2 Digitalisation and productivity: A story of complementarities

Introduction and overview

Digital technologies are transforming our lives and our economies. They change the way firms produce goods and services, innovate, and interact with other firms, workers, consumers and governments. These technologies seem to offer a vast potential to enhance firm productivity and ultimately living standards. For example, cloud computing gives firms access to flexible data storage and processing capacities, online platforms can make their interactions with consumers more fluid, and artificial intelligence enables them to automate increasingly complex tasks (OECD, 2019a).

However, despite ongoing digitalisation, labour productivity growth has declined sharply across OECD countries over the past decades (Figure 2.1). This is not just a measurement issue. Uncertainties around productivity measurement have increased, notably due to digitalisation and the growing importance of intangible assets (e.g. algorithms, data), and they deserve further research, but most researchers assess that mismeasurement is not the main reason of the observed productivity slowdown.[1]

The productivity slowdown reflects both lower multifactor productivity growth and weak capital accumulation.[2] It has multiple and partly interlinked causes, some related to the global financial crisis and its aftermath (e.g. reduced credit availability affecting tangible and intangible investment) and some to more structural factors, such as a decline in business dynamism and the poor performance of low-productivity firms.[3] The productivity slowdown started before the crisis and, a decade after the crisis, productivity growth remains weak despite some recent improvement. This suggests that structural factors play an important role in the slowdown.

The aggregate productivity gains from digitalisation have not been sufficiently large to offset these headwinds, at least not to date. This contrasts with the late 1990s, when a previous wave of digitalisation associated notably with the diffusion of personal computers lifted productivity growth, at least in the United States. The disappointing productivity gains from the current wave of digitalisation have become a major economic puzzle, sometimes called the “modern productivity paradox” in reference to the earlier productivity paradox formulated by Robert Solow in 1987.[4] Shedding light on this paradox requires looking in detail at the channels through which digitalisation can support firm productivity and living standards, the reasons why they may be impaired, and the policies that can activate them.

This chapter argues that digitalisation has supported productivity, but that economy-wide productivity gains have been disappointing due to shortfalls in key complementary factors and policies. Indeed, digital technologies are characterised by strong complementarities (i) between the technologies themselves; (ii) with firms’ capabilities and assets, such as technical and managerial skills, organisational capital, innovation and financing capacity; and (iii) with policies that promote competition and an efficient reallocation of resources in the economy. Shortfalls in these complementary factors have slowed the diffusion of digital technologies and reduced the associated productivity benefits.

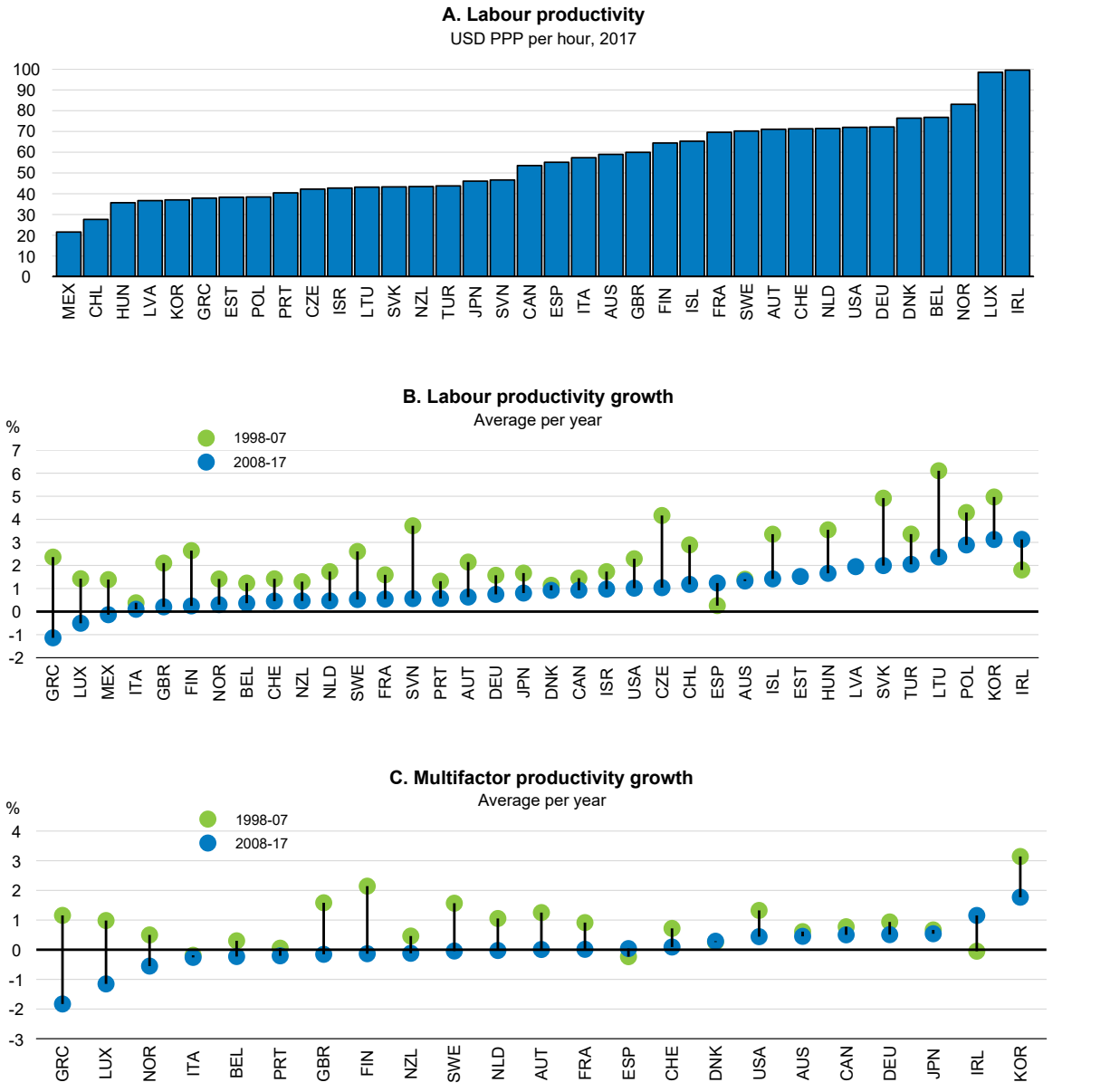
[1] See, for example, Ahmad et al. (2017), Syverson (2017) and Sichel (2019).

[2] See, for example, Ollivaud et al. (2016) and OECD (2019b). Multifactor productivity (MFP) can be defined as the overall efficiency with which labour and capital inputs are used together in the production process.

[3] See, for example, OECD (2015a), Berlingieri et al. (2019) and Calvino et al. (2019).

