingdom, and the United States.

Complementary skills and reorganizations are more important for more advanced digital technologies, potentially explaining the slow diffusion of some of these technologies across firms (see figure 1.4). Implementing customer relationship or supply chain management software and integrating it with ICT systems of customers and suppliers requires a well-trained workforce and the adoption of new organizational processes incorporating real-time information flows.

Figure 1.18 Firms' ICT investments as a share of GDP in several countries are comparable to those of U.S. firms, but they invest much less in complementary skills and reorganization, 2006



Sources: Corrado and others 2013; Hulten and Hao 2011; Hao, Hulten, and Jaeger 2013; Dutz and others 2012. Data at http://bit.do/WDR2016-Fig1_18.

Note: The countries are ordered by their investments in computerized information (digital technology) as a share of GDP.

Countries need to invest in skills and logistics to enable firms to use ICT more effectively

Since a shortage of skills can lower aggregate productivity growth despite investments in broadband infrastructure, countries need to invest in education to complement investments in new digital technologies (chapter 2). They also need to invest in infrastructure such as electricity, trade logistics, and payment systems.

Online marketplaces for nondigital goods enable scale effects if trade infrastructure is adequate. After an online transaction has been completed, the timely delivery of (physical) goods requires offline trade infrastructure.[59] Countries thus need ports with enough capacity to connect domestic firms to international markets and efficient domestic logistics infrastructure to complete the "last mile" delivery.

Online retailers in some countries still struggle to deliver their parcels to domestic customers. In 38 countries in 2012—27 of them in Africa—less than 50 percent of the population had access to home postal delivery (figure 1.19).

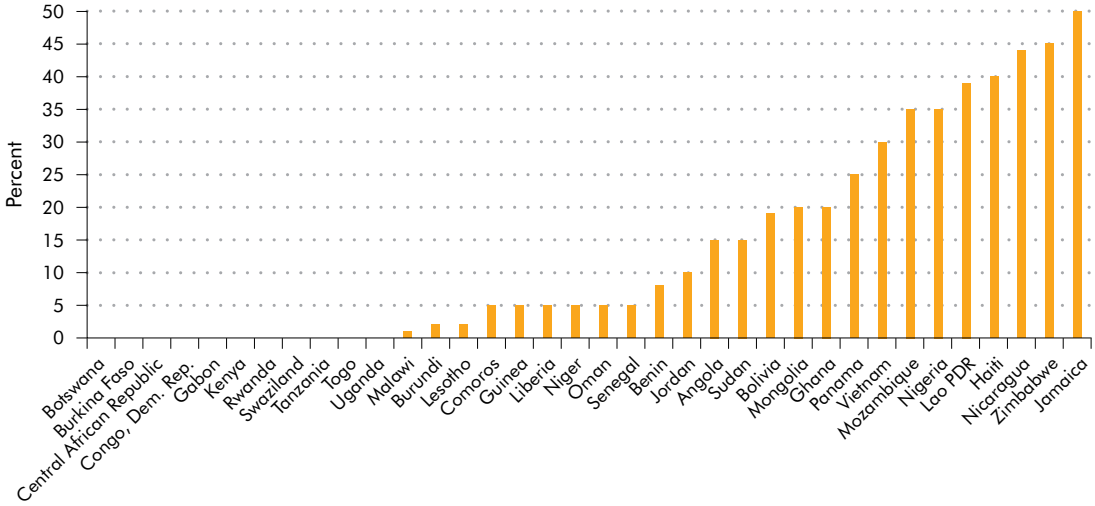
Faced with such difficulties, many e-commerce companies have come up with their own solutions. Alibaba has partnered with logistics firms in China to create a network for delivering parcels to Chinese cities within a day. Flipkart has partnered with the Dabbawalas, the deliverymen famous for their reliable delivery of hot lunches, to deliver parcels in India. Russian online retailer Ozon created its own logistics service company to increase the speed of deliveries.

Online payment services are available to firms in many countries but not in most African and Central Asian countries (map 1.3). Consumers and firms need a way to pay for online transactions. e-commerce relies on the ability of firms and consumers to pay for their products online. Credit cards are accepted on most online platforms, but many individuals do not have credit cards: less than 10 percent of the population in developing countries had a credit card in 2012.[60] Online payment systems providing business accounts, such as PayPal, MercadoPago, and PayU, are alternatives. For instance, MercadoPago provides online payment services to small businesses that do not have bank accounts.

The low share of firms using e-commerce in some developing countries can also originate from network effects in internet use. Network effects are present because the value of the internet to a firm depends on the number of internet users (creating online content). Thus low rates of domestic internet use by individuals, firms, and government reduce the benefits of e-commerce. But the argument is only relevant for firms that target the domestic market in developing countries with few internet users; exporting firms targeting world markets face over 3.5 billion potential online customers. The rapid increase in the number of internet users worldwide in recent years,

