Digital and Technical Transformation

We are witnessing a profound change in the way we live, perceive the world, and participate in it. At the core of this transformation is an immense increase in global connectivity, which allows, in principle, for more efficient use of both physical and human resources. On the other hand, the near-zero marginal cost of production, storage, sharing, and analysis of information enables fast growth of digital platforms that may become a new type of global information monopoly. Leading platforms add large value for customers and complete markets in many innovative ways. Through platforms, even small companies and individuals from all over the world can have global reach for their products and services. Along with the growth in the quantity of data, our ability to process and analyze these enormous information flows increases exponentially. The promise of Artificial Intelligence (AI) and automation is likely to be transformative for the way we live and work.

Such processes also raise important challenges from the European perspective. None of the largest global platforms are European but rather American and Chinese. These companies rely strongly on Intellectual Property (IP), which is more mobile than physical capital. Their services can be provided in markets where they have no physical presence. This raises issues of how to regulate and tax them. Europe is lagging behind the United States and China in part due to a trade-off that exists between data and privacy protection, the latter advocated in Europe, and the time it takes to amass large quantities of cheap data needed for fast development of AI and other key technologies (as in the United States and China). As Europe develops policies regarding privacy in the digital world, its policymakers should keep this trade-off in mind.

The changing nature of globalization presents a potential challenge to the European economic model. Whether the European welfare state model can be sustained in the future may depend on the fiscal consequences of digitalization, among other things. In addition, digitalization creates both winners and losers. Inequality may be rising not only on the individual but also on the company level, with winning platforms becoming a new type of global monopoly (at least for a while). There is a risk that American and Chinese platforms can increasingly capture the lion's share of the value added in the emerging global economy. This view seems to be supported by the enormous market valuation of leading platforms. Relatively low profitability of most of these platforms (Apple is an exception) indicates that each player pays a premium for their current market domination. But low profitability is also a sign of their potential fragility. Preventing domination of American and Chinese platforms in Europe should be a matter of industrial and competition policy. To the extent that the development cannot be stopped, European interests in international tax policy may need to change. An additional important issue is that the gig economy, enabled by new technologies and global connectivity, puts pressure on the worker/employee relationship traditionally prevalent in developed Europe.

In this chapter, we present some of the core issues related to the digital transformation of the global economy and how Europe can potentially respond to these momentous changes. In the chapters that follow, we specifically focus on problems and potential solutions related to fair taxation in the mobile and digitalized world.

2.1 MAJOR TRENDS

Since 1990, the world has become dramatically more connected, but the character of that connection has changed, and in recent years its physicality diminished. A McKinsey Global Institute study in 2016 estimates that the global cross-border flows of goods, services, and finance amounted to USD 5 trillion, or 24 percent of global Gross Domestic Product (GDP) in 1990, compared with USD 30 trillion, or 39 percent of global GDP in 2014. At the same time, global tourism increased from 435 million international tourist arrivals in 1990 to 1.1 billion in 2014. The public internet, which was just starting in 1990, has become a global network connecting billions of people, companies, and public entities. An increasing number of people work remotely part- or even full-time.

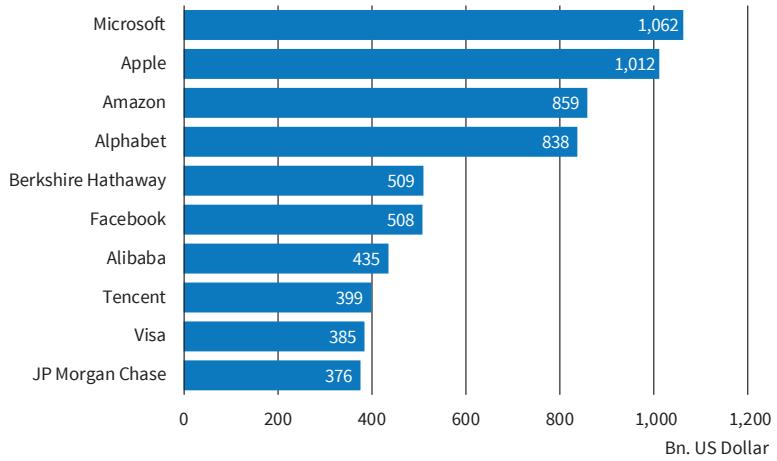
Flows of physical goods and finance drove globalization in the 20th century. However, after a 20-year period of growing roughly twice as fast as the world economy and peaking at 53 percent of global GDP in 2007, the patterns of traditional global trade flows have shifted. Growth in goods trade, traditionally driven by large multinational value chains, has flattened, while financial flows driven by large financial groups have fallen sharply, and trade in services grew only modestly. In the recovery period after the global financial crisis, total flows have regained their pre-recession levels in terms of dollar value, but by 2014 they represented just 39 percent of world GDP (McKinsey Global Institute, 2016), a smaller fraction than in 2007.

EEAG (2020), "Digital and Technical Transformation",
EEAG Report on the European Economy, CESifo, Munich, pp. 38–55.

Part of this relative decline has been in response to the global financial crisis and was thus cyclical in nature. But there are reasons to believe that the stagnation in traditional global trade driven by large multinational value chains is likely to be structural. Namely, the makers of many finished goods are now placing less importance on labor costs and more on speed to market and non-labor costs. As a result, part of global production is moving closer to end consumers. Massive introductions of industrial robots and 3D printers may further facilitate this process. Trade is also declining for many intermediate goods such as chemicals, paper, textile fabrics, and communications and electrical equipment. This suggests that global value chains may be shortening. Managing complex, lengthy supply chains is costly and potentially risky (on risk management of global supply chains, see Lessard, 2013). The risks are heightened by the ongoing US-China trade war. Europe may be significantly impacted by all of these processes. On one hand, nearshoring may bring some previously outsourced manufacturing back to developed Europe. On the other hand, automation may prevent significant job gains from materializing. In addition, if the trade war(s) continue, they may threaten European export prospects.

Figure 2.1a

Top 10 Global Companies by Market Capitalization in 2019



Source: Financial Times Global 500. All figures from 2019 Q3.

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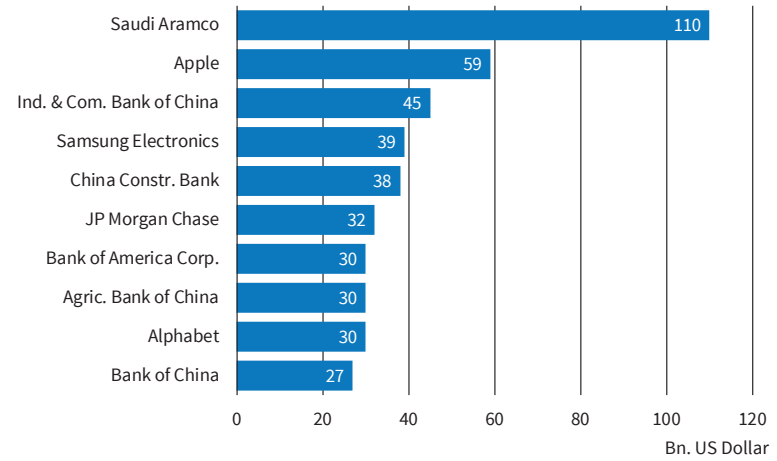
Figure 2.1b

Fortune 10 Global Companies by Profits in 2019



Source: Fortune 500.

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In the past few years, globalization has entered a new era driven by data flows that transmit information, ideas, and innovation. This has enabled the creation of digital platforms. They create more efficient global markets in which geographically distant buyers and sellers find each other with a few clicks. The near-zero marginal costs of digital communications and ease of digital transactions open up new possibilities for conducting business across borders, even for small companies and individuals. This potentially sets the stage for more inclusive globalization than what we had in the past. On the other hand, there are no natural bounds on growth of successful platforms. Therefore, they can become information-based monopolies, a new type of (temporary) monopoly with the power to influence our lives in ways that were previously not possible. This is reflected in the market valuation of leading platforms. In the top ten global companies by market capitalization, the vast majority are American and Chinese digital platforms (see Figure 2.1, Panel a).

As a result of their vast capitalization, internet giants have not only information power but also financial power. They can easily purchase potential competitors and spread their power both vertically and horizontally, entering and potentially dominating industries that were previously a domain of traditional companies. Importantly, no leading platform (currently, at least) has originated in Europe.

Yet with the exception of Apple, none of the leading platforms are in the top ten most profitable companies (Figure 2.1, Panel b). High valuation, therefore, likely stems from investors' perceptions of the degree of platforms' market dominance. Another important characteristic of these firms is their strong reliance on IP rather than on physical capital. This is reflected in part in their high price-to-book (P/B) ratio with respect to more traditional production companies. In 2019, while Amazon had a P/B ratio of 15.50 and Apple

12.85, Deutsche Telekom had a ratio of 2.33. Furthermore, traditional European manufacturers Volkswagen and Daimler had ratios below 1 (0.74 and 0.87, respectively). Heavy reliance on IP and relatively low profitability make global platforms vulnerable to change in market sentiment and the emergence of new competitors.

While the digital economy and digital trade are increasingly important and the leading players are gaining power, governments and international institutions are having a hard time handling new developments. At present, for example, there is no full agreement even on how to define or measure the 'digital economy'. A Organisation for Economic Co-operation and Development (OECD) study from 2013 argues that most existing industrial classification systems are too broad to identify relevant digital trade-related activities. The OECD has developed a framework for more comprehensive measurement of digital trade adopted by, among others, the United Nations Conference on Trade and Development (UNCTAD). The OECD defines an electronic or e-commerce transaction as the sale or purchase of goods or services conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders. Payment and delivery do not have to be conducted online.