[4] Robert Solow wrote in 1987 in a New York Times article that “you can see the computer age everywhere but in the productivity statistics”. On the modern productivity paradox, see Brynjolfsson et al. (2017).

Figure 2.1. Productivity growth has declined sharply across OECD countries



Note: Labour productivity is measured as GDP per hour worked. Multifactor productivity growth is measured as a residual, i.e. that part of GDP growth that cannot be explained by growth in labour and capital inputs assuming a Cobb-Douglas production function. Data on multifactor productivity growth are only available for a subsample of countries. For Ireland, the data on productivity growth (Panels B and C) exclude the foreign-owned multinational enterprise dominated sector and cover 2000-16 (source: Irish Central Statistics Office). For Latvia and Estonia, data on labour productivity growth over 1998-2007 are missing.

Source: OECD Productivity Statistics Database; and OECD Compendium of Productivity Indicators.

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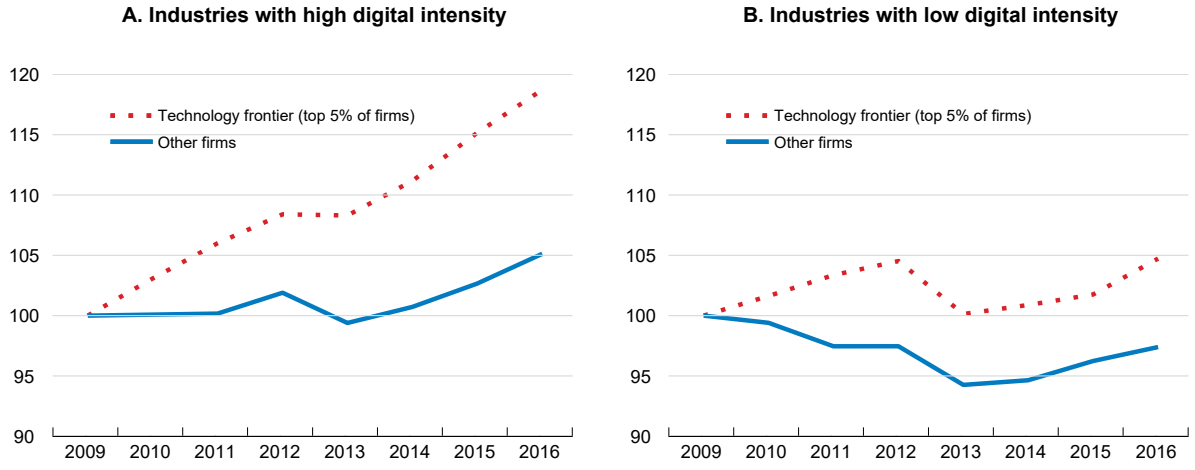
Gains from digitalisation have not spread evenly across firms. Firms having better access to key technical, managerial and organisational skills have benefitted more than other firms. These firms already tended to be more productive than the average firm and digitalisation has contributed to increase their lead (Figure 2.2). In addition, the low marginal costs and strong network effects that characterise certain digital activities tend to benefit a small number of highly productive "superstar" firms that other firms increasingly struggle to compete with. Even in relatively low-tech industries (e.g. accommodation and food services) the growing availability of online user ratings and reviews tends to shift demand towards the more productive firms. Looking ahead, new technologies, such as artificial intelligence, that require complex skills, large intangible investments (e.g. in R&D, algorithms and data) risk further increasing the edge of the most productive firms relative to the less productive ones.

Figure 2.2. Productivity dispersion across firms has increased, especially in digital intensive sectors

Average multifactor productivity, index 2009 = 100



Note: The "technology frontier" is measured by the three-year moving average of log multifactor productivity, based on the Wooldridge (2009) methodology, on average among the top 5% of companies across 25 OECD countries, i.e. those with the highest productivity levels, in each 2-digit industry (among manufacturing and market service industries, excluding finance) and in each year. The "other firms" lines correspond to the average of the same variable among all firms excluding the top 5% in each industry and year. Industries are classified either as having "high" or "low" digital intensities based on the methodology in Calvino, F. et al. (2018), "A Taxonomy of Digital Intensive Sectors", *OECD Science, Technology and Industry Working Papers*, No. 2018/14, OECD Publishing, Paris.

Source: OECD calculations using Orbis data, following the methodology in D. Andrews, C. Criscuolo and P. Gal (2016), "The Best Versus the Rest: The Global Productivity Slowdown, Divergence Across Firms and the Role of Public Policy", *OECD Productivity Working Papers*, No. 5, OECD Publishing, Paris.

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These trends have far-reaching implications for living standards and inclusiveness. Weak productivity growth has led to sluggish average wage growth, even more so in countries where wages have "decoupled" from productivity over the past decades (OECD, 2018a). In addition, the increasing dispersion in productivity performance across firms has been mirrored in an increasing dispersion in average wages across firms, contributing to rising income inequalities between workers (Berlingieri et al., 2017). Within firms, digitalisation has so far benefitted mainly high-skilled workers, while routine tasks performed by low and medium-skilled workers have been increasingly automated. At the same time, a small but fast-growing share of workers has been shifting to flexible work arrangements on "gig economy" platforms, where they generally enjoy less protection and fewer benefits than regular workers. In the future, digital technologies (e.g. automated translation) may enable more automation and offshoring of certain service tasks to low-wage countries.[5] This would potentially bring efficiency gains, but also put further pressure on labour conditions in advanced economies, raising crucial questions about the future of work (OECD, 2019c).

Policies have a key role to play to promote an efficient and inclusive digital transformation by ensuring that the necessary complementary factors are in place. This involves a range of priorities, such as upgrading skills, ensuring adequate access to high-speed internet, promoting an efficient reallocation of resources across and within firms, dealing with new competition challenges (e.g. data-driven network effects and switching costs in online platform markets), addressing financial and tax systems' potential biases against intangible investments, and transitioning to more digital government services. In addition, the central role of data in digital economies and its implications for policies requires further analysis.

To exploit potential complementarities between policies, a consistent policy agenda based on a whole-of-government approach is warranted, and broader issues related to digitalisation, such as taxation, labour relations, consumer protection, privacy, trust and cybersecurity also need to be addressed (OECD, 2019a). As digitalisation is global in nature, further international dialogue on issues such as regulation and standards interoperability, and competition and taxation policies, is crucial. Finally, as non-inclusive digitalisation can undermine equality of opportunities and exacerbate income gaps, policymakers should strive to bridge "digital divides" and create the conditions to help lower-skilled workers and less-productive firms to catch up with best performers. Enhancing skills is a key priority in this respect.