Figure 1.19 Many countries still have poor postal delivery systems

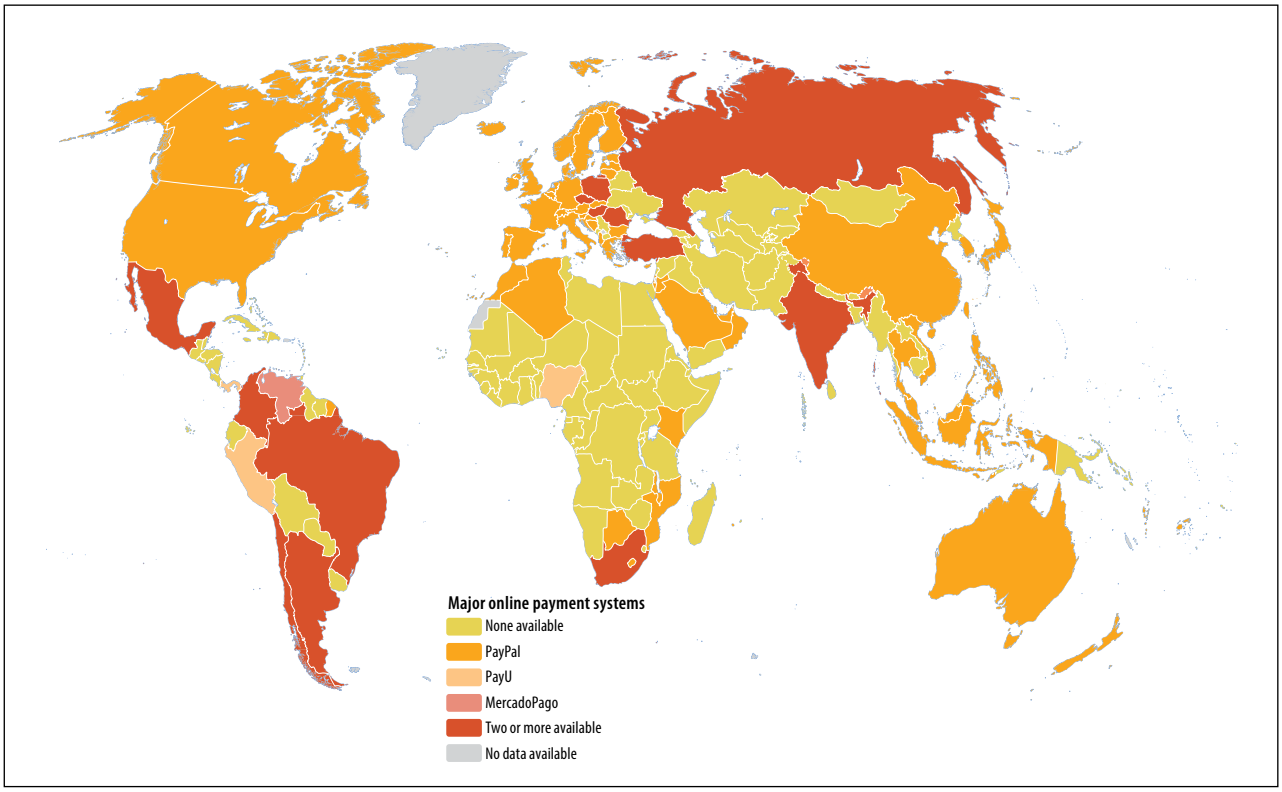
Percentage of population receiving home postal delivery in 2012



Sources: Universal Postal Union (http://www.upu.int/en.html); UNCTAD 2015. Data at http://bit.do/WDR2016-Fig1_19.

Note: The figure shows the 36 of 130 countries where less than 50 percent of the population receives mail delivery at home. Qatar and the United Arab Emirates have been excluded because they have a comprehensive public postal delivery system even though they usually do not deliver mail to homes but instead to local post offices.

Map 1.3 International online payment systems for businesses are unavailable in many parts of Africa and Central Asia, 2012–14



Sources: World Bank staff calculations; UNCTAD 2015. Data at http://bit.do/WDR2016-Map1_3.

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together with the lower transaction costs in online marketplaces should, in turn, encourage more firms (in developing countries) to use the internet to export to foreign markets in coming years.

Countries need policies to encourage competition

Domestic or foreign barriers to entry and competition reduce firms' incentives to invest in digital technologies or complementary skills and reorganization. Without competitive pressure, private firms lack incentives to invest in costly or risky new technologies. The complementary factors at the firm level correspond to competition policies at the country level. Firms are more likely to invest in skills or organizational restructuring if they are subject to product market competition.[61]

European manufacturers are investing in machines that communicate with one another (internet of things) to escape the increasing competition from low-cost Asian producers. For instance, BuS Elektronik invested in information technology to specialize in custom-designed electronics components produced in lot sizes that are too small to spur the entry of Asian electronics firms. The Daimler Group's Smart automobile plant uses modern information technology to integrate assembly and production lines among a network of seven large suppliers. The interlinked production system allows Daimler to optimize its value chain and to customize its products, with 10,000 variations of its vehicle cockpits. Low-cost factories in emerging countries cannot easily copy this strategy, which requires proprietary data.[62]

The mechanism is illustrated in Schumpeterian growth models predicting that each firm will invest in technologies new to the firm to reduce its costs and escape competition—albeit only temporarily. But these incentives are attenuated when leading firms in the sector have cost advantages that trailing firms cannot overcome. The market leaders have little incentive to invest in technologies new to the firm since they do not face competitive pressures to reduce their costs; the laggard firms are too far away from the frontier to bridge the cost gap and instead use vintage production technologies, focusing on local market niches to survive.[63] Thus fast-growing sectors with a high share of firms using new technologies exhibit specific firm dynamics, echoing high firm churning and neck-and-neck competition market structures, forcing firms to enhance their efficiency by investing in more productive technologies. The positive links among competition, technology adoption, and productivity growth are well documented.[64]