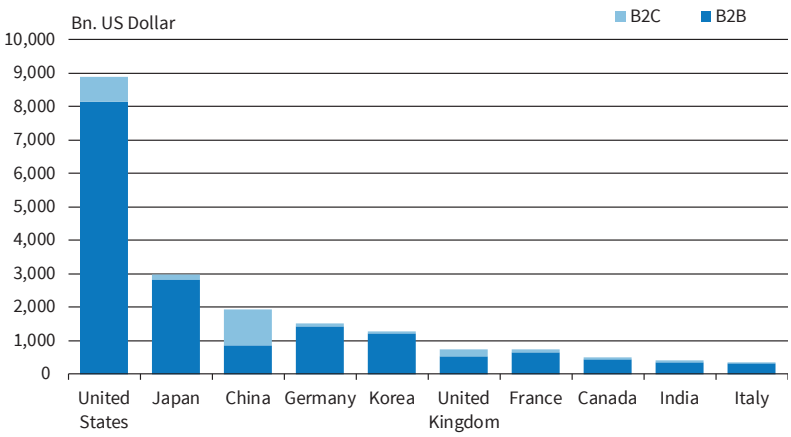
Here we present UNCTAD (2019) estimates of global e-commerce (the estimates are for 2017). They consider primarily Business-to-Business (B2B) and Business-to-Customers (B2C) trade. B2B e-commerce is the sale of goods or services between businesses via an online sales portal. In general, it is used to improve the efficiency and effectiveness of a company's sales efforts. B2C e-commerce refers to online transactions between a business and a consumer, where an e-commerce website enables customers to shop like they do in stores but by using an online catalog, selecting items for purchase, and checking out virtually. C2C commerce, which is arguably on the rise, is not part of that report.

UNCTAD estimates the volume of global B2B and B2C commerce (domestic and cross-border) to be around USD 25.5 trillion and USD 3.85 trillion, respectively, for a total of around USD 29.4 trillion (see Figure 2.2).

Figure 2.2

Global E-Commerce in 2017: Top 10 Countries

Global B2C: US Dollar 3.85 tn., Global B2B: US Dollar 25.5 tn.



Source: UNCTAD (2019); EEAG calculations. © CESifo

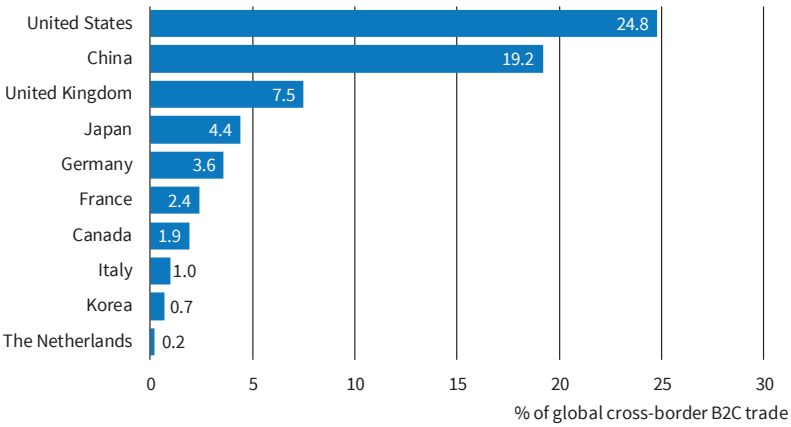
As expected, the United States is, overall, a dominant force in e-commerce, followed by Japan and China. In the top ten globally, there are four large European countries. The best-placed European country, Germany, is in fourth place, not too far behind China. But there is a significant difference: while Germany's position is mostly due to B2B, China has made serious strides in B2C, the area which the UNCTAD (2019) report says is growing stronger than B2B. It is in B2C and C2C that digital platforms are traditionally the most active.

While B2B is dominating the world's e-commerce overall, there is no data that allows us to reliably separate how much of it is due to cross-border transactions (see the discussion below, though). The situation is slightly better in that respect with B2C. UNCTAD (2019) estimates that cross-border B2C sales amounted to USD 412 billion in 2017, of which around USD 270 billion were due to the top ten countries (see Figure 2.3).

Figure 2.3

Top 10 Countries by Cross-Border B2C Sales in 2017

Global B2C Cross-Border Trade: US Dollar 412 bn.



Source: UNCTAD (2019); EEAG calculations. © CESifo

Note that China, while lagging behind the United States in 2017, had a strong lead in B2C crossborder trade with respect to the leading continental European countries. The best-ranked European country in this category was the United Kingdom.

How important are B2C cross-border sales for these ten countries (and the world as a whole) as a fraction of merchandise (goods) exports? This is shown in Figure 2.4.

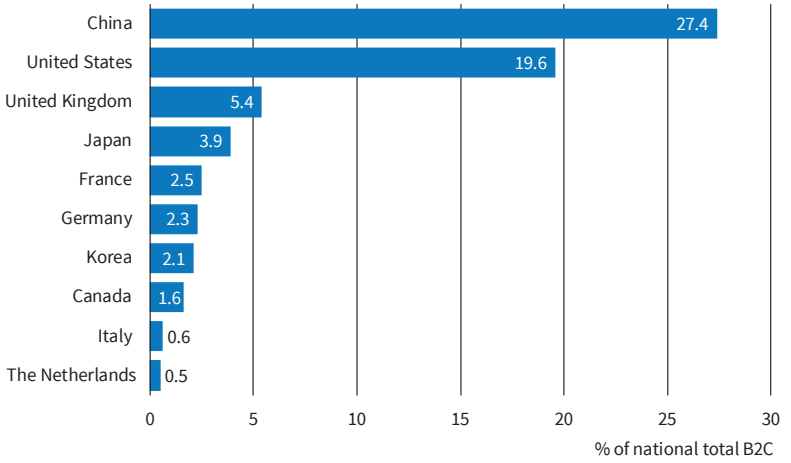
Overall, B2C cross-border sales are only around 2.3 percent of the global merchandise sales. But this channel is the most important for the United Kingdom and the United States, followed by China. On the other end of the spectrum, only 1 percent of German merchandise (goods) exports is realized through B2C cross-border sales.

As platforms cut out the middleman in an ever increasing number of industries, the key question for Europe is whether it shall become primarily just a producer of commodity products, leaving the lion's share of the value-added to the American and perhaps Chinese platforms. If this were the situation that develops over time, a legitimate response by Europe would be to tax global platforms based on destination and consumption.

The total B2C market (domestic plus cross-border) is around USD 3.8 billion (Figure 2.5). Of that amount, B2C cross-border sales were around 10.7 percent in 2017. Note that when the domestic B2C market is included, China is clearly ahead of the United States, reflecting a very large domestic Chinese market in this segment of the digital economy.

Figure 2.5

Cross-Border B2C Sales as Share of Total B2C Sales (Domestic and Foreign) in 2017



Source: UNCTAD (2019); EEAG calculations.

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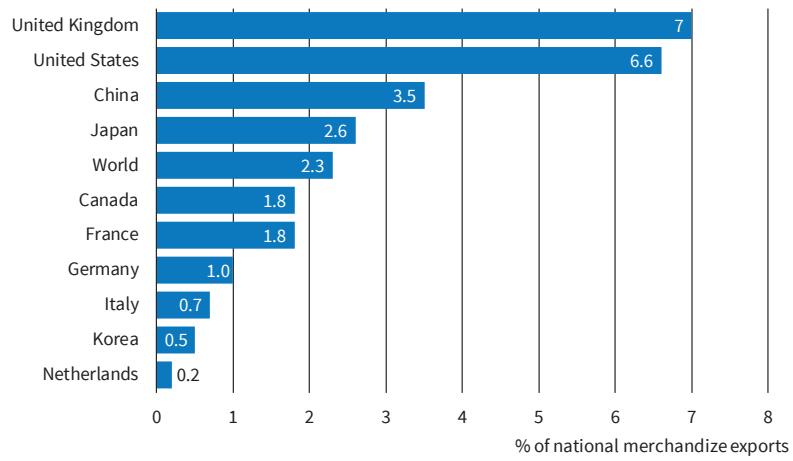
Interestingly, when the domestic B2C market is included, Germany is lagging behind both the United Kingdom and France.

The UNCTAD B2C e-commerce Index measures an economy's preparedness to support online shopping. Countries are scored on the access to secure internet servers, the reliability of postal services and infrastructure, and the portion of the population that uses internet and has an account with a financial institution or mobile money-service provider. In terms of e-commerce readiness, Europe dominates the rest. For the second year in a row, the Netherlands led the index in 2018, followed by Switzerland. In fact, the only non-European countries (out of 151) on the top ten list were Singapore (third) and Australia (tenth). Thus, the potential for fast development of B2C in Europe clearly exists. Nevertheless, there is a danger that Europe may be missing out on the expanding global opportunities in that market. This is reflected in the fact that among the leading platforms, not a single one is European. At the same time, the number of online shoppers is on the rise globally. Based on UNCTAD (2019) estimates, the number of online shoppers grew in 2015–2017 overall by 24 percent to reach 1.34 billion shoppers in 2017 (see Figure 2.6). Importantly, the growth was driven primarily by an increase in cross-border shoppers of almost 70 percent in that period. By 2017, an estimated 277 million people were shopping online across borders. These numbers are expected to rapidly expand as contractors gain confidence in cross-border transactions.

As we have stated before, UNCTAD (2019) does not pro-

Figure 2.4

Cross-Border B2C Sales as Share of Merchandize Exports in 2017



Source: UNCTAD (2019); EEAG calculations.