This chapter describes recent progress in digitalisation and assesses how it has influenced productivity and inclusiveness, based notably on recent OECD work[6] and in the broader context of the OECD Going Digital project (Box 2.1), the transition agenda for the Future of Work presented in the *OECD Employment Outlook 2019*, as well as the *OECD Skills Outlook* and *Jobs Strategy* (OECD, 2018b; OECD, 2019c; OECD, 2019d). In turn, it discusses the complementarities inherent to the efficient adoption of digital technologies, and the policy challenges and priorities to promote a successful digital transformation.

[5] In contrast, progress in advanced robotics may lead to some reshoring of certain manufacturing tasks to advanced economies.

[6] This chapter builds on recent studies on the drivers of digital adoption by firms (Andrews et al., 2018), the productivity gains from adoption (Gal et al., 2019), policies to harness the benefits of digital adoption (Sorbe et al., 2019), the productivity implications of online platform development (Bailin et al., 2019) and the emergence of gig economy platforms (Schwellnus et al., 2019).

Box 2.1. The OECD Going Digital project

The Going Digital project is an OECD initiative to examine how the digital transformation affects policymaking across a large spectrum of policy areas. The project brings together the expertise of all relevant OECD committees and bodies to draw lessons from national experiences and policy experimentation across OECD countries and other economies.

The first phase of the project culminated with the March 2019 Going Digital Summit and the publication of two synthesis reports: "Going Digital: Shaping Policies, Improving Lives" and "Measuring the Digital Transformation: A Roadmap for the Future". It identified seven policy dimensions that allow governments – together with citizens, firms and stakeholders – to shape digital transformation and improve lives: 1) access; 2) use; 3) innovation; 4) jobs; 5) social prosperity; 6) trust; and 7) market openness.

The second phase of the project will take place in 2019-20. It aims to help countries implement an integrated policy approach to the digital transformation, especially through further development of the Going Digital Toolkit (including indicators, policy notes and innovative policy examples) and Going Digital national reviews. It will also address new opportunities and challenges through analysis of frontier technologies, notably artificial intelligence and blockchain, with an ongoing focus on jobs, skills and social inclusion, and on productivity, competition and market structures (including the evolving role of platforms and SMEs).

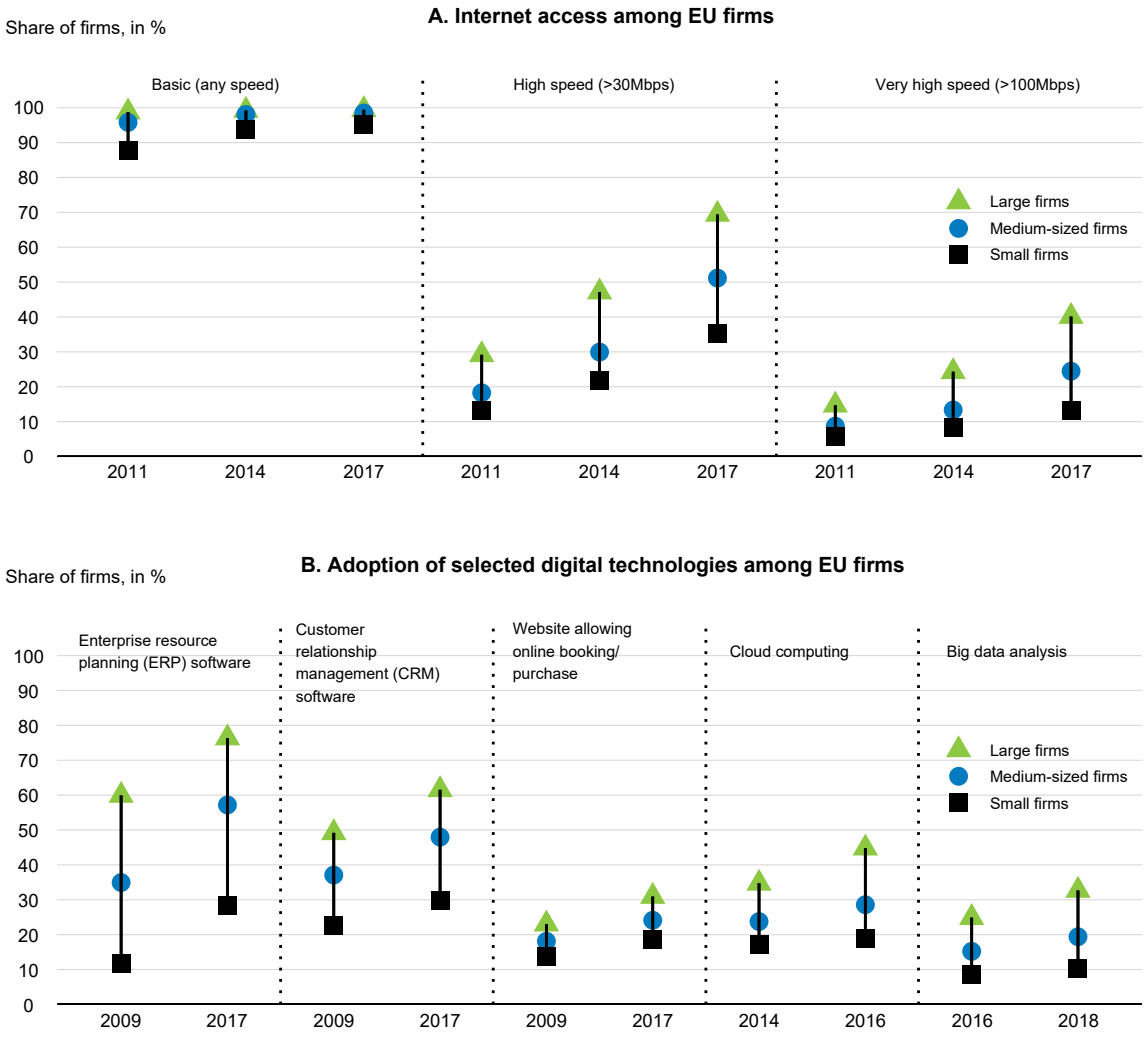
For more information, see https://www.oecd.org/going-digital/.

Digitalisation has accelerated but remains incomplete

Digitalisation is a complex and multi-dimensional process enabled by rapid increases in computing power, data storage capacity and communication speed. These two factors have brought about the emergence of a vast and diverse ecosystem of technologies, some already used for a decade or more (e.g. front and back-office management software, cloud computing) and some at an earlier stage of adoption (e.g. artificial intelligence, blockchain, internet of things). This fast-evolving ecosystem is characterised by strong complementarities between technologies and an increasingly central role of data as a source of value (OECD, 2015b). These technologies are transforming the way firms produce goods and services, but also how firms interact between themselves and with consumers, since these interactions are increasingly intermediated by online platforms.