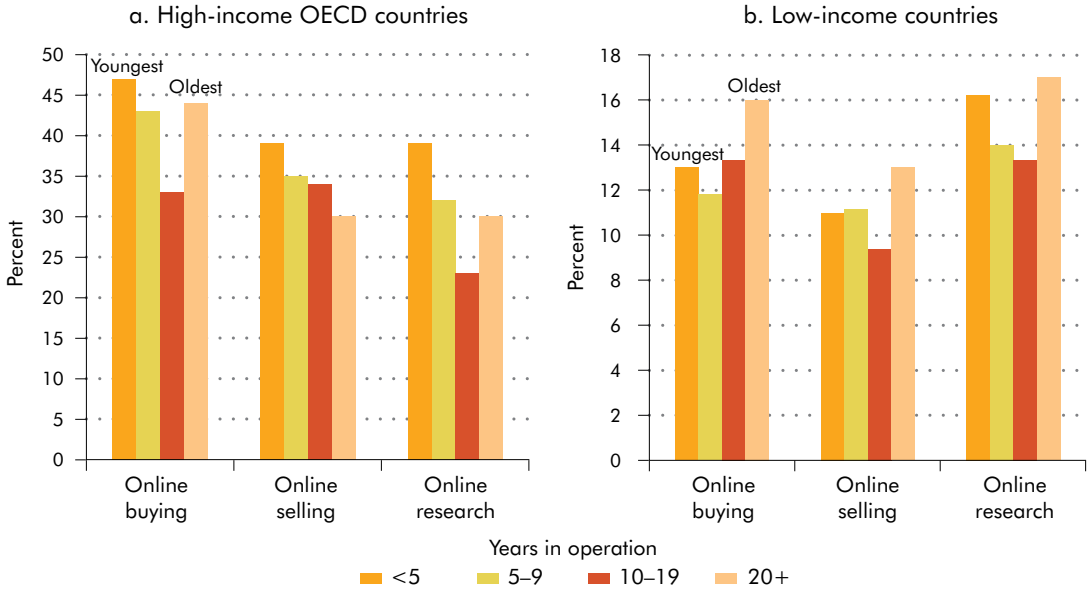
Consistent with the Schumpeterian mechanism, firms in more contested industries use digital technologies (more effectively). The allocation and selection mechanism in more contested markets drives firms to invest in new digital technologies.[65] Competition from China has induced the adoption of new technologies and ICTs in OECD countries, accounting for 15 percent of their technology investment between 2000 and 2007 and contributing to their productivity growth.[66] Arguably, the entry and innovations of Taobao, Alibaba's consumer-to-consumer (C2C) platform, were at least in part encouraged by foreign competition from eBay. Similarly, firms in more contested sectors in Vietnam, which have higher entry and exit rates, are more likely to invest in broadband internet. And younger firms in Mexico use e-commerce more intensively: the share of online sales in total sales is almost twice as high in young firms (less than five years old) than in older firms.[67] In France, automobile dealers enhanced their investments in ICT, such as human resource software and other innovations, when facing more intense product market competition after the liberalization of the automobile distribution system in the European Union in 2002.[68]

In high-income countries, the youngest firms use the internet more intensively, while in low-income countries, the oldest firms do (figure 1.20). In low-income countries, however, startups seem to face barriers to more intensive internet use, which the oldest firms (typically also larger) tend to overcome. In middle-income countries, the results are mixed.

Domestic firms in developing countries use the internet more intensively when they face pressure from foreign competition. The probability that domestic firms (with at least five employees) facing foreign competition use broadband internet increases by 41 percent; that they sell their products online, by 29 percent; and that they purchase inputs online, by 36 percent (figure 1.21). The increase in internet use due to foreign competition is independent of firms' initial productivity.

Among six African countries in 2014, for instance, increased competition incentivized firms to use the internet more intensively, leading to more product and process innovation. Firms that had experienced more competitive pressure, leading to a decline in their market shares over the past three years, invested in more intensive uses of the internet. For example, a 10-percent reduction in the market share increased the probability that these firms used the internet to market their products, on average, by 11 percent, and the probability that they used the internet to manage their inventory by 8 percent.[69] Domestic firms in

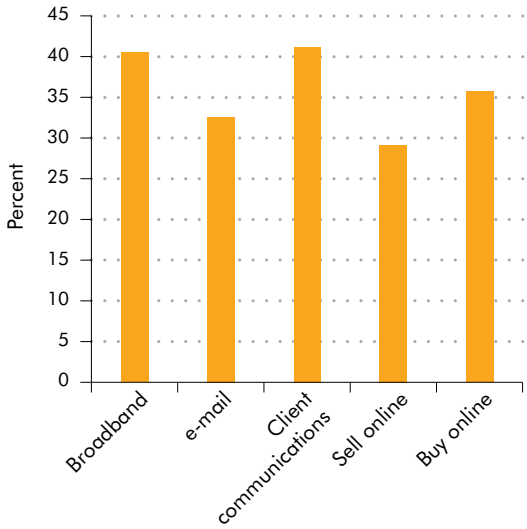
Figure 1.20 Young firms use the internet more intensively in high-income countries—old firms, in low-income countries, 2010–14



Source: Hussain (2015) based on World Bank Enterprise Surveys, various years. Data at http://bit.do/WDR2016-Fig1_20.

Note: OECD = Organisation for Economic Co-operation and Development.

Figure 1.21 Domestic firms use the internet more intensively when they face foreign competition, 2010–14



Source: Hussain (2015) based on World Bank Enterprise Surveys data, 2010–14. Data at http://bit.do/WDR2016-Fig1_21.

Note: The bar chart shows the coefficients of six firm-level cross-section regressions of dummy variables for internet use on a dummy if the firm reports pressure from foreign competition. All coefficients are significant at the 5 percent level. Each regression controls for firm age, firm size, foreign ownership, and sector- and country-specific effects. The data include all firms with at least five employees in more than 80 developing countries. The number of firms in the different regressions varies from 3,400 to 8,200.