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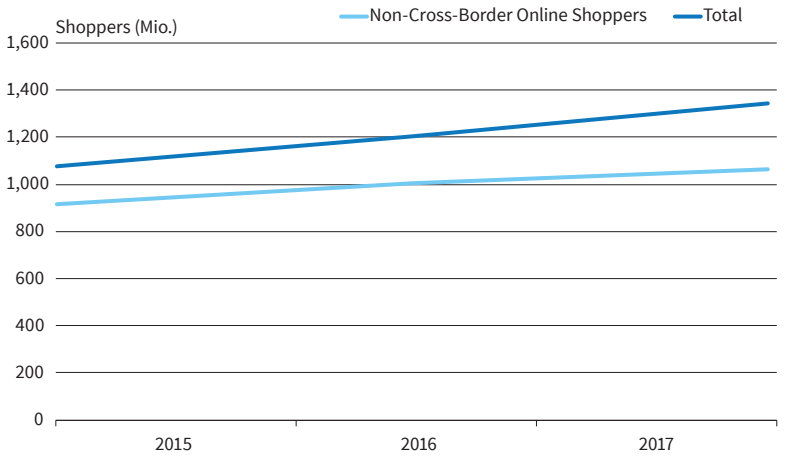
Figure 2.6

Global Cross-Border vs. non-Cross-Border Online Shoppers Globally, 2015–2017



Source: UNCTAD (2019). © CESifo

vide an estimate of cross-border B2B trade. One way to estimate it is to use the same fraction as in the case of B2C cross-border trade, i.e., around 10.7 percent. This would lead to an estimate of USD 2,730 billion for cross-border B2B. Together with USD 412 billion for the cross-border B2C estimate, we obtain around USD 3.2 trillion as an estimate for B2B and B2C cross-border sales. As a proxy for cross-border digital trade, this estimate is likely to be too low for several reasons. Assuming the same ratio as B2C may be unrealistically low since companies have incentives to use digitization to lower costs when trading with each other. Since much of the trade is between various parts of supply chains, trade frictions in B2B are likely to be smaller than in the case of B2C. In addition, the estimate does not take into the account the C2C component of cross-border trade. We show later that, at least in Europe, people are very actively using the internet to augment their labor income. Part of these transactions is certainly cross-border.

Perhaps most importantly, the estimate is unlikely to fully account for the value of global data flows simply because they are too difficult to measure. Digital flows primarily consist of information, searches, communications, transactions, video, and intra-company traffic. Importantly, they enable virtually every other kind of cross-border flow. For example, container ships move products to markets around the world, but now customers order them online, track their movement using wireless trackers, and pay for them via digital transactions. Although videos use a majority of internet bandwidth, the Internet of Things and other business applications are gaining in importance.[1]

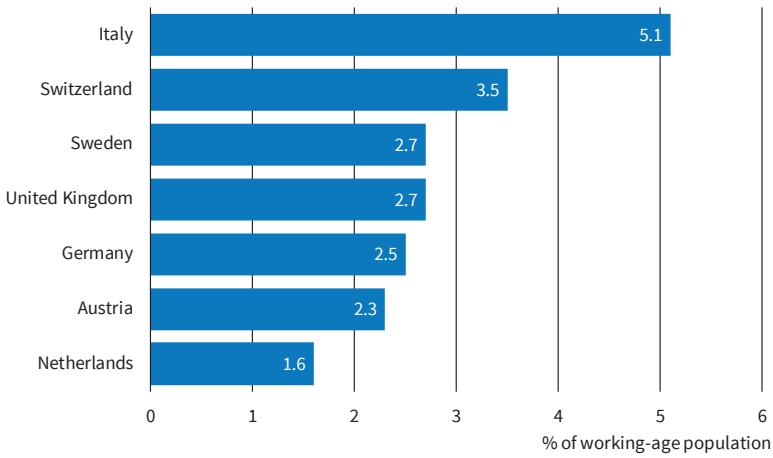
Beyond e-commerce, digital platforms such as UpWork are starting to change the way people work, making the job market for certain skilled labor truly global. On the flip side, digitalization is putting pressure on traditional employment patterns and facilitates growth in the gig economy. In developed European countries, up to 5 percent of the working people are deriving more than 50 percent of their labor income in the gig economy (see Figure 2.7). This number is likely going to increase as more of the economy goes digital.

A large part of the growth in the flow of data stems from communication between individuals (Lund and Manyika, 2016). As transmission costs fall and internet speed increases, people and companies are using digital and mobile connections to share ideas, collaborate, and make social connections, both within countries and across borders. Voice over Internet Protocol (VoIP) has generated a surge in global cross-border telephone calls increasing from 162 billion call minutes in 2002 to 570 billion call minutes in 2014. Since 2004, the number of call minutes on VoIP has increased by 24 percent per year, while traditional analogue call minutes have grown by less than 8 percent. In addition to VoIP calls, cross-border computer-to-computer calling through Skype amounted to 44 percent of traditional international calls in 2014 in terms of the number of minutes.

[1] Castro and McQuinn (2015) find that around 50 percent of the world's traded services are already digitized.

Figure 2.7

Share of Individuals Earning at Least Half of Their Income in the Gig Economy in 2016



Source: Huws et al. (2018). © CESifo

Most of these changes have happened in the past decade. Prior to that it was not obvious that the internet and internet-enabled communication were going to be so transformative. For example, in his article titled "Why Most Economists' Predictions Are Wrong," Nobel Laureate and New York Times columnist Paul Krugman made the following prediction (Krugman, 1998): "The growth of the internet will slow drastically" as it "becomes apparent [that] most people have nothing to say to each other! By 2005 or so, it will become clear that the internet's impact on the economy has been no greater than the fax machine's."

Apart from the rapid increase in global communication and the creation of global internet platforms, there are two other important factors impacting digital globalization.

The first is transformation of many goods that used to be traded in physical form into purely digital goods delivered through the internet, thus eliminating all distribution and transportation costs. Consumers can now choose from a near-endless supply of games, movies, music, books, magazines, and newspapers from anywhere in the world. A growing share of customers is now in foreign countries. For instance, in the case of Netflix, by the end of 2014, nearly one-third of its streaming customers lived outside the United States (Netflix, 2014). In the future, 3D printing technologies may further alter the flow of physical goods. Rather than producing goods in one location and shipping them around the world, firms may send digital design files across the internet and then use 3D printers to produce the goods in small batches locally. Some replacement parts, medical prosthetics, and industrial components are already being produced this way. The range of goods thus produced is likely to expand and may include complex industrial parts. Analysts from the Dutch bank ING estimate that 3D printing may substantially negatively impact traditional global trade in goods (ING, 2017). Furthermore, the results of their survey of relevant market players indicate that currently the key impediment for a much broader use of 3D printers is mostly psychological (the lack of stakeholder trust in this new technology) and not technological. Even education has become an increasingly digital good that can be globally traded, through the rise of online training and educational courses. For example, more than three-quarters of Coursera users come from outside the United States, and almost one-third of them from India, Brazil, Russia, and China (Lund and Manyika, 2016).

As the volume of trade in digital goods expands, their value grows as well. But it is often not captured in statistics on trade. For example, user-generated content on blogs and on YouTube is driving very high volumes of internet traffic both within countries and across borders, but very little of this content is paid for by consumers. As it does not involve a monetary transaction, the significant value that this content generates does not show up in economic or trade statistics but instead reveals itself as 'consumer surplus.' Another important way in which digitization impacts physical flows is through the so-called 'digital wrappers' around traditional products. Radio-frequency identification (RFID) technology uses wireless radio communications to uniquely identify objects or people and collect information about a product, place, time, or transaction. RFID has a variety of uses, including access management, payments, and logistics. In logistics, this has improved inventory management in long global supply chains, helping reduce inventory costs by up to 70 percent while improving the service offered (Sarac, Absi, and Dauzere-Peres, 2009). Digital tracking of physical shipments reduces the volume of goods lost in transit, enabling trade in larger volumes and higher value goods. RFID increasingly enables trade with emerging economies with underdeveloped infrastructure. Last but not least, this type of sensor is a key component in the Internet of Things (IoT), which is supposed to seamlessly connect billions of different pieces of equipment and machines and thus further dramatically increase the connectivity of our global world. A Cisco study (2015) estimated that machine-to-machine connections will account for more than 40 percent of global devices and connections by 2019.

A very different but also very important type of digital wrapper are the websites that provide customers with the ability to add reviews on e-commerce platforms in order to help others choose the right product and/or provider. These reviews can help reduce ambiguity and uncertainty about a product's quality and help increase sales.

In summary, the patterns of globalization and global trade are rapidly changing as a result of the digital transformation of the world economy and the introduction of advanced new technologies. While some of these changes tend to have a negative impact on traditional global trade, others have the opposite effect. What is clear, however, is that the new type of organization, digital platforms, is increasingly displacing traditional multinational value chains as the key players in the global economy. This shift in the way we do business is perhaps even more profound than the technology shift that is enabling it. This is what we address next.

2.2. PLATFORMS AND THE REMODELING OF THE CORPORATE WORLD

Digital platforms play a transformative role in the global economy, but Europe is lagging behind in this arena. In order to better understand the role of platforms in the 21st century economy, as well as their salient characteristics, let us first briefly review the 20th century corporations. Until quite recently, a typical model of a business has been the one-directional business model. In the one-directional model (some-

times also called a linear model) value flows in one direction through the company's supply chain.

There are two main types of one-directional businesses. The first one is the standard product company. It builds physical assets, such as factories and distribution centers, in order to make its products and get them to consumers. Almost all manufacturing has worked in this fashion over the last century. So have distributors and resellers, which are companies that build or lease physical assets or technologies in order to distribute and sell physical products. Many of today's software companies are also of this type. Even though their products are digital, these companies still function in a single direction, with value flowing from the companies to their customers. The only difference is that software companies benefit from the low marginal cost of digital distribution. The second type of one-directional business model is a services company that hires employees who provide services to customers. Services can be physical (car repairs, construction, plumbers), or based on intangible assets (attorneys, consultants, bankers). Either way, using the top-down planning and hierarchical organization, one-directional companies can create and distribute value efficiently to the target customers.