The Internet is a key enabler of digital technologies. The possibility to access the Internet at basic speed is almost universal in OECD countries. In contrast, access to high-speed internet, which is critical to the use of recent data-intensive technologies, can remain expensive and difficult, especially in rural and remote areas. Encouragingly, it has been increasing rapidly over recent years in European countries (Figure 2.3, Panel A).

Figure 2.3. Internet access and adoption of digital technologies are increasing



Note: The data cover firms with at least 10 employees in the European Union (EU28). Small firms are those having 10-49 employees, medium-sized firms 50-249 employees, and large firms 250 employees and above. In Panel B, selected years correspond to the first and last year available in the data for each technology at the EU level (for example, data on cloud computing are only available in 2014 and 2016).
Source: Eurostat Digital Economy and Society Statistics.

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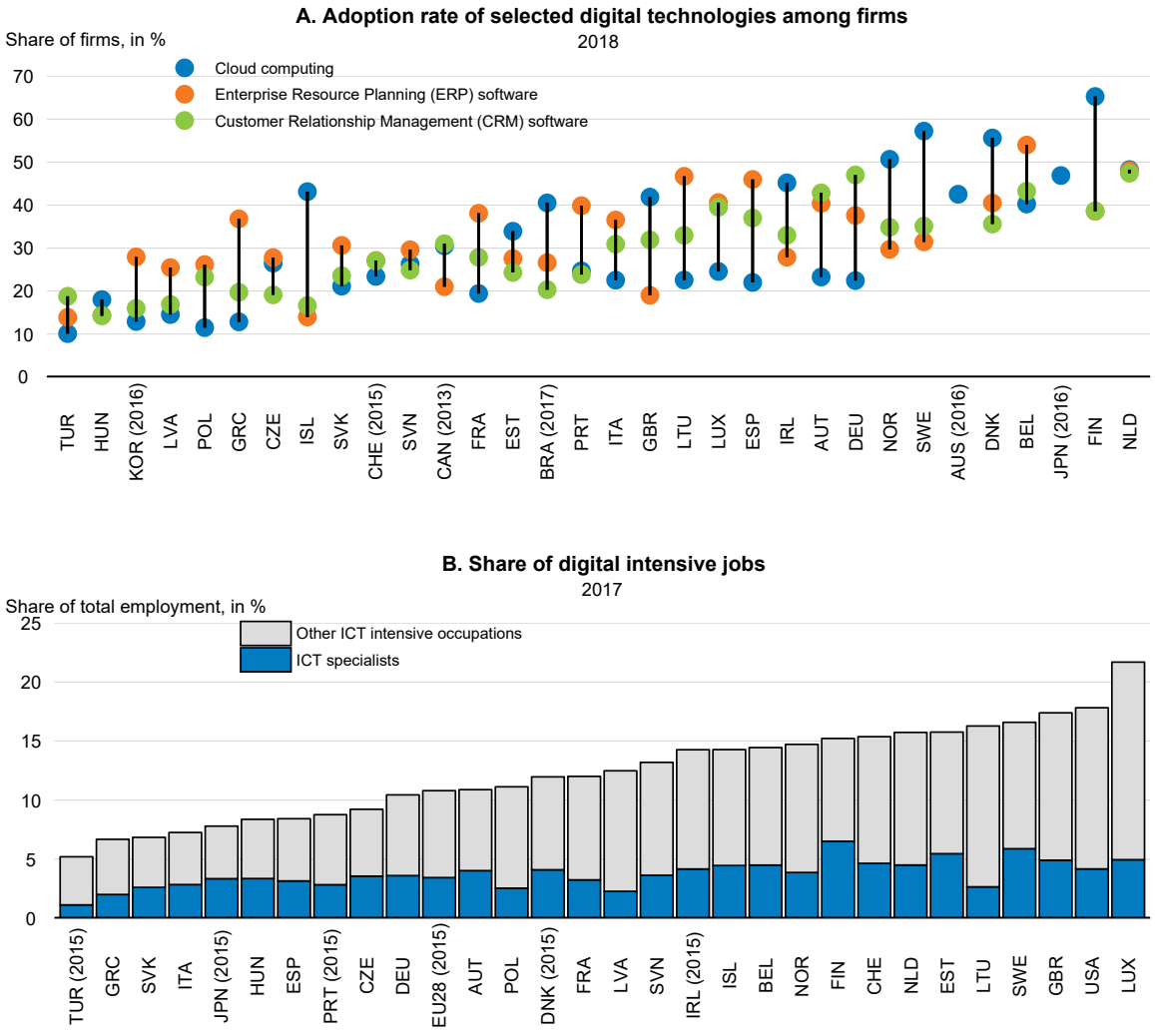
Firms' adoption of digital technologies has also increased substantially in recent years (Figure 2.3, Panel B). However, adoption remains uneven across countries (Figure 2.4). Disparities in adoption across industries and firms may reflect to some extent intrinsic differences in technological needs. For example, activities involving more routine tasks stand to gain more from digitalisation. However, these differences do not explain all disparities in adoption. Indeed, small firms generally gain more from adopting cloud computing than larger firms, possibly because it allows them to increase scale flexibly without mass, but adoption of cloud computing has been higher among large firms (Bloom and Pierri, 2018; Gal et al., 2019). Similarly, manufacturing industries have tended to gain more from digitalisation, but adoption of digital technologies has on average been higher in services (Hagsten, 2016; Dhyne et al., 2018; Gal et al., 2019). This suggests a potential for further adoption of existing digital technologies, which could support productivity beyond the (harder-to-assess) potential offered by new technologies that are still relatively untested or under development (e.g. artificial intelligence and blockchain).

Figure 2.4. Digitalisation has been uneven across countries



Note: In Panel A, countries are ranked according to the average adoption rate across the three technologies. Only firms with at least 10 employees are covered, except for Japan (at least 100) and Switzerland (at least 5). ERP and CRM data refer to 2017 unless otherwise specified. On cloud computing, data for Australia is fiscal year 2015/16; for Canada, it refers to enterprises that have made expenditures on "software as a service"; for Iceland, it refers to 2014; and for Korea, to 2015. OECD countries for which data are not available are omitted.
Source: OECD (2019e), *Measuring the Digital Transformation: A Roadmap for the Future*, sections 4.2 and 6.1, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264311992-en.