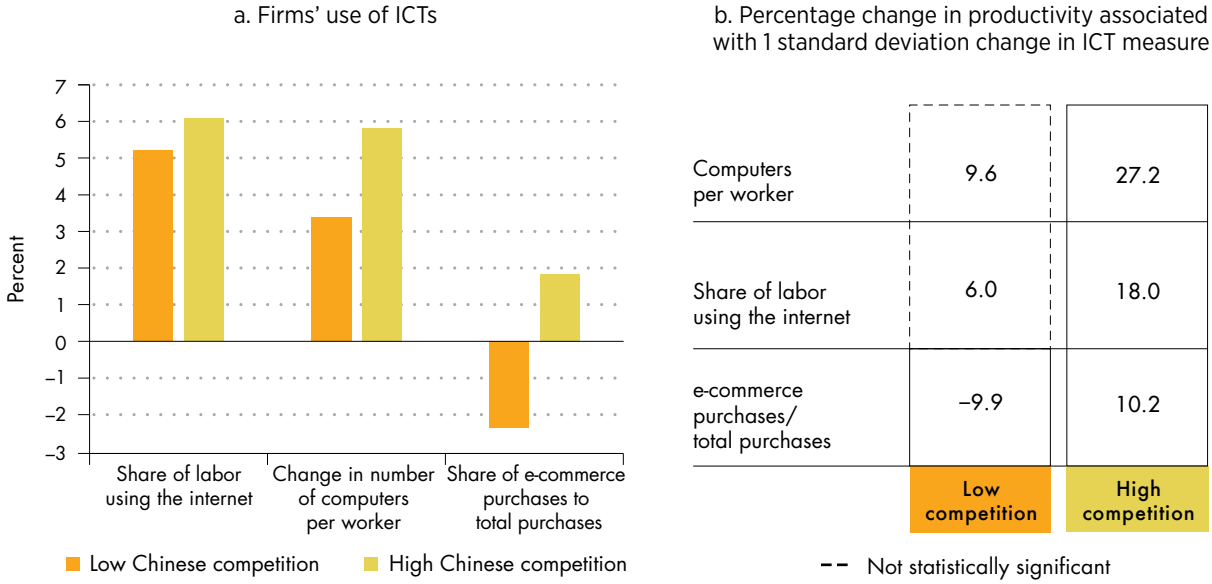
Kenya and Uganda used the internet more intensively in sectors with increasing competition from foreign direct investment (FDI). The (more intensive) internet use due to higher competition had led to more product and process innovation among firms in these six African countries.

Manufacturing firms in Mexico are more likely to invest in digital technologies and use them more productively when they sell products that are directly competing with imports from China. Firms that faced this external shock of higher foreign competition between 2000 and 2008, either in the domestic or the U.S. (export) market, increased their number of computers per employee, their share of labor using the internet, and their share of online purchases in total purchases in the subsequent four years, 2008–12 (see figure 1.22). As a result, the share of labor using the internet in 2012 was 11 percent higher for firms that faced more Chinese competition—and the share of online purchases was 114 percent higher. The more intensive use of digital technologies due to Chinese competition translated into productivity growth among firms in Mexico. By contrast, ICT use had no impact on labor productivity growth among Mexican firms that did not face import competition from China.[70]

Manufacturing firms confronted with an increase in competition in Brazil are more likely to implement

Figure 1.22 Firms in Mexico facing higher import competition from China use more ICTs more productively

percentage-point change, 2008–12



Source: Iacovone, Pereira-Lopez, and Schiffbauer 2015. Data at http://bit.do/WDR2016-Fig1_22.

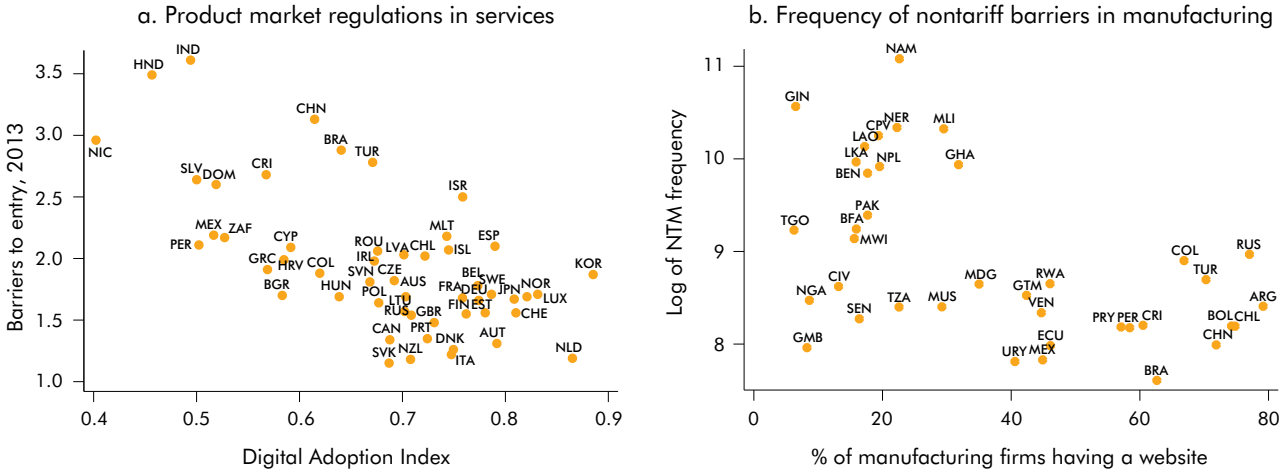
Note: Chinese competition is measured as the change in the share of China in Mexico's imports in the period 2000–08. The two groups depicted in these figures are defined as below the median (low competition) and above the median (high competition). The Mexico ICT survey, ENTIC, represents over 52,000 manufacturing and services firms with at least 10 employees. ICT = information and communication technology.

e-commerce systems. They are also more likely to move to more complete e-commerce systems—providing an online order and integrating payment system on their website—when they face more competitive pressure.[71]

Consistent with these findings, aggregate sector and country data suggest a negative correlation between regulatory barriers to product market competition and firms' investments in digital technologies. More restrictive product market regulations on firm entry in service sectors are associated with lower ICT use (figure 1.23, panel a). The negative relation prevails when comparing restrictions to domestic or foreign entry in individual service sectors with firms' internet use in these sectors across countries. Professional service firms in Europe—for architecture, design, consulting, legal, and accounting—are less likely to sell their services online in countries that have higher barriers to entry in these sectors. Transport service firms are less likely to purchase cloud computing services, such as CRM software, over the internet in European countries that have higher regulatory barriers for foreign firms to enter. Domestic retail firms are less likely to use the internet for online sales if they operate in countries with higher entry barriers for foreign retailers. The same is true for manufacturing firms: higher nontariff barriers to trade are associated with lower ICT use in manufacturing (figure 1.23, panel b).[72]