The efficiency is achieved through the supply chain. For example, an automobile manufacturer like BMW buys parts from its suppliers, which in turn may have bought parts or raw materials from another supplier. BMW then uses these parts to create a finished product, a car. It sells it to a dealership, which finally sells it to a consumer. In this chain, value flows through the suppliers to the manufacturer and eventually down to the end consumer. At each step in the supply chain, someone adds value to the product or service and moves it to the next link in the chain. Information in this process has a similarly one-directional flow, with top-down forecasting. Each part of the chain can, in principle, be optimized, leading to efficiency gains.

However, the efficiencies of the supply chain approach come at a cost. One-directional businesses require large factories and/or investments in human capital and elaborate distribution channels in order to create products and move them to market. For these companies, the resources a business owns and controls internally are its most valuable assets.

It turns out that in the digital age, when a sufficient level of global interconnectedness is reached, what a company owns matters less than the resources to which it can connect. Today's most valuable businesses are those that can build and orchestrate large networks, not those that can aggregate and centralize large amounts of resources under one roof (see Figure 2.1, Panel a, and the discussion around it). In the one-directional business model, scale was a result of investing in and growing internal resources. But in a networked world, scale comes from cultivating an external network built on top of your business.

In order to see how different these two business models are, consider a hotel chain like Holiday Inn and compare it with Airbnb. Holiday Inn operates physical assets (hotels). In order to add capacity, it needs to build or purchase more hotel rooms (i.e., acquire more physical assets). Airbnb, in contrast, owns no rooms or apartments for rent. Instead, it 'just' connects people that own apartments or rooms to rent to potential renters. In order to add capacity, Airbnb can simply add another listing to its website. Note that Airbnb has in fact created a new market, not just taken over part of the old one. A lot of people that have previously never rented their properties before are now getting economic value from that otherwise 'dead capital.' And, importantly, this is happening not only in the United States and developed European countries, but increasingly in emerging markets as well. Finally, Airbnb is making affordable foreign visits possible for people with limited financial means, furthering global connectivity.

Similarly, eBay does not own any goods sold on its network. However, it creates a significant value to both buyers and sellers by connecting them and enabling them to transact. On that platform, anyone can buy unique and hard-to-find goods from all over the world while also accessing detailed information about these goods. As a result, businesses that had been geographically limited can suddenly have global distribution at almost no cost. The same is true for individuals (eBay is a pioneer of the online C2C market). In emerging markets with relatively underdeveloped traditional retail outlets, the impact of a platform like Alibaba has been great. Through Taobao, Alibaba's subsidiary, close to 10 million Chinese merchants sell their products. There are whole villages created around members of the Taobao network (called 'Taobao villages'). And in all that, Alibaba has only 35,000 employees. In contrast, Walmart, a very successful but traditional (one-directional) retailer of comparable revenue size, has around 2 million employees (Moazed and Johnson, 2016).

It is important to understand the difference between digitalization and digital platforms. Consider encyclopedias, for example. For a very long time, the market was dominated by the famous Encyclopedia Britannica. The company had a great tradition of producing the most complete sets of encyclopedias, carefully researched and edited, beautifully printed, and distributed all over the world through their vast and expensive sales force. To recoup the cost and make a profit, Britannica sold for anywhere between USD 1,500 and USD 2,000 per set. Then Microsoft introduced Encarta, which contained a more or less comparable information set. However, it was sold on CDs for USD 50 apiece. This put a lot of pressure on Britannica as many price-sensitive people switched to the new medium. Note that Microsoft had a significant advantage in terms of the distribution cost (no expensive salespeople) but still faced a significant

cost in terms of producing the information that was placed on CDs. In fact, both of these businesses were one-directional even though one used digital delivery. Then came Wikipedia. Not only is it delivered over the internet free of charge, but after the initial system was set up, its marginal production costs are close to zero since it relies on human creators of content that create and edit that content for free. Wikipedia is an example of a very successful digital network. As the network of contributors and users grew, no one-directional business model could compete. Consequently, Microsoft exited the encyclopedia market, while Britannica is now available online only.

After providing these examples, let us now define what exactly a digital platform is. According to Moazed and Johnson (2016), it is a business model that facilitates the exchange of value between two (or more) user groups, consumers, and producers. Typically, this is done over the internet. In order to make these exchanges happen, platforms harness and create large, scalable networks of users and resources that can be accessed on demand. They create communities and markets that allow users to interact and transact. We have mentioned some platforms. Other very successful platforms are, for example, Google (now part of the holding Alphabet), Apple, Amazon, Facebook, etc. In fact, most of us are users and/or contributors to at least some of the most successful platforms on a daily basis. Note that Microsoft, which was a very successful company in the desktop era before getting into trouble with the advent of the internet, is making a concerted effort under its new leadership to transform itself, at least partially, into a digital platform. In an unprecedented move, it has opened up its development platform .NET Core and its key programming language C# to all major operating systems, not just to its own, Windows. And it has offered access to these technologies free of charge. The effort has been paying off in terms of market valuation (Figure 2.1, Panel a).

A platform enables value creation by facilitating transactions. Uber does not deliver a ride, but it facilitates the connection and exchange of value between drivers and passengers. The transaction that is at the heart of the platform is called the core transaction. It is the process that turns potential connections into transactions and creates value for its users. Getting the core transaction right is the key to a successful platform design, as the platform will need its users to repeat this process over and over to generate and exchange value. However, although a platform enables the core transaction, it does not directly control its users' behaviors. Thus, the challenge of growing a platform is to convince a critical mass of users to join (both 'producers' and 'customers' at the same time) and create incentives for everyone to behave in a way desirable for the platform. In other words, one needs to match the appropriate parties of the transaction together, provide the technology to facilitate the transaction, and establish the rules that govern the network in order to build trust and maintain quality. These are the core functions of a platform (Moazed and Johnson, 2016).

For example, on YouTube, people posting the videos are producers while people watching the videos are consumers. Of course (and this is in sharp contrast with a traditional media company), the same person can be both a consumer and a producer at different points in time. The core transaction is enabled when a person watches a particular video. In the case of YouTube, the key for success is to attract star producers, those whose videos are watched by large numbers of people. For eBay, on the other hand, the key is to have as many reliable sellers and buyers as possible. Here, the equivalent of a star producer would be somebody with a high rating signaling good behavior. Only platforms that get core transactions right can have a chance to become successful. And very many platforms that try to scale up simply do not succeed.

Now that we have explained what platforms are, let us consider the preconditions for the rise of this novel business model. First, advances in technology have made computing a commodity. Computers are now cheap and widely available. They are embedded in all aspects of our lives whether we are conscious of it or not. Furthermore, technological progress and increasing competition are driving down cloud processing and storage prices. This allows start-up companies to quickly start and scale up their business using the external cloud services provided by companies such as Amazon, Google, or Alibaba instead of purchasing and managing expensive servers on their own. The second major factor is the declining cost of transmitting and collecting information. Activities that typically happened within the bounds of one organization can now take place in a decentralized manner through networks. The third factor is a rapid growth in connectivity and data production. In a smartphone, typically, there are over half a dozen tiny sensors that transmit data via connected technology. This data is collected and processed. Companies collect data automatically as a by-product of the business itself. This is in sharp contrast with the situation not more than ten years ago when companies had to create distinct processes to measure and collect information on a business. All this leads to an exponential growth in available data (see, however, our discussion on privacy violations in the last section of this report).

Yet another precondition for the creation of digital platforms are enormous improvements in our ability to process and make sense of this flood of data. As more and more data is collected, new increasingly powerful algorithms are created that can analyze this data on a large scale. AI is fundamentally based on this: collecting and processing large amounts of data through deep machine learning algorithms. One of most notable successes in AI of recent times is the realization that a large number of different types of pat-

terns (images, sounds, videos, stock price patterns, texts) can all be embedded into vectors of dimensions numbering no more than a few hundred (Mikolov et al., 2013). Remarkably, vectors in this vector space are close to each other, in terms of the standard Euclidean distance, precisely when the meaning of the embedded features are close to each other. Mapping problems of understanding real-life data patterns and their relationships (a hard problem) onto a problem of manipulating vectors in finite dimensional vector space (something that machines know how to do very well) increases the likelihood that significant progress in AI is going to be faster than previously expected.

With all of these four factors in place, platforms have become the center of information exchange and integrators of economic activity. In this new budding economic system, the areas where businesses could create and add the main economic value have shifted away from production and toward the curation and management of networks. These networks do not form and grow all by themselves, however. It takes an organization acting as the primary node to facilitate network growth and coordinate all network activity on a large scale. Thus, platforms combine characteristics of traditional organizations and markets. Such firms primarily invest in building the infrastructure and tools to support and grow a networked marketplace or community. What these platforms are creating are, in essence, centrally planned markets. Consider the product marketplaces created by eBay and Alibaba, the content networks created by Facebook, Twitter, and YouTube, or the information and software marketplaces created by Google and Apple. All of these networks enable millions of individuals and companies to interact, but they are built and coordinated by a central entity.