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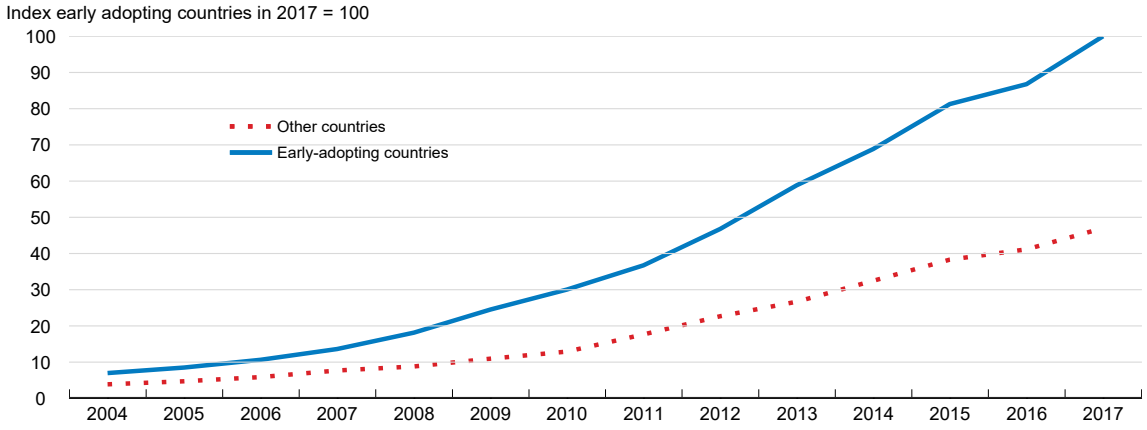
Another dimension of digitalisation is the rapid development of online platforms. Platforms increasingly link consumers to service providers – either firms or self-employed workers – in sectors such as personal transport, accommodation, food service, retail trade, finance, entertainment and personal services (OECD, 2019b). As illustrated by Figure 2.5, platform development has been remarkably fast on average since the mid-2000s, but its speed has differed across countries. Taken together, four sectors where platforms have become frequent intermediaries (hotels, restaurants, retail trade and taxis) represent roughly a quarter of non-farm business employment in OECD countries. Partly overlapping with this, self-employed workers on "gig economy" platforms, which match workers with clients on a per task basis, represent 0.5 to 3% of overall employment depending on the estimates – a relatively small but fast-growing share (Schwellnus et al., 2019). Business-to-business (B2B) platforms, while much less widespread than business-to-consumer (B2C) ones, are also gaining ground.

Figure 2.5. Online platforms are developing fast, but unevenly across countries

Use of online platforms in selected industries (hotels, restaurants, taxis and retail trade)



Note: Popularity of the largest relevant platforms in each industry, based on the number of Google searches for each platform, as a share of total Google searches in each country. Unweighted average of the four selected industries (hotels, restaurants, taxis and retail trade). "Early-adopting countries" is the unweighted average of the five countries in the sample with above-average platform development (France, Italy, Spain, the United Kingdom and the United States). "Other countries" is the unweighted average of the five other countries in the sample (Belgium, Germany, Hungary, Poland and Sweden).

Source: Bailin, A., P. Gal, V. Millot and S. Sorbe (2019), "Like It or Not? The Impact of Online Platforms on the Productivity of Service Providers", *OECD Economics Department Working Papers*, No. 1548, OECD Publishing, Paris.

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As further discussed below, the adoption of digital technologies depends both on firms' capabilities (e.g. managerial and technical skills, access to financing) and incentives (e.g. a competitive business environment) with strong complementarities between the two (Andrews et al., 2018). In contrast, there is little empirical evidence on what drives the development of online platforms across countries and industries. A range of factors are likely to matter, such as technical accessibility (e.g. Internet access, smartphone penetration rates), the perceived quality of platform service (e.g. reliability of user reviews and ratings), the existence of barriers to cross-border digital trade, the way platforms and platform-based activities are taxed, and labour market rules both concerning work on platforms and elsewhere. Sectoral regulations can also play an important role in platform development. For example, overly strict regulation of an activity may contribute to undersupply and invite the development of alternative platform-based services (e.g. Uber vs taxi services). In turn, countries have taken different approaches to the regulation of new types of service providers enabled by platforms (e.g. ride hailing and home sharing services), affecting their development.

Digitalisation can support productivity in various ways

Digital technologies can allow firms to improve product design and production processes, automate routine tasks, perform certain tasks remotely, and facilitate relations with suppliers and clients, among other things. They can also have positive spillovers for other firms, including low-tech ones – for example, online platforms can reduce information asymmetries between (often low-tech) service firms and consumers, and also enable firms to access wider markets, giving productive firms more opportunities to grow. More broadly, digital technologies offer prospects of boosting longer-term productivity, as they can support research and innovation by firms and governments and have the potential to enhance skills, for example thanks to online courses and educational games (OECD, 2016a; OECD, 2019g).

At the same time, certain (relatively less-explored) implications of digital technologies may also undermine productivity. For example, high exposure to screens and an overflow of information and potential distractions can contribute to sleep deprivation and reduce workers' ability to focus. There is evidence of a causal association between greater access to high-speed internet and lower quantity and quality of sleep and, in turn, that lower sleeping duration can undermine labour productivity (Billari et al., 2018; Gibson and Shrader, 2018). Another potential issue is "cyberloafing", i.e. employees' personal use of the Internet at work, which is generally perceived as detrimental to productivity, although the scant empirical evidence in this area is mixed (Koay and Soh, 2019).

Looking ahead, artificial intelligence will extend the range of automatable tasks, including routine cognitive tasks that are typical of service activities, while further development of communication technologies will increase possibilities to outsource service tasks (Sorbe et al., 2018; Baldwin, 2019). While these technologies offer many possibilities, the magnitude of their future effect on productivity remains difficult to assess at such an early stage, and debates between techno-optimists and pessimists are not settled. What is more certain is that regardless of these effects, a greater diffusion of existing technologies (e.g. broadband internet, cloud computing and online platforms) could already yield clear productivity benefits, as discussed in the remainder of this section.

Adoption of digital technologies can support firm productivity

A vast literature has documented the existence of positive links between the adoption of digital technologies and firm and industry-level productivity.[7] For example, OECD estimates suggest that a 10-percentage point increase in the share of firms using high-speed broadband internet (cloud computing) at the industry level is associated with a 1.4% (0.9%) increase in multi-factor productivity for the average firm in the industry after 1 year, and 3.9% (2.3%) after 3 years across EU countries (Gal et al., 2019).