Firms' internet use varies with barriers to competition across sectors in the same country. The Philippine retail sector has substantial restrictions to domestic and foreign entry and is dominated by a few incumbent firms, while few firms use ICTs. Foreign retailers that aim to establish a commercial presence need to pass prequalification procedures, meet minimum capital requirements, meet limitations to foreign equity participation, and have the majority of the board of directors be Filipinos. Only about 20 percent of retail firms (with at least five employees) sell online in the Philippines.[73] By contrast, the Philippine business process outsourcing sector is characterized by high entry rates and few regulatory barriers to competition. It is intensive in ICT-related services such as software development, animation, contact centers, and transcription. These ICT-specific services experienced high productivity growth in recent years and provided about 1.2 million jobs in 2015. Similarly, Nigeria's retail sector, Indonesia's banking sector, and India's and Bulgaria's ICT sectors are more internet intensive and have fewer regulatory barriers to competition in otherwise difficult business environments.

Figure 1.23 **Restrictive product market regulations in services and higher nontariff technical barriers to trade in manufacturing are associated with lower ICT use, 2010–14**



Sources: Panel a: Product Market Regulation Index (OECD, various years); Digital Access Index (DAI) (Internet Coaching Library, various years). Panel b: World Integrated Trade Solution (WITS) database (World Bank, various years); World Bank Enterprise Surveys (World Bank, various years). Data at http://bit.do/WDR2016-Fig1_23.

Note: Panel a: The y-axis shows the barriers to entry subindex of the Product Market Regulation (PMR) Index (OECD, various years) for service sectors. The x-axis shows the Digital Adoption Index, as computed for this Report. The PMR index is available for 47 OECD and large developing countries, as well as for eight smaller Latin American countries. Panel b: The y-axis shows the (log) frequency of nontariff barriers (excluding class A, B, and D restrictions) across developing countries. The x-axis shows the share of manufacturing firms that have a website in the corresponding developing countries. ICT = information and communication technology; NTM = nontariff measure; OECD = Organisation for Economic Co-operation and Development.

Regulation to foster competition in the digital economy needs to consider network effects and switching costs, which can lead to new entry barriers in parts of the digital economy. To address these changes in market structures, regulations must prevent anticompetitive behavior and ensure that potential entrepreneurs have fair market access. Regulatory authorities in many countries play a similar role for other network industries, such as electricity or telecommunications. Regulators in several countries have made phone numbers portable across carriers—so that users can keep the same phone number while switching to a new provider—minimizing switching costs and ensuring a level playing field for new entrants. Similar regulatory innovations might be required for social media, digital marketplaces, digital payment systems, and the sharing economy, where users need to be able to change internet platforms with ease and at zero cost.

But regulating the digital economy is far from straightforward. It requires deep understanding of technical characteristics of the corresponding technology. Most internet firms, operating in two-sided markets, can blur price signals in either of the two markets. For instance, sharing economy platforms typically set the rates they charge customers as well as suppliers (drivers or homeowners). Once the platform has a large set of users, it can charge suppliers higher fees, despite having competitive rates for customers. So greater digital use needs to be accompanied by unified standards, full interoperability, and competition across platforms and contracts.

Overall, countries that pursue procompetitive regulations in most sectors grow faster, as firms in these countries invest in digital technologies and use them more effectively. Given the substantial variations in barriers to domestic or foreign competition and entry across countries, the divergence in firms' use of the digital technologies across sectors and countries is not surprising.

The future of markets

Uber, the world's largest taxi company, owns no vehicles. Facebook, the world's most popular media owner, creates no content. Alibaba, the most valuable retailer, has no inventory. And Airbnb, the world's largest accommodation provider, owns no real estate. Something interesting is happening.

—Tom Goodwin, Havas Media

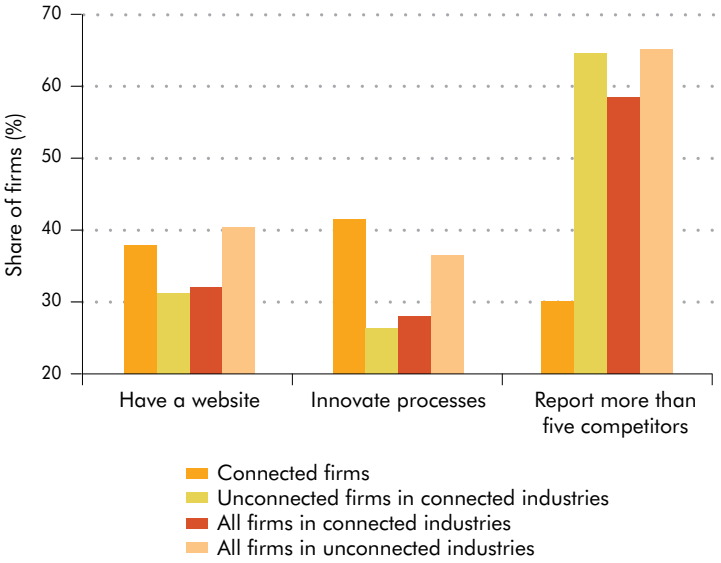
The internet promotes competition, which encourages more firms to use the internet—a potential virtuous cycle. So, competition is not only a complementary factor but also a mechanism for the internet to increase growth. Internet firms can circumvent

regulatory barriers to competition and entry in traditional sectors such as retail, transport, or finance. But this will not happen if vested interests are strong enough to capture regulators and create new barriers to competition and technology adoption.