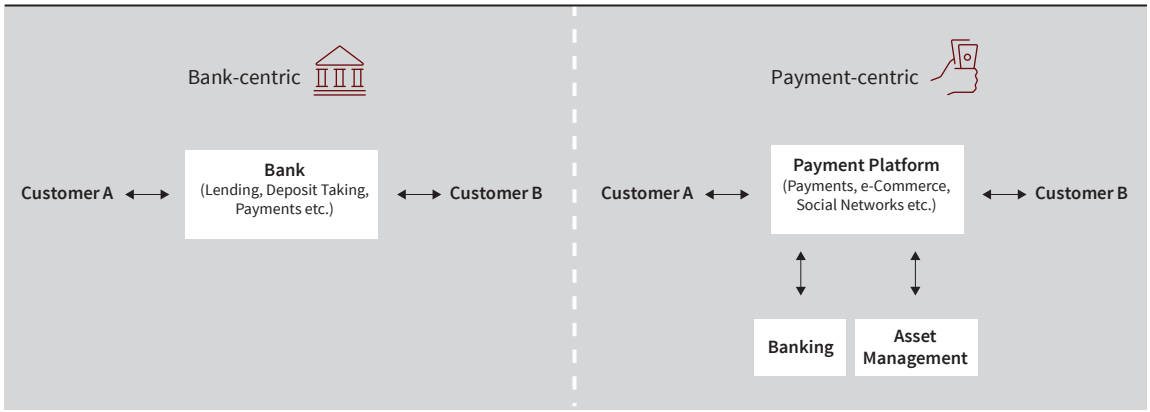
Platforms are also likely to revolutionize financial intermediation, with the creation of new payment mechanisms and new forms of currency or money. There already exist a wide variety of private payment mechanisms, many but not all of them linked to traditional currencies. There are currently an estimated USD 1.6 billion held on Starbucks customer cards; and USD 20 billion in PayPal accounts. One reason that this development is likely to proceed at an increasingly rapid pace – and make for a tipping point in comparison to both the use of traditional cash and of old-style banking facilities – is that the cost of e-transactions is falling rapidly, while many banking services have increased considerably in price. This is a development analogous to the widespread replacement of managed funds in the investment world by low-cost Exchange-Traded Funds (ETFs). The development of both new kinds of money and of new investment practices brings clear regulatory challenges. The use of private payment platforms raises financial stability questions – might they be subject to runs? – as well as the question of whether AliPay or PayPal might contemplate their own monetary policy. Many such financial and monetary stability concerns will be fanned and played up by existing institutions, which rightly perceive themselves to be under threat from a radically different replacement technology.

While traditional one-directional companies have a classical U-shaped economies of scale curve (i.e., after reaching a certain size, the firm further becomes uneconomical because of increased coordination costs), platforms face decreasing marginal costs which, after the critical mass of users is reached, virtually drops to zero. As a result, there is no natural boundary to how large a successful platform could optimally be. In theory, it can take the entire market. Since the value of the network grows nonlinearly with an increase in its membership, this monopoly status may be good for the users at the early to medium stages of the near-monopoly status, i.e., before the platform reaches a state where it primarily tries to stifle the competition instead of innovating (Moazed and Johnson, 2016).

In contrast to the monopolies of the past that were based on the one-directional business model (such as AT&T or Standard Oil), platform monopolies are not based on the ownership of assets, but rather on the consent of the users/customers. The users can,

Figure 2.8

Bank-Centric vs. Payment-Centric Financial Intermediation



Source: Brunnermeier et al. (2019).

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in principle, switch to a competing platform any time they want, as long as they get higher value from doing so than from remaining. Having said that, the information and financial might of platform giants makes it relatively easy for them to purchase potential competitors and thus reduce the competition. They are also trying to expand into ever broader areas of the economy (not always successfully, as Apple's abandoned foray into the driverless cars market clearly demonstrated).

Having said all this, there is a good chance that the near-monopoly status of a particular platform is not likely to last too long. First, there is great competitive pressure from successful platforms to enter into the territory of other platforms. Second, new start-ups that can challenge the dominance of the existing players are cheaper than ever to create, provided that one has the right ideas and an excellent core transaction. However, potential competitors have to grow very fast and reach the critical mass of users, otherwise they stand no chance. Thus, in the platform economy the rule of the game is: "get big or go home!" Not surprisingly, therefore, many new successful start-up platforms become unicorns (billion dollar startups) in a very short time. Or they lose out before they even get off the ground.

In order to illustrate how a monopoly position in the technology market can be lost, consider Microsoft. Not that long ago, everybody was worried about its near-monopoly status in PCs. The move to mobile changed everything and now Microsoft is just a small player in this huge market. In response, Microsoft is now making a comeback by adopting a platform strategy. Similarly, Google – a dominant player in desktop searches and in ad revenues related to that – is not as successful as, say, Facebook, in monetizing in the mobile environment. Advances in AI may bring a competitor along who can substantially improve upon the search process (e.g., enabling the so-called semantic search). This would have the potential to seriously challenge and perhaps displace Google from the throne of the search engines. As we can see, given the breakneck speed of technological and scientific progress, none of these new monopolies is guaranteed to last very long.

In summary, platforms are adding value and completing markets – but the enriching is concentrated in a very few entities, usually located far away from Europe. These platforms can rise fast but also lose out fast, and dominance of any particular platform may not last too long. Thus, while they might be future monopolies, their valuation can also be the result of hype and wild speculations by investors. Many companies heavily rely on Google, yet even that company is very fragile – there is always the possibility that some new entrant comes and reaches a significant market share in a very limited time. To what extent is a failure of a global platform a potential source of concern for the global economy? Probably not too much. Namely, if an internet giant fails it will be most likely because it has been replaced by some company that is even more efficient in what it does. Thus, consumers are likely to gain in the process.

In the next section, we explore how new technology and new business organizations impact the way we work.

2.3. TECHNOLOGICAL PROGRESS, DIGITAL PLATFORMS, AND THEIR IMPACT ON LABOR

There is an interesting dichotomy in the way we perceive technology. On one hand, we get used to carrying our cell phones and laptops everywhere we go, 'googling' information that we need or using the latest drugs and medical treatments that we can afford. On the other hand, there is also a deep discomfort and worry in many people whether all these changes are happening too fast and, in particular, whether machines are going to take over our jobs. A cursory look at the airports in many European countries shows that machines that facilitate check-in and baggage handling processes have done two things: they have reduced the check-in times as well as the number of people working in the check-in process. Importantly, though, there are still people in the check-in process, but their roles have somewhat changed. Instead of actually doing the check-in or baggage drop-offs, the human agents are now primarily there to guide us and reduce skepticism of people who may not be comfortable trusting the machine to do the job. This may be a preview of things to come. Namely, as machines get increasingly sophisticated, some of the jobs previously done by humans will be done by machines. However, humans will, most likely, be needed to work along with them and provide those distinctly human qualities that machines do not and cannot possess.

Nowhere is the dichotomy of attitudes towards technology better seen than in Europe. In the recent Eurobarometer special survey entitled "Attitudes towards the Impact of Digitization and Automation on Daily Life" (European Commission, 2017), around 52 percent of the citizens surveyed from European Union countries expressed belief that their work moderately benefits from digitization and automation, while 23 percent thought that it very much benefits from it. Only 3 percent of the people rated impact of technology on their work as very negative. Around two-thirds of the people rated impact of technology on their quality of life and society as a whole as fairly good or very positive.

However, as elaborated in the recent World Development Report (WDR, 2019), despite the overall positive attitude about the role of digitalization and automation in their work and daily life, people living in advanced economies are often anxious about the sweeping impact of technology on employment. Many worry in particular that they may lose their jobs as a result of automation. Also, rapid but uneven adoption

of new technology may increase inequality. In addition, the development of communication technology and the advent of digital platforms allows for more jobs to become non-permanent, creating the so-called gig economy. Many fear that it encourages a race to the bottom in working conditions. In this section, we try to address these and some related concerns.

Worries that machines would take over our jobs are not new. From the time of Luddites who destroyed machines during the early stages of the Industrial Revolution, to Keynes who has argued that use of new technology may eventually lead to massive unemployment, and Stephen Hawking, who warned about the dangers of AI, these concerns have been part of our everyday life. Fears of 'rogue technology,' in particular robots and AI, have been the subject of many Hollywood blockbusters. At the same time, our ability to innovate has been dramatically improving living standards and the quality of life in most parts of the world. And so far, it has not led to massive unemployment, rather the opposite. Machines have been replacing workers in many tasks for more than a century. Technology has brought higher labor productivity to many sectors by reducing the demand for workers performing routine tasks. At the same time, technology has also been constantly opening up new possibilities. New jobs are created that were previously technologically unfeasible, or even impossible to imagine. For example, who could have imagined just 20 years ago that someone might make a career as an 'internet influencer'? Some individuals make an exceptionally good living by posting YouTube videos on how to play popular video games or how to play with Lego bricks. In addition, many old jobs are now done better and faster. Perhaps most importantly, we have learned how to live and work with technical innovations and take advantage of them. Over time, they become part of our life, and to some extent, part of our identities.

As technology advances, firms are managed more efficiently while consumers enjoy a wider range of products and services at lower prices. Being the first to embrace new technology often gives companies a competitive edge, increasing their incentives to adopt it. For example, Danish firms strengthened their lead on the global market for hearing aid products in the 2000s by being the first to introduce the use of 3D printers in the production process in this industry (Freund, Mulabdic, and Ruta, 2018). The number of industrial robots operating worldwide is rising quickly. According to the International Federation of Robotics, a total of 2.6 million should be in operation worldwide by 2019. Is the introduction of robots reducing employment? So far the evidence is not clear-cut. In 2018, the number of robots per worker was the highest in Germany, Korea, and Singapore, countries that despite the high levels of robot penetration also have high employment rates at the same time. However, introduction of robots does not impact every category of workers the same way. While overall, the adoption of robots has not so far had any substantial net effect on employment in Germany, it has reduced the hiring of young entrants into the labor market (Dauth et al., 2017). Thus, the effects of automation can be different in countries that are aging compared with those that have young populations and anticipate large numbers of new labor market entrants. This bodes rather well for aging developed countries, including most of Europe. While 3D printers can reduce manufacturing jobs in lower-income countries by moving the production aimed at high-income markets close to end customers, people in emerging markets can start printing products for their own markets based on 3D designs instead of purchasing end products from the developed countries. Even individuals can learn to do it, especially if they are interested in customization. Thus, changes in employment and opportunities can cut both ways.