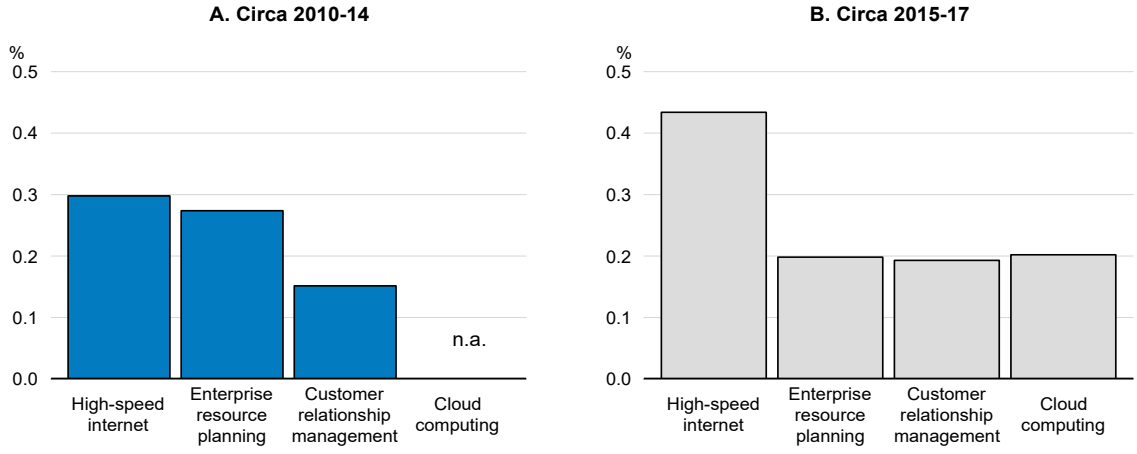
While the association is clear, causality between digital adoption and productivity can be difficult to establish, because more productive firms are more likely to adopt new technologies. Nevertheless, a number of studies relying on exogenous drivers of digital adoption, such as changes in the availability or quality of network infrastructure, find evidence that digital adoption can support productivity.[8] At the aggregate level, however, effects of the adoption of digital technologies are difficult to assess systematically, due to the variety of technologies involved and limitations in the coverage of data on technology adoption. Figure 2.6 illustrates the orders of magnitude involved, building on the adoption rates among EU firms with at least ten employees (see Figure 2.3) and the estimates of adoption-productivity links in Gal et al. (2019). Taken at face value, these results suggest that gains from digital adoption have been substantial. Adoption at the average annual rate observed among EU firms over recent years (between 1 and 3 percentage point per year depending on the technology) may have increased MFP by about 1% every year in the average firm if the gains from the various technologies considered are added up. However, these estimates probably represent an upper bound of actual gains since they assume that the estimated effects are fully causal. In addition, effects for individual firms, industries and countries can vary widely around these averages as they depend on complementary factors (e.g. available skills), as discussed below.

[7] See for example the reviews in Draca et al. (2009), Syverson (2011) and Gal et al. (2019).

[8] Grimes et al. (2011) find that broadband adoption boosted firm productivity by 7–10% in New Zealand. Based on Norwegian data, Akerman et al. (2015) find that broadband internet supports the marginal productivity of high-skilled workers, but reduces that of lower-skilled ones. DeStefano et al. (2019) find that cloud computing enhances the productivity of small firms based on UK data. In contrast, DeStefano et al. (2018) find no effect of high-speed broadband internet on productivity, but a positive effect on firm size.

Figure 2.6. Adoption of digital technologies has supported firm productivity

Annual gain in multifactor productivity associated with technology adoption (average EU firm)



Note: The exact sub-periods (based on available data) are the following: 2011-14 and 2014-17 for high-speed internet, 2009-13 and 2013-17 for Enterprise Resource Planning software, 2009-14 and 2014-17 for Customer Relationship Management software, and 2014-16 for cloud computing. The effects correspond to the average annual change in the adoption of each technology among EU firms with at least ten employees, multiplied by the elasticity between digital adoption and multifactor productivity growth estimated by Gal et al. (2019). To avoid potential double counting due to collinearity between the adoption of different technologies, the effects are computed using the contribution of each technology to the first principal component of the adoption rate of the selected technologies, and the sensitivity of productivity growth to this first principal component (Table 2, column 7 in Gal et al., 2019). The effects presented correspond to productivity gains after three years, which are obtained by iterating on the error-correction model on which the estimation relies.

Source: OECD calculations based on Gal, P., G. Nicoletti, T. Renault, S. Sorbe and C. Timiliotis (2019), "Digitalisation and Productivity: In Search of the Holy Grail – Firm-Level Empirical Evidence from EU Countries", *OECD Economics Department Working Papers*, No. 1533, OECD Publishing, Paris.

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Online platforms can also stimulate firm productivity

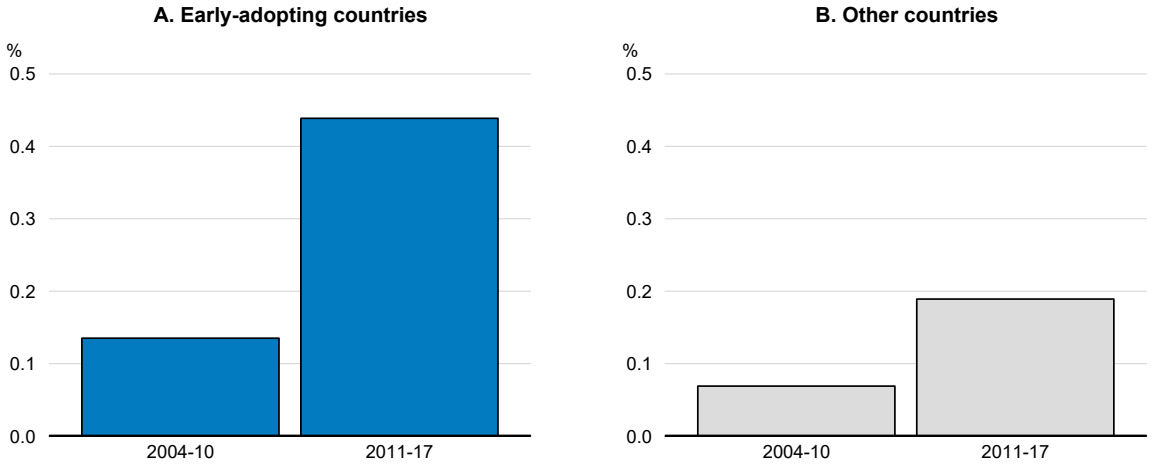
A less-explored aspect of digitalisation is that the development of online platforms can also support firm productivity (Bailin et al., 2019). For example, user ratings and reviews can reduce information asymmetries between consumers and service providers, thereby intensifying competitive pressures by shifting demand toward better-rated providers and incentivising service providers to offer better value for money. In addition, platforms can also bring efficiency gains to service providers by taking care of and rationalising certain side-activities, such as managing bookings and processing payments. Platforms can also enhance capacity utilisation (e.g. hotel occupancy rates) by improving matching efficiency and making the real-time availability of services easily visible online.