For instance, some taxi companies try to protect their lucrative businesses by pushing for new regulations that block ride sharing companies. Prices of the ride sharing companies, estimated *before the ride takes place*, can easily be compared, introducing greater transparency—something that taxi regulators attempted for years by requiring taxis to publish their price lists. Cities with tighter market controls like Barcelona, Berlin, and Paris recently saw widespread protests by the taxi industry, as opposed to Dublin, which deregulated its taxi market and lifted restrictions on the number of taxis practically overnight in 2000 (fares remain regulated).[74] In India, taxi associations wrote to the Reserve Bank of India complaining that Uber's credit card transactions violate the country's foreign exchange regulations. Uber collects the fare from a passenger's credit card, transmits it abroad in a foreign currency, and then sends 80 percent of the transaction value back to the driver. The taxi association argues that this violates Indian laws that permit Uber to collect the commission but not the fare in a foreign currency.

In Morocco, the market power of firms owned by influential politically connected businessmen stifles competition, ICT adoption, and innovation among manufacturing firms. Firms that are directly or indirectly owned by the political rulers are larger, have higher market shares, and have higher profits.[75] The larger scale seems to help these firms adopt digital technologies and innovate (figure 1.24). While politically connected firms individually invest more in ICT, their presence seems to discourage other firms from doing so. Politically connected firms appear to dominate their markets: only 30 percent of them report more than five competitors, compared with 65 percent of all other firms; only 11 percent of politically connected firms report price competition in domestic markets, compared with 37 percent of all other firms. There is no difference between politically connected and unconnected firms for price competition in foreign (export) markets. The dominance of politically connected firms and the resulting lack of competition seem to discourage all other firms in their industry from adopting digital technologies or innovating, leading to inferior aggregate technology adoption: only 32 percent of all firms in industries with at least one politically connected firm have a website, compared with 40 percent in industries without politically connected firms.[76] Only 28 percent of all firms innovate in politically connected industries, compared with 37 percent in industries without politically connected firms (figure 1.24).

Figure 1.24 The dominance of a few politically connected firms stifles competition and innovation in Morocco, 2004 and 2007



Source: Saadi 2015. Data at http://bit.do/WDR2016-Fig1_24.

Note: The analysis is based on 48 politically connected and 620 unconnected manufacturing firms with at least five employees in 2004 and 2007. See Saadi (2015) for more details.

Economic activities with a high potential growth impact from digital technologies are often protected from foreign or domestic competition in developing countries. The potential impact of the internet on firm productivity is often highest for economic activities that typically have higher barriers to competition (table 1.3). These sectors include utilities that are often natural monopolies, which are more difficult to regulate. But they also include banking, insurance, transport, retail trade, and some professional services, which are often protected by regulations from more foreign or domestic competition in developing countries (see figure 1.23).

In sum, developing countries with an institutional environment that safeguards competition and easy market entry will more likely harness the full growth opportunities of digital technologies and catch up faster with high-income countries. But countries will more likely remain poor if the institutional environment allows firms to obtain profits by lobbying for protection rather than investing in new digital technologies.[77]

Table 1.3 Economic activities with high potential for firms to use digital technologies more intensively are often protected from foreign or domestic competition in developing countries, reducing productivity growth

	Sectors or activities with barriers to competition		
Potential impact	**Lowest**	**Medium**	**Highest**
High	—	Banking, insurance, retail and wholesale trade	Transport
Medium	Manufacturing	Agriculture, hotels and restaurants, mining, technical services	Education, health care, real estate, utilities
Low	—	Legal services	Construction

Source: WDR 2016 team.

Note: The approximate grouping of sectors for the potential impact of digital technology is determined by scalability and contract complexity of most products in the sector, as defined in table 1.1. Digital technologies have a high potential in sectors that are more scalable and less complex (upper left cell in table 1.1), a medium impact for sectors that are more scalable but more complex or less scalable but less complex, and a low impact for sectors that are less scalable and more complex (lower right cell in table 1.1). The approximate grouping of sectors for the degree of competition is based on sectors' tradability, their average barriers to foreign or domestic entry across countries (for example, the Product Market Regulation Index [OECD, various years] and the Services Trade Restrictions Index), and their fixed costs (natural monopolies or land intensiveness). — = not available.

Notes

1. These channels can affect growth through more than one mechanism. For instance, the internet increases trade not only by allowing more and smaller firms to export (inclusion) but also by allowing existing exporters to trade more intensively, exploiting economies of scale (efficiency).
2. Nguyen and Schiffbauer 2015.
3. The results are based on ICT surveys linked to census data of firms in manufacturing and service sectors. The data cover more than 300,000 firms in Vietnam in 2011 (Nguyen and Schiffbauer 2015); 8,000 firms with at least 10 employees in Turkey in 2011 (Atiyas and Bakis 2015); more than 52,000 firms in Mexico in 2009 (Iacovone, Pereira-Lopez, and Schiffbauer 2015); and more than 3,000 manufacturing firms in Brazil (Cirera, Lage, and de Oliveria 2015).
4. See, for example, Cardona, Kretschmer, and Strobel 2013; Bartelsman, Hagsten, and Polder 2013.
5. There are two exceptions: firms in the second-lowest productivity quintile have the largest share of broadband users in low-income countries, and firms in the third-lowest quintile have the largest share of broadband users in upper-middle-income countries.
6. Cirera, Lage, and Sabetti 2015. Note that firm labor productivity is higher due either to higher TFP or to higher capital intensities.
7. See, for example, Haller and Siedschlag 2011.
8. Atiyas and Bakis 2015.
9. The statistics are based on census data including all manufacturing and service firms in Vietnam between 2007 and 2012 (no size restrictions). In Mexico and Turkey, the statistics are based on a representative sample for all manufacturing and service firms with at least 10 employees.
10. The results here are somewhat higher than the ones in Jorgenson (2011), who finds that the accumulation of ICT capital raised aggregate growth by 13 percent a year on average for more than 100 countries from 1995 to 2008. Moreover, Manyika and others (2011) estimate that the average contribution of the internet (alone) to economic growth was 0.3 percentage points among seven high-income countries between 2004 and 2009, and 0.4 percentage points for five large developing countries (Brazil, China, India, the Republic of Korea, and the Russian Federation). These results should be regarded with caution, however, since the growth contribution of the internet is effectively equated with the contribution of TFP.
11. Melitz 2003.
12. The internet reduces information frictions by providing a tool for firms to easily find information about new markets and advertise their products to multiple buyers. In addition, the internet can reinforce business and social networks and reduce communication costs with potential customers (Rauch 1999; Rauch and Trindade 2002; Fink, Mattoo, and Neagu 2005).
13. Freund and Weinhold (2004) examine the growth of bilateral merchandise exports of 56 countries and (2002) consider the growth of U.S. imports and exports of services. Both studies use data from 1995 to 1999.
14. There are two common measurements of internet usage in these studies. Freund and Weinhold (2002, 2004) and Clarke and Wallsten (2006) measure internet usage by the number of web hosts, while Osnago and Tan (2015) use the percentage of individuals using the internet in a country.
15. Osnago and Tan (2015) estimate a panel gravity equation using aggregate bilateral trade flows from 2001 to 2012 for all countries with country-pair and year