Recent evidence from Europe shows that although technology replaces workers in some jobs, overall it raises the demand for labor (Gregory, Salomons, and Zierahn, 2016). Technological progress leads to an increase in demand for jobs in the tech sector. There are more opportunities in mobile app development and virtual reality design, development of AI systems, design of 3D blueprints, and programming and/or controlling industrial robots. Instead of hiring traditional loan officers, JD Finance, a leading fintech platform in China, created more than 3,000 risk management and data analysis jobs to sharpen algorithms for digitized lending. Andela, a US company that specializes in training software developers, has built its business model on the digitization of Africa. It has trained 20,000 software programmers across Africa using free online learning tools. Once qualified, programmers work with Andela directly or join other Andela clients across the world. The company aims to train 100,000 African software developers by 2024. 90 percent of its workers are in Lagos, Nigeria, with other sites in Nairobi, Kenya and Kampala, Uganda.

As mentioned before, technology enables the gig economy, also known as crowd work. It cannot be distinguished precisely from other forms of work. Rather, it is part of a continuum of casual, on-call, temporary, or other forms of contingent work. Producing the EEAG report, a process done mostly by electronic communication across countries and even continents, might be an example of a new way of doing something that could have been done differently and more cumbersomely in the pre-electronic age. In a recent report, Huws et al. (2018) show that a large fraction of the European population earns some money by participating in the internet economy. Participating in the gig economy is part of that process. Conducting in-depth surveys of people in seven developed European economies, researchers found that between 50 to 64 percent (depending on the country) of the respondents have been selling their own possessions over the internet

(say, via eBay), between 13 and up to 48 percent resold products via Amazon and similar platforms, between 10 and 21 percent sold their own products over the internet, while between 8 and 17 percent rented to paying guests (e.g., via Airbnb). Likewise, a significant proportion of the working population (from 9 percent in Germany and the United Kingdom to as high as 22 percent in Italy) reported having done some work 'virtually' from their own homes via an online platform such as Upwork or Clickworker, providing driving services via a platform like Uber, or working in somebody else's home for a platform like Helpling. In the majority of cases, this is a very occasional supplement to other earnings. However, a non-negligible fraction of the working population ranging from 1.6 percent in the Netherlands to 5.1 percent in Italy derives more than 50 percent of their labor income from such work (see Figure 2.7). Also, from 4.7 percent (in the United Kingdom) to 12.4 percent (in Italy) of the working population is participating in the crowd economy on at least a weekly basis.

Crowd workers are relatively evenly balanced between men and women. They are more likely to be in younger age groups, although such work can be found in all life stages. Huws et al. (2018) found that when asked about their employment status, more than half of all declared crowd workers (except in Italy, where it was 41 percent) said that they were employed full-time. This proportion was even higher among those who earn more than half of their income from the gig work. Having said that, it is not clear whether these people considered themselves to be full-time employees of a platform or another, standard, employer (both situations likely occur). Only 7 percent to 13 percent regarded themselves as self-employed. While gig workers typically valued the flexibility, respondents complained about many aspects of work organization and working conditions. These included difficulty in communicating with platform personnel, arbitrary terminations, perceptions that platforms always take the side of clients against workers, and frequent changes to payment and other systems (see Huws et al., 2018).

As a rule, people working gigs are not paid the benefits normally associated with full-time jobs. This is of course a potentially serious concern. While some online platforms that enable freelance work are starting to look for ways to provide benefits for some of their most active workers, this is an exception rather than the rule. But one has to bear in mind that a person counted as a freelancer may have a regular job, too. In fact, in the United States, this is the case with more than two-thirds of freelancers. In order to protect the rights of people involved in the gig economy and to prevent the race to the bottom in terms of working conditions in Europe, Huws et al. (2018) argue that it is practically impossible to separate gig workers into a separate employment category since their working situations vary too much.

Instead, they propose going back to the underlying principles of the current regulations and legal frameworks to establish a basis for determining how genuine self-employment should be defined (and what should be the rights and obligations of these genuinely self-employed own-account workers), as well as what protections should be available for workers when a relationship of subordination is present (and what should be the rights and obligations of these workers and those who exercise control over their labor). This may imply creating new legal definitions of self-employment and of subordinate worker status. New regulations should recognize that when work involves the delivery of services in public spaces, the rights and responsibilities of consumers and the general public, as well as the public authorities, must also be considered and specified, along with those of workers. In addition, the definition of private employment agencies and temporary work agencies needs to be revised. Applicability of minimum wage regulations (where these exist at a national level) need to be addressed in the case of employees facing subordinate relationships. On the other hand, genuinely self-employed people should have the right to set their own prices and hire other people to do the job. Also, statutory rights for platform workers in relation to suspension or termination of employment need to be considered as well as the right to challenge customer ratings. Direct means of communication including emergency hotlines, insurance coverage of workers, data protection, and health and safety of everyone involved need to be ensured. Finally, the system of benefits applicable in European countries needs to be carefully reconsidered in order to take into account the needs of the growing numbers of the just-in-time workforce.

While many people work gigs because they cannot find regular full-time jobs, a growing number of designers, programmers, and other professionals (there is a new word: 'techno-nomads') find personal freedom in being able to live on the move, experience other countries and cultures while working when they decide to do so wherever they happen to land at the time. For them, gigs are a choice, a way of living (at least for a while). With skills in demand, this has become a feasible lifestyle choice. Millennials in search of meaningful experiences share a similar mindset and are known for being motivated by the allure of life enrichment, gained from experiencing different cultures. If they pursue work, many prefer gigs instead of steady employment.

These people are part of the growing group of professionals on the move. Giordano (2017) argues that digital transformation drives an immense increase in (physical) global mobility. Business expansion opportunities are worldwide and even new companies can become global almost from the start. Corporations are confronted with skill gaps brought on by rapid change. This often requires that people relocate for

a while internationally. While in the past these relocations were relatively infrequent and long in duration, now they are more frequent and usually for a shorter time spell (the average is around 18 months). Another variation of this is commuting and extended business travel to a location without relocation. There are developmental rotational programs for high-potential employees. Reverse transfers allow talent from emerging markets to gain skills in established markets in order to fill future needs upon their return home. Short-term professional stints abroad are quite common for otherwise full-time employed professionals such as medical doctors (performing operations and diagnosing patients during visits to foreign clinics), visiting professors, etc.

We have seen that technological revolution is bringing many exciting prospects globally. But at the same time, introduction of new technologies and the new ways in which the world economy is organized create serious challenges as well. The declining cost and increasing quality of machines puts at risk workers who are employed in low-skill routine tasks that are 'codifiable.' The examples are numerous. More than twothirds of robots are employed in the automotive, electrical/electronics, and metal and machinery industries. Based in China, Foxconn Technology Group, the world's largest electronics assembler, cut its workforce by 30 percent when it introduced robots into the production process. In 2017, 3D printing technologies enabled the German company Adidas to establish two 'speed factories' for shoe production: one in Ansbach, Germany, and the other in Atlanta in the United States, both with small numbers of employees. At the same time, the company eliminated more than 1,000 jobs in Vietnam. Some service jobs are also vulnerable to automation. The largest (state-controlled) bank in the Russian Federation, Sberbank, relies on AI to make 35 percent of its loan decisions, and it anticipates raising that rate to 70 percent in less than five years (see TASS, 2017). 'Robot lawyers' have already replaced 3,000 human employees in Sberbank's legal department. In total, the number of back-office employees in that bank will shrink from 59,000 in 2011 down to 1,000 by 2021. They will be replaced by AI.

Technological changes drive both job growth and job losses, and it is hard to predict with any degree of precision the net outcome both across countries and within each individual country. Such forecasts are primarily based on automation probabilities developed by machine learning experts at the University of Oxford. They were asked to categorize a sample of 70 occupations taken from the O*NET online job database used by the US Department of Labor (Frey and Osborne, 2017). Relying on the probabilities of automation that the authors derive, initial estimates placed 47 percent of US occupations at risk of automation. WDR (2019) applies this approach to forecast potential job losses for several other countries. All of these numbers are very tentative, however.

What is clear, though, is that technology is changing the skills rewarded in the labor market. WDR (2019) documents that the premium is rising for skills that cannot be replaced by robots, such as general cognitive skills (e.g., critical thinking) and socio-behavioral skills (e.g., managing and recognizing emotions that enhance teamwork). Workers with these skills are more adaptable in labor markets. Since 2001, the share of employment in occupations intensive in non-routine cognitive and socio-behavioral skills has increased, on average, from 19 to 23 percent in emerging economies and from 33 to 41 percent in advanced economies. Within the same industries, workers performing non-routine analytical tasks and those involved in problem-solving are paid a significant premium. Highly valued are teamwork, relationship management, people management, and caregiving. In these activities, people must interact with one another on the basis of intuitive understanding and empathy. Designing, producing art, conducting research, managing teams, nursing, and even cleaning have proven, thus far, hard tasks to automate.

The demand for routine job-specific skills is declining when these tasks are codifiable. Some of these tasks are cognitive, such as processing payrolls or bookkeeping, credit analysis, or routine law procedures. Others are manual, such as operating welding machines, assembling goods, or driving forklifts. These tasks are easily automated. Employment has shifted away from middle-skill occupations such as machine operators. This may translate into rising inequality in advanced economies including developed European economies. Both middle- and low-skill workers could see falling wages: the former because of automation, the latter because of increased competition (WDR, 2019).