Cross-country empirical analysis in four industries (hotels, restaurants, retail trade and taxis) suggests that platform development has enhanced the productivity of existing service firms over the past decade. The effects are substantial – about 0.4% every year over 2011-17 (i.e. about 2.5% in total) for the average service firm in these industries in the countries experiencing relatively fast platform development (Figure 2.7). This order of magnitude is roughly similar to the one found for the effect of increased access to high-speed internet (Figure 2.6).[9] Similar to technology adoption, effects for individual firms, industries and countries can vary around these averages depending on complementary factors, including the intensity of competitive pressures among platforms, as further discussed below.

[9] Since platform development and access to high-speed internet are probably correlated, there would be a risk of double counting if one would sum the effect of greater high-speed internet access and that of platform development.

Figure 2.7. Online platforms can enhance the productivity of service firms

Annual gain in multifactor productivity of the average firm in selected service industries associated with online platform development



Note: "Early-adopting countries" is the average of the five countries in the sample where the platform development indicator is above median on average over the 2004-17 period (France, Italy, Spain, the United Kingdom and the United States), while "other countries" is the average of the five other countries in the sample (Belgium, Germany, Hungary, Poland and Sweden). The figures are unweighted averages of the effects across four selected industries (hotels, restaurants, taxis, retail trade).
Source: Bailin, A., P. Gal, V. Millot and S. Sorbe (2019), "Like It or Not? The Impact of Online Platforms on the Productivity of Service Providers", *OECD Economics Department Working Papers*, No. 1548, OECD Publishing, Paris.

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In addition, there is an important conceptual distinction between so-called "aggregator" platforms, which connect users to existing service providers (e.g. Booking.com, Tripadvisor), and "disruptor" platforms, which enable new types of service providers (e.g. Airbnb, Uber).[10] The positive effects presented above come from aggregator platforms, while there has been on average no significant effect of disruptor platforms on the productivity of incumbent service firms.[11] The effect of disruptor platforms on aggregate productivity therefore depends solely on the productivity of the new providers they enable (e.g. ride-hailing and home-sharing services) relative to that of existing firms, which is difficult to assess on a systematic basis due to data limitations and conceptual issues.[12]

[10] This distinction was originally made in Sorbe et al. (2018) and Bailin et al. (2019).

[11] This absence of a significant average effect may reflect opposing forces. On the one hand, greater competition from disruptors may incentivise incumbents to increase their productivity, for example by adopting some efficiency-enhancing features from the disruptors (e.g. taxi firms developing online reservation apps). On the other hand, competition from disruptors may reduce demand for incumbents, lowering their productivity until they adjust capacity downwards.

[12] On the one hand, innovative features such as efficient matching algorithms can give new types of providers a productivity advantage over existing providers. For example, Uber drivers have been found to spend less time idle than taxi drivers – their average driving time per hour can be up to 50% higher than taxis (Cramer and Krueger, 2016). They have also been found to offer on average lower waiting times for consumers (Rayle et al., 2015) and to do less detours than taxis (Liu et al., 2018), which both suggest a higher quality of service (which may not be visible in productivity figures). On the other hand, "disruptor" platforms also allow more non-professionals to participate in markets, who are likely to be on average less productive than specialised professionals (Schwellnus et al., 2019). Another important question is whether the capital used by these new service providers is a resource that was previously idle (e.g. a dwelling not

Complementarities and main policy challenges

The propensity of digital technologies to boost productivity, and ultimately living standards, depends crucially on complementary factors. This is because reaping the benefits of digitalisation generally requires changes in business practices, work organisation, skill composition, and a reallocation of resources within and across firms and industries. These changes can take time and involve transitory adjustment costs, meaning that effects on productivity may materialise with a lag (Brynjolfsson et al., 2018).

A vast body of research highlights the complementarities associated with digitalisation: (i) between different technologies, for example between back and front-office management software; (ii) with firms' assets or investments, such as technical, managerial and general cognitive skills, financing capacities, organisational capital, intangible assets and R&D investment; and (iii) with policies, such as the propensity of the regulatory environment to promote competition and efficient resource reallocation.[13] Shortfalls in these complementary factors may explain why adoption of digital technologies and gains from digitalisation have, to date, been weaker than anticipated.

Higher-skilled workers and more productive firms are generally better placed to exploit these complementarities than other workers and firms. As a result, these firms have tended to benefit relatively more from digitalisation (Figure 2.8), while lagging firms are failing to catch up with them (Berlingieri et al., 2019). About half of the increase in productivity dispersion across firms over 2010-15 can be related to digitalisation (Gal et al., 2019). In an extreme form of this dispersion, there is a risk that certain highly productive "superstar" firms escape competition, thanks to firm-specific intangible assets (e.g. data and algorithms), especially in industries characterised by low marginal costs and strong network effects.

Policies have a key role to play in encouraging further diffusion of digital technologies in the economy and addressing these challenges. Action in a range of policy areas has the potential to stimulate this diffusion by enhancing firms' capabilities and incentives to adopt, and thereby to support productivity (Figure 2.9). To ensure that these productivity gains translate into higher living standards and well-being for all, policymakers should focus on the productivity-inclusiveness nexus and aim to create the conditions for less productive firms and lower-skilled workers to catch up (Berlingieri et al., 2019; OECD, 2018c). Enhancing skills is a priority since it can offer a double dividend of boosting productivity while supporting inclusiveness.

Skills are crucial in a digitalised economy

The digital transformation implies vast shifts in skill demand (Grundke et al., 2018; OECD, 2019d). The demand for skills that are easier to substitute with digital technologies has been declining, while the returns to skills that are complementary to technologies have been increasing. In general, this has put downward pressure on the wages and employment prospects of low-to-medium skilled workers that perform routine tasks, while supporting the wages of higher-skilled workers that benefit from working with digital tools. In addition, the development of "gig economy" platforms, while offering increased flexibility for workers and firms, also tends to offer workers lower protection and benefits than regular employment.