fixed effects. They determine whether a country has high internet usage when it has an internet usage above the median for all countries, which changes yearly.

16. The results are based on Osnago and Tan (2015).
17. eBay 2013.
18. Chen and Xu (2015) compare transaction-level data from AliExpress (a branch of Alibaba) and Chinese customs data across seven months. The online trade data are transaction-level data based on AliExpress from January to July 2014, and the offline trade data are Chinese customs data from January to July 2006.
19. Chen and Xu 2015.
20. The average number of export destinations is relatively low since the study focuses on only nine products that are narrowly defined at the 10-digit level (harmonized classification system). Thus, the average firm is only exporting about two different specialized products, for instance, silk and pure cotton T-shirts.
21. As a comparison, large firms selling on eBay reach an average of 30 export destinations (eBay 2013); large firms are defined as having an annual export of more than US$10,000 in 2012.
22. See http://www.theanou.com/.
23. Andjelkovic 2015.
24. Tan 2015; Osnago and Tan 2015. Tan (2015) uses the World Bank Exporter Dynamics Database (World Bank, various years) and estimates a panel regression to examine the effect of the internet usage of 4.5 million firms in 47 developing countries between 2002 and 2012. A product is defined as a harmonized system (HS) six-digit category.
25. This measure of physical infrastructure predicts firms' internet use; it is strongly positively correlated with the number of internet users by province over time (correlation coefficient of 0.55). Therefore, the length of the fiber-optic cables per population is also a good proxy for the number of "last mile" connections to firms or households in a province.
26. The number of exporting firms and firms' export share follow a similar pattern across provinces over time.
27. Fernandes and others (2015) use changes in the number of internet users per capita, Chinese internet domains per capita, and the length of fiber-optic cables per population to measure the rollout of broadband infrastructure across Chinese provinces between 1999 and 2007. The analysis is based on census data for manufacturing firms. The ICT intensity per industry is measured by the ICT capital services share in total capital services based on World KLEMS two-digit sector-level data for the United States, two-digit sector-level data on telecommunication expenses in China, and four-digit sector-level data from a Vietnamese firm census. All empirical specifications include firm fixed effects and *year x province* fixed effects controlling for time-invariant differences across firms and changes in any other export determinants across provinces over time.
28. Baldwin (2011) describes the reduction of transportation costs from the late 1800s as the first unbundling, where consumption and production can be geographically separated.
29. This relationship has been confirmed in Canada (Baldwin and Gu 2008), Germany (Rasel 2012), Ireland (Murphy and Siedschlag 2013), Italy (Benfratello, Razzolini, and Sembenelli 2009), the United Kingdom (Abramovsky and Griffith 2006), and globally based on a large dataset of multinational firms and their subsidiaries (Alfaro and Chen 2015).
30. Cristea (2014) also finds that the negative relationship between the headquarter services exports and communication costs weakens with the education of the foreign workers.
31. Fort 2014.
32. Alfaro and Chen (2015) examine the patterns of entry of multinational firms into 70 countries from 2005 to 2007. The data are from the Harvard Business School's Orbis Database (http://www.library.hbs.edu/go/orbis.html) and cover 1.2 million manufacturing companies.
33. Computer and information services exports include computer services such as hardware- and software-related services, news agency services, and database services.
34. Cardona, Kretschmer, and Strobel (2013) provide a survey of the recent microeconomic studies estimating the relationship between the use of digital technologies and firm productivity growth.
35. See UNCTAD 2013 and Ogodo 2009.
36. McKinsey Global Institute 2014; *Economist* 2014.
37. Chick, Huchzermeier, and Netessine 2014.
38. Chick, Huchzermeier, and Netessine 2014.
39. McKinsey Global Institute 2014.
40. The analysis is based on an annual panel of firm census data from 2007 to 2012 with more than 300,000 observations each year. TFP is estimated following the methodology of Olley and Pakes (1996). Each regression controls for two-digit sector dummies, year dummies, and firm characteristics (firm size, age, and ownership as well as export status). See Nguyen and Schiffbauer (2015) for details.
41. Brown and Goolsbee 2002. Their availability raised price dispersion initially and then reduced it as internet use became more widespread, which is consistent with the theory of search costs by Stigler (1961) and Stahl (1989).
42. The results are based on a regression of the average entry density on a dummy that is one in the years of or after the reform, controlling for year-specific effects.
43. The positive link between the use of new technology and competition is well documented. For instance,

Collard-Wexler and De Loecker (2015) show that two-thirds of the higher productivity in the U.S. steel sector after the introduction of a major new technology, the minimill, originated primarily from an increased competition effect and only one-third from a technology replacement effect. In particular, the minimill expansion drove a productivity resurgence at the surviving vertically integrated producers and thus for industry as a whole.