For the middle classes in developed countries, the abundance of well-paid industrial jobs has been a traditional guarantor of stability and an indirect measure of equality of opportunity. Thus, decline in industrial employment in many high-income economies (including the United States) over the last two decades is causing social and political friction. This trend is structural and reflects a shift in employment from manufacturing to services in these countries. Industrial employment has moved increasingly to East Asia, which offered a high price differential with respect to developed Western economies. In the rest of the world, the share of industrial employment has remained stable. While at present, industrial employment in East Asia continues to rise, anticipated shortening of the global supply chains, buttressed by the protectionist US trade policies, may challenge that trend. However, even if part of industrial production is brought back to the US, it is the robots and 3D printers, rather than factory workers, that are likely to play a key role in the revival of the US manufacturing sec-

tor. Thus, this may not be a boon for the majority of underemployed US factory workers.

Digital platforms can and should be important drivers towards more inclusive global development. We have talked before about the impact that Alibaba has had in enabling millions of small Chinese enterprises to engage in economic activity. Similarly, eBay's Public Policy Lab has studied the geographical distribution of net enterprise growth in the United States, United Kingdom, and Germany (Olbe, 2018). It has found that eBay supports business growth in places that the traditional economy does not serve very well. Between 2010 and 2014, only 41 percent of US counties saw an increase in the number of traditional business establishments. But nearly 75 percent of counties saw a net increase in their number of eBay-enabled firms (commercial sellers with at least ten transactions worth a total of at least USD 10,000 annually). Similar results held true in the UK and Germany. Northwest England is far behind Greater London in its contribution to enterprise growth in the traditional economy, but not so in the platform-enabled economy. The West Midlands, Yorkshire, and the Humber – regions with third-tier GDP per capita levels – saw eBay-enabled firm growth on a par with southeast England, which has the highest GDP per capita. In Germany, traditional enterprise growth is clustered in the rich southern regions of Baden-Wuerttemberg and Bavaria, as well as in Berlin. Yet four of the poorest regions saw eBay-enabled firm growth. The ability to serve an entire country, continent – or in fact the whole world – is powering a new breed of enterprises: small, independent firms that are more resilient to local economic changes and less dependent on traditional conditions for growth.

Yet, in some important ways, inequality is on the rise, driven in no small part precisely by digitalization and globalization. Andrews et al. (2016) demonstrate that both the leading digital platforms as well as more traditional global champions like BMW, L'Oréal, and Nestlé recorded impressive productivity gains over the 2000s. At the same time, aggregate productivity growth in the OECD – which reflects the performance of all businesses – has stagnated. The authors show that large productivity gaps between the winners and all the other businesses have been growing over time.

The productivity divergence is strongest among information and communication (ICT) services. These are sectors with the 'winner takes all' dynamics. At the same time, aggregate productivity performance was significantly weaker in sectors where divergence was more pronounced. Not only are frontier firms pushing the technological boundary, but a slowdown in the diffusion of best business practices from the frontier to other firms can be recognized. As a result, it has become more difficult for laggard firms to join the frontier.

Importantly, recent studies find that the rise in productivity divergence between the best firms and the rest is much more extreme in sectors where the pace of pro-competitive product market reforms was slowest. This highlights the potential for promoting market competition, especially in services which are generally more sheltered from international markets. This would also create better conditions for growthenhancing reallocation through the entry of more productive businesses and the exit of less successful ones.

Berlingieri et al. (2017) argue that firms that were the most successful in harnessing the power of digital technology and global opportunities pull away even within the same industry sectors and within the same countries. As firms grow apart in productivity, they also become more unequal in how much they pay workers. This is the second great divergence. Again, it is not just the case that Silicon Valley firms are paying more than fast-food restaurants. The pay gap between the top- and bottom-paying firms in the same sector has increased by more than 12 percent from 2001 to 2012. The authors find that wage inequality has grown the most in sectors in which productivity differences have increased the most. To combat inequality of wages, it is thus crucial to encourage overall productivity growth, which in turn requires more and not less competition in the long run.

In addition, to make the most out of global digitalization opportunities, investing in human capital (in all countries) and bridging the digital divide (mostly in emerging economies) has to be among the top priorities. We have seen before that three types of skills are increasingly important in labor markets: complex problem-solving skills, teamwork, and adaptability. Chief Executive Officer of Infosys, Salih Parekh, states in his recent blog that one of the very critical skills is to learn not just to consume technology, but rather to be able to create it. The key would be for children to learn how to code from an early age. He argues that: "In the future, not knowing the language of computers will be as debilitating as illiteracy. If we can bring this 'superpower' to everybody across the global, economic, social, professional, gender, and age divides, then I believe it has the potential to become the great equalizer of our humanity and the amplifier of our potential" (Parekh, 2018).

To prepare for the future, early childhood development coupled with school curricula that foster creative problem-solving and teamwork on projects has to replace the traditional memorize-repeat style of schooling, still prevalent in most of the world. Equally critical is to establish lifelong learning habits. Educational platforms can play an important role in lifelong education. They already offer an increasing array of courses across many of the critical skills either for free or for a small nominal fee. Furthermore, educational platforms can partner up with the existing educational institutions, especially in emerging markets, in order to provide much more impactful educational content and delivery methods at all levels of formal education.

In this way, teachers can be free to spend more time working with students on less commoditized parts of the educational process (supervising teamwork and creative problem-solving, for example), while standardized parts of the curriculum can be learned online. The idea is to increase the reach, lower costs, and substantially upgrade the quality and relevance of the educational process around the globe.

None of this is possible, however, if people have no access to the internet. To that end, one may search for innovative technological solutions in conjunction with private-public partnerships in countries that have difficulties securing internet access for their citizens. Encouragingly, some of the digital giants are currently working on different ideas on how to make high-speed internet truly universally accessible.

2.4 PRIVACY, SECURITY, AND GOVERNMENTS

The key 'currency' of the digital economy is data, a large fraction of which is about ourselves: what websites we visit, what books and newspapers we read, what do we like to eat or drink, what do we do for fun and, of course, what are we interested in buying. Not only is this kind of information collected, but it is also retained, often forever. Since the cost of collecting and retaining data has fallen dramatically, many corporations are automatically collecting all the information that they can get. This information is then mined for useful patterns using increasingly powerful data mining algorithms. As a result, digital platforms and other companies enabling the digital economy may know the most intimate details about our personal lives, our interests, and desires.

The biggest casualty of the digital transformation has been, therefore, our privacy. And yet, privacy matters to everyone. Even to the big proponent of the end of privacy, Facebook CEO Mark Zuckerberg. He has in 2010 famously declared that privacy is "not any more a social norm." Yet he purchased four houses adjacent to his Palo Alto villa in order to secure his own privacy (Schneier, 2015). Obviously, data collection is necessary in a digital economy. The issue however is how much and what kind of data is collected about us, whether and for how long is it retained, whether it can be sold to others and under what conditions, how this data is used, how it is combined and correlated with other data, etc. In particular, it matters whether we own data collected about us, whether we can force companies not to use it in ways that violate our sense of privacy, and whether we can make them even completely delete it.

In contrast to the citizens of the United States and many other countries, citizens of the European Union since 2014 have had the right to request that links to webpages containing sensitive personal information about them be removed. This right was further buttressed by the General Data Protection Regulation (GDPR) which came into force in 2018. Members of the public can make a request to any organization "verbally or in writing" and the recipient has one month to respond and decide whether to comply or not. In response, Google introduced a geo-blocking feature in 2015 that prevents European users from being able to see delisted links. Since then Google has received more than 845,000 requests from EU citizens to remove a total of 3.3 million web links from its searches, with about 45 percent of the links ultimately getting delisted. This involves both removing the results from its European sites – such as Google.fr, Google.co.uk, and Google.de – as well as restricting results from its other sites – such as Google.com – if the system detects that a search is being carried out from within Europe. However, users can still circumvent the action if they use a virtual private network (VPN) or other tools to mask their location (Kelion, 2019), as long as the data is residing somewhere outside of the European Union.

Importantly, Google resisted censoring search results for people in other parts of the world. In September 2019, the European Court of Justice issued a landmark ruling that the right to delisting upon request of European citizens is limited to Europe only and cannot be applied globally. "Currently, there is no obligation under EU law, for a search engine operator who grants a request for de-referencing made by a data subject [...] to carry out such a de-referencing on all the versions of its search engine," the European Court of Justice ruling said (Kelion, 2019). In effect, the court has declared that the European Union cannot extend its internet privacy policy outside of EU borders unilaterally.

While internet giants violate our privacy, they are by no means alone. Governments do it too. Some would like us to believe that there is a natural trade-off between security and privacy, and that we need massive government surveillance and thus a complete loss of privacy in order to be protected from possible terrorist attacks. Bruce Schneier, a renowned expert in the field of cybersecurity, convincingly argues that, even in principle, indiscriminate massive government surveillance of our digital communications cannot achieve the goal that it claims to pursue, namely to identify potential terrorists (Schneier, 2015). Suppose that a government believes that some people are potentially connected to terrorists. It then collects all kinds of data not only on them, but also on all of the people connected to them in any way, on the people connected to these people, etc. The idea is to be exhaustive in data collection and cast as wide a net as possible. The problem is that any two individuals on Earth can be connected in some way through a very small number of links (recall the six degrees of separation game?). So, the net is indeed cast wide and consists, de facto, of the entire connected world. With this huge data volume in place (and constantly adding to it), sophisticated data mining algorithms and AI are applied in the search for terrorist links. After all, data

mining works well for credit card fraud detection as well as (to some extent) the detection of tax avoidance and fraud. The reason it works in cases of credit card fraud is that in millions of credit card transactions, there are relatively large numbers of fraudulent activities. Thus, the algorithm has enough 'positives' to learn from. Erroneously flagging a transaction as fraudulent simply leads to a temporary halt in credit card payment, and perhaps to a nominal charge. Similarly, the IRS uses data mining to flag tax violations. Again, there is a large enough number of 'positives' for this method to work relatively well (but with higher errors than credit card fraud). The cost of a false positive is an audit.