44. Mbiti and Weil (2011) find this effect based on firm-level data comparing competing money transfer services.
45. Wei and Mozur 2014.
46. Golovin 2014.
47. Andjelkovic 2015.
48. Van Welsum 2015.
49. Cirera, Lage, and Sabetti 2015.
50. Comin and Mestieri 2013.
51. According to data from the market-research firm IDC.
52. Rochet and Tirole 2003.
53. A two-sided market is one in which (1) two sets of agents interact through an intermediary platform and (2) the decisions of each set of agents affect the outcomes of the other set of agents, typically through an externality (Rysman 2009). For instance, in an e-commerce platform like Amazon, the two agents are the consumers and the online sellers whereby consumers benefit from more online sellers using the platform and vice versa.
54. Nunn (2007) constructed a measure of contract intensity for tradable goods. Contract-intensive goods include packaging machinery, musical instruments, and alcoholic beverages. Goods with low contract intensity include wearing apparel, frozen food, plastics and rubber, base metals, or fertilizers.
55. The correlation coefficient between the contract-intensity four-digit sectors in Vietnam from 2007 to 2011 and the share of firms that use the internet (have a website) in these sectors is 0.44 (0.28); see Nguyen and Schiffbauer 2015.
56. Bloom, Sadun, and Van Reenen (2012) argue that digital technologies enhance managers' information set, improving their ability to monitor staff and allowing them to delegate decisions to subordinate management layers. They show that the impact of good management practices on firm productivity is larger in ICT-intensive sectors.
57. Bresnahan, Brynjolfsson, and Hitt 2002; Brynjolfsson and Hitt 2003; Crespi, Criscuolo, and Haskel 2007; Bartel and others 2009; Bloom, Sadun, and Van Reenen 2012.
58. See Commander, Harrison, and Menezes-Filho (2011) for Brazil and India, and Nguyen and Schiffbauer (2015) for Vietnam.
59. Riker (2015) shows that internet access increases the probability of product entry into the United States, and the probability is higher for countries with better logistics.
60. UNCTAD 2015.
61. Bloom, Sadun, and Van Reenen 2012; Inklaar, Timmer, and van Ark 2008.
62. Chick, Huchzermeier, and Netessine 2014.
63. See Aghion and others 2001. The theoretical framework is also closely related to Parente and Prescott (1999). Aghion and others (2001) also discuss whether perfect competition can reduce the incentives for any innovation by reducing the discounted present value of associated rents, leading to an inverted U-shaped relation between competition and growth. They provide evidence, however, that the negative part in the competition-growth nexus is less empirically relevant (see also Aghion and others 2006, 2008, 2009).
64. For instance, Aghion and others (2006, 2008, 2009) find that more product market competition and entry deregulation lead to higher productivity growth. Buccirossi and others (2013) show that improvements in competition policy, measuring restrictions to domestic and foreign entry and restrictions to antitrust, led to higher TFP growth among 22 industries in 12 OECD countries. The effect was strongest for antitrust activities.
65. Bartelsman, Hagsten, and Polder 2013.
66. Bloom, Draca, and Van Reenen 2011.
67. The findings are consistent for the other available measures of ICT, such as the share of firms that have a website or use e-commerce in Vietnam (Nguyen and Schiffbauer 2015), and the average share of a firm's workforce using the internet or the share of firms' e-commerce purchasing over total purchases in Mexico (Iacovone, Pereira-Lopez, and Schiffbauer 2015).
68. Kretschmer, Miravete, and Pernías 2002.
69. Cirera, Lage, and Sabetti 2015. The results are based on more than 2,300 firms in these six African countries in 2014.
70. The effect is based on a regression of (log) labor productivity from 2008 to 2012 on the ICT variables, the product-level degree of import competition from China from 2000 to 2008 (in the Mexican or U.S. markets), and the interaction term between these two variables. Each regression controls for firm fixed effects and changes from 2008 to 2012 in other firm characteristics (firm size, age, location, exports, foreign or state ownership, and share of skilled labor). See Iacovone, Pereira-Lopez, and Schiffbauer 2015. The results are robust when using the interaction term between household internet use at the province level and sectors' ICT intensity based on U.S. data as an instrumental variable controlling for the endogeneity of the ICT variables.

71. Cirera, Lage, and de Oliveria 2015. An increase in competition is measured by a change in firms' market share in previous years. The results are based on a multinomial logit regression from 2009 to 2012 where the dependent variable indicates different stages of the e-commerce system; the most advanced e-commerce system also allows for online payments. The regressions control for firm characteristics such as firm size, age, export status, and ownership and sector-specific effects.
72. Countries with available data that are not members of the World Trade Organization (Afghanistan, Kazakhstan, Lebanon, and Liberia) are excluded because they do not face restrictions on using tariff rates as an alternative mode to restrict import competition.
73. See World Bank Enterprise Surveys (http://www.enterprisesurveys.org/); the World Bank's Services Trade Restrictions Index (Borchert, Gootiiz, and Mattoo 2013).
74. See Golovin 2014. To deal with the problem at the time, Ireland set up a "hardship fund" with payments of up to €15,000 to alleviate the financial hardships suffered by license holders due to the devaluation of their assets, although the general consensus was that the government was under no obligation to compensate the taxi industry.
75. The analysis is based on 48 politically connected and 620 nonconnected manufacturing firms with at least five employees in the World Bank Enterprise Surveys data in 2004 and 2007. The 48 politically connected firms operate in almost all of the 22 two-digit manufacturing industries. But within these, they operate in fewer than half of the more than 100 four-digit subsectors in total. See Saadi (2015) for more details.
76. Almost all firms in connected and nonconnected industries use e-mail.
77. See, among others, Parente and Prescott (1999) or Acemoglu, Johnson, and Robinson (2005).

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