Why does this not work well for finding terrorists? The 'problem' is too few terrorist attacks given the massive and almost indiscriminate surveillance data. In technical terms, the signal-to-noise ratio is too low. Thus, even the most sophisticated algorithms have a too-high margin of error. Furthermore, the cost of 'false positives' are very high (think of the fate of those erroneously flagged as related to terrorism). What is worse, massive surveillance may actually hurt security. First, for each false lead generated by the AI, valuable human resources have to be assigned. This prevents them from being deployed in traditional spying and counterterrorism activities. And it is through these targeted activities, and not through indiscriminate surveillance, that governments typically catch the bad guys. Worse yet, in order to facilitate data collection on this massive scale, governments collect vulnerabilities that always exist in software systems. They help patch many of them but try to hide a select few in order to use them for attacking adversaries or to spy on us. In addition, with or without cooperation of companies, spy agencies create 'back doors' for ease of access, undermine cryptographic protection of systems, and employ a number of other methods that undermine the security of internet and telecommunication systems (see Schneier, 2015, for fascinating details). While this allows an agency easy access to the entire universe of our data, these loopholes can (and sometimes are) used by other governments as well as criminal elements. They can be used by terrorists too, if they are sophisticated enough to discover them.

Thus, in a world in which data is the most valuable asset, privacy matters. Violation of privacy by both companies and governments is not making us, our data, or the digital infrastructure of our economy any safer – just the opposite. What can be done to improve the situation? In particular, what are policy options at the disposal of Europeans? Whatever the response may be, some things are clear. Europe is lagging behind the United States and China in the development of AI and digital platforms in part due to a trade-off that exists between data and privacy protection, advocated in Europe, and amassing sufficiently large quantities of cheap data needed for fast development of AI systems and other key technologies (as in the United States and China). As Europe develops its policies regarding privacy in the digital world, policymakers should have in mind this trade-off.

One possible approach is to try to play catch-up while protecting privacy of European citizens. The idea is to bring down barriers for cooperation and data exchange within the European internet companies, scale up European venture capital industry, and possibly provide EU-wide fiscal incentives for the most prominent platforms 'made in Europe' that would act in accordance with the European privacy laws. Harmonization of tax rules among the member states regarding the digital economy, if feasible, would be part of that process. Investors and customers these days like dealing with 'good governance' companies. For this reason, there are likely to be both investors and customers in Europe and around the world that would support privacy-friendly platforms, especially if they reach a sufficient scale. Emergence of largescale European privacy-friendly platforms could create serious positive externalities for Europe in the economic, security, and strategic arenas. Their success would demonstrate that a different way from the American and Chinese one is indeed possible. This would be 'leading by example'.

In parallel to building viable alternatives to privacy-less platforms, Europe should spearhead negotiations of an international treaty that would ensure that people around the world have the same basic privacy rights related to data protection and that the internet stays international, free, and open to all. Imposing national boundaries on data should be opposed since that would be the beginning of the end of the internet's global character. Countries like Russia or China want to have data on their citizens confined within their national boundaries in order to more easily censor information flows and stifle potential dissent. Europe should be careful not to, inadvertently perhaps, provide ammunition for these ideas when talking about 'data sovereignty.' European discourse might be more usefully framed therefore in terms of protecting freedoms of citizens of the European Union and globally. Another option would be to allow different pricing models, offering choices: one for instance would reward customers willing to surrender personal information; another would offer privacy guarantees, but at a cost.

A particularly big danger for the global character of the internet is the US-China trade and technology clash, which threatens to split the world into Chinese and US technological spheres of influence. This would harm the long-term interests not only of the United States and China, but also of the silent majority who may be forced to pick sides in this battle. This would, in turn, reduce potential growth and lower the chance of creating a truly global digital economy and society. By developing an alternative to both the US and Chinese approaches, Europe may increase its stature in

the emerging digital global economy as well as provide those unwilling to take sides with a viable third option.

Security of data, digital systems, and the global internet infrastructure is crucial for the digital economy to flourish. But it cannot be achieved if the most powerful countries actively subvert it by not patching all systemic vulnerabilities they discover, or if government agencies create new security breaches enabling them easier access for spying. It is paramount, even if not easily achieved, for an 'International Internet Arms Treaty' to be signed that would prevent countries from behaving in this predatory manner. Obviously, such a treaty would be hard to negotiate and even harder to police. However, international cooperation is necessary if we are serious about security: it is not possible to create a secure internet for yourself while creating vulnerabilities for others. As long as the internet is a global network, breaches in one part of the network easily propagate to all other parts whether we like it or not. Again, Europe should try to take the lead in negotiating such a treaty.

Internet platforms generate a substantial fraction of their revenues in large EU countries but often have little or no 'physical footprint' in them. This makes it difficult for governments to tax them. Pursuing tax optimization strategies, internet giants locate their official activities in countries with low tax rates (e.g., Ireland). Of course, tax optimization is not illegal and is pursued by other multinationals, not just internet companies. But given the fact that internet platforms play an increasingly important role in the economy, it is paramount that European governments successfully address the issue of fair taxation while preserving their incentives for innovation. We discuss taxation of the digital economy in Chapter 3 of this report. Creation of globally competitive European platforms ('European Googles') may be facilitated with some tax incentives since the creation of such companies would provide important positive economic and strategic externalities to Europe. If Europe becomes instead just a commodity goods producer with the lion's share of profits going to American and Chinese platforms, this would become a matter of industrial and competition policy. In addition, it would have clear implications for the interests of Europeans and their incentives to design tax systems. Tax wars, in that sense, are another face of trade wars in the digital age.

Another issue important to consider here relates to taxation of crowd work provided over the internet platforms. Remote work makes the labor more mobile. One can work in Italy for a Japanese client and get paid in the United States. This creates a problem of finding a fair and effective way to tax the mobile labor and protect the rights of the providers of labor. We have argued before that it is important to clarify whether a particular crowd worker is an independent contractor or a subordinate worker. As an example, take Serbia, a country seeing a rapid increase of internet-based gig work. Its designers, programmers, and other high-value-added gig workers are required by the government to either register a firm and pay tax as a small business (the procedure for that has been greatly simplified lately) or pay a lump sum annual tax as individuals. Either way, since platforms that provide them with work are usually out of reach of the Serbian government, the government gets its cut. Obviously, providers of services have to take that into account when they negotiate the deals with the platforms. Chapter 4 discusses in more detail taxation of mobile jobs and people.

Digital technologies hold significant promise in helping increase efficiency of governments around the world. In particular, digitalization of tax systems is likely to improve both the efficiency and userfriendliness of the process (Musgrove, 2018). To embark on a digital transformation, tax administrations need to have secure and scalable tax compliance digital infrastructure, capacity to process large amounts of digital data and draw insights from it, capacity to automate and personalize services using AI, as well as communication platforms for Government-to-Government (G2G), Government-to-Business (G2B), and Government-to-Citizens (G2C) interactions. Technologies in use in the private sector could perhaps be adapted for these purposes. Of course, none of that can work without hiring, incentivizing, and retaining people that can effectively work with these new technologies. With people and systems in place, tax administrations can use predictive modeling, analyze economic trends and the effects of policy changes, employ AI to predict fraud, etc. At the same time, it is critical for privacy rights of individuals and companies as well as security of data to be protected at all times. Previous discussions make it plain that this is not an easy task, as it goes against the instinct of many governments to simply ignore such things 'for the sake of expediency.'

Likewise, digitalization of other government departments is likely to lead to substantial savings, increased efficiency, and ultimately, better services for citizens and businesses. This would attract more investments and improve growth prospects. The examples of the governments of Estonia and Denmark, which have significantly increased their efficiency through digitalization, are encouraging. The savings that can be achieved would open up the possibility for more targeted spending on protecting the welfare of those who are adversely impacted by technological changes. In addition, governments would have more resources to substantially improve and modernize the educational processes and to build better digital and physical infrastructure. This would, in turn, make such countries more successful on the global digital marketplace.

In summary, while digital transformation holds immense promise, it raises very important issues and challenges, including threats to financial stability. Europe can and should do more to be competitive

with the major players (United States and China). In particular, it could try to lead by example, providing the third way that would couple innovation and entrepreneurship with protection of privacy and freedoms, perhaps by giving individuals a choice in the amount of privacy they surrender.

However, if this is not possible and Europe loses companies that are profitable, it has to defend its interests both in terms of competition policy and in terms of an appropriate taxation policy. Chapter 3 discusses corporate taxation of corporations in the digital and mobile world. On one hand, tax revenues are at record-high levels. But politically there is the issue of perceived fairness. Giant internet companies have little or no physical presence in most European countries where they make large revenues. As a consequence of current rules, they pay little or no taxes in these countries. Also, if IP gets separated from physical products, we have issues with taxation. Thus, the current tax system, designed decades ago, may not be appropriate anymore. Having said that, national taxation based on revenues is a lot like tariffs; as a consequence, tax wars are logically not very different from trade wars and are increasingly linked to them.

In Europe, a large part of the welfare state is linked to jobs. In the mobile world, this may have to change so that the welfare of people is continued to be protected even if jobs are more fluid. Chapter 4 discusses these issues.

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