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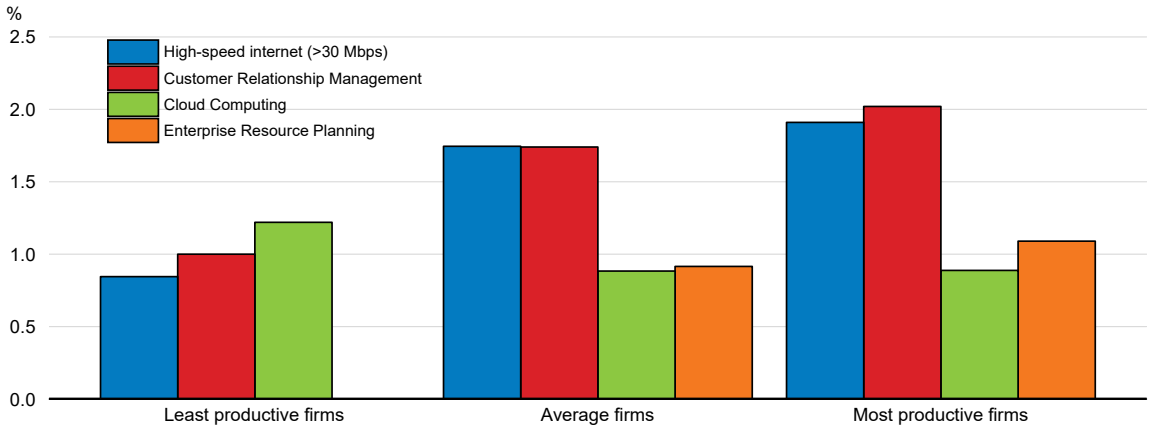
occupied during the owners' holidays) or one that is fully dedicated to this service and therefore has opportunity costs (e.g. a dwelling rented on home sharing platforms during the whole year).

[13] See, for example, Aral et al. (2006) and Bartelsman et al. (2017) on complementarities between different technologies; Bloom et al. (2012), Corrado et al. (2017) and Mohnen et al. (2018) on complementarities with skills, intangibles and R&D; and Conway et al. (2006), Bartelsman (2013) and Bailin et al. (2019) on complementarities with regulations that promote competition and resource reallocation.

Figure 2.8. More productive firms have benefitted more from digitalisation

Firm-level increase in multifactor productivity associated with an increase in the industry-level adoption rate of selected digital technologies by 10 percentage points



Note: "Least productive firms" corresponds to the first quartile of the productivity distribution in each industry-country-year cell, "average firms" to the second and third quartiles and "most productive firms" to the fourth quartile. Results for Enterprise Resource Planning for the least productive firms are omitted since they are not statistically significant. Effects are estimated over 2010-15 for EU firms with at least ten employees. The only technology for which less productive firms benefit more than more productive ones is cloud computing, which may reflect that it requires less complementary investments in organisation and skills.
Source: Gal, P., G. Nicoletti, T. Renault, S. Sorbe and C. Timiliotis (2019), "Digitalisation and Productivity: In Search of the Holy Grail – Firm-Level Empirical Evidence from EU Countries", *OECD Economics Department Working Papers*, No. 1533, OECD Publishing, Paris.

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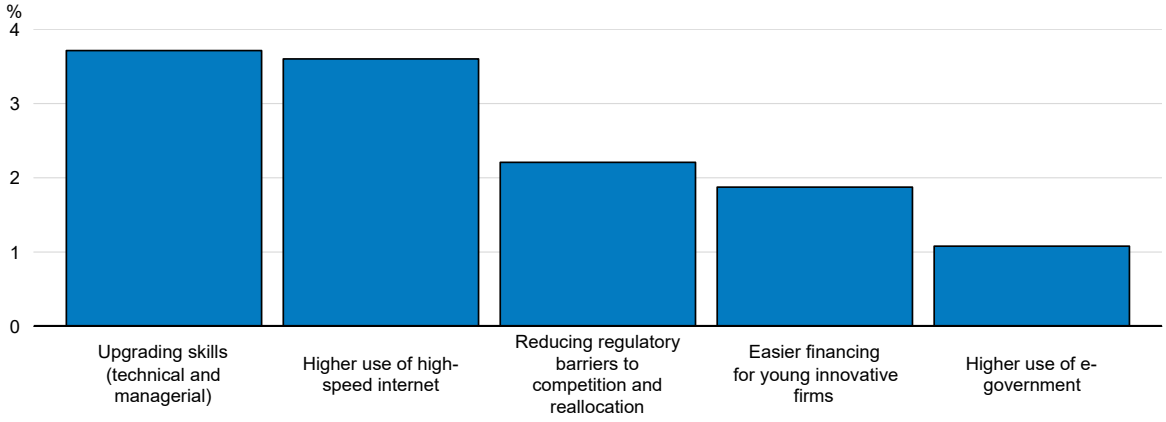
Further technological advances will increase the range of automatable tasks, offering the potential to enhance productivity, but also involving important transition costs. While automation has started with manual routine tasks in manufacturing activities, it is increasingly affecting "cognitive routine" tasks that are typical of service sectors. As the performance of artificial intelligence is improving – for example, it has recently surpassed average human abilities at speech and image recognition – more tasks will be automated, even potentially in relatively high-skilled occupations. This means that certain jobs will disappear, but above all that the nature of many jobs will change. For example, Nedelkoska and Quintini (2018) assess that 14% of jobs in OECD countries are highly automatable, and that another 32% may undergo significant changes due to automation. At the same time, new tasks and jobs will appear and labour demand may not necessarily decline overall (Gregory et al., 2019). Still, ensuring that the labour force has the right skills for this new environment and reducing personal costs for displaced workers will pose considerable challenges.

Skill shortages can reduce the benefits from digitalisation, especially among less-productive firms, as it is more difficult for them to attract skilled workers than for more productive firms (Figure 2.10). Several types of skills matter in a digitalised economy: (i) advanced technical skills for digital specialists, (ii) generic digital skills for other workers, and (iii) complementary skills to work in a digitalised environment, including general cognitive skills, interpersonal skills as well as managerial and organisational skills (OECD, 2016b; Grundke et al., 2018).

Figure 2.9. A range of policies can support productivity by promoting greater diffusion of digital technologies

Effect on multifactor productivity of the average EU firm of closing half of the gap with best-performing EU countries in a range of structural and policy areas, after 3 years



Note: The effects correspond to the estimated productivity gains associated with greater diffusion of high-speed internet, cloud computing, and Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) software resulting from closing half of the gap with best EU countries in a range of structural and policy areas. "Upgrading skills" covers participation in training (for both high and low-skilled), quality of management schools and adoption of High Performance Work Practices (HPWP). "Reducing regulatory barriers to competition and reallocation" includes lowering administrative barriers to start-ups, relaxing labour protection on regular contracts and enhancing insolvency regimes. "Easier financing for young innovative firms" covers the development of venture capital markets and the generosity of R&D tax subsidies. Structural and policy indicators are measured circa 2016. The detailed description of the sub-indicators used and the best-performing EU country for each sub-indicator can be found in Annex B of Sorbe et al. (2019).

Source: Sorbe, S., P. Gal, G. Nicoletti and C. Timiliotis (2019), "Digital Dividend: Policies to Harness the Productivity Potential of Digital Technologies", *OECD Economic Policy Papers*, No. 26, OECD Publishing, Paris.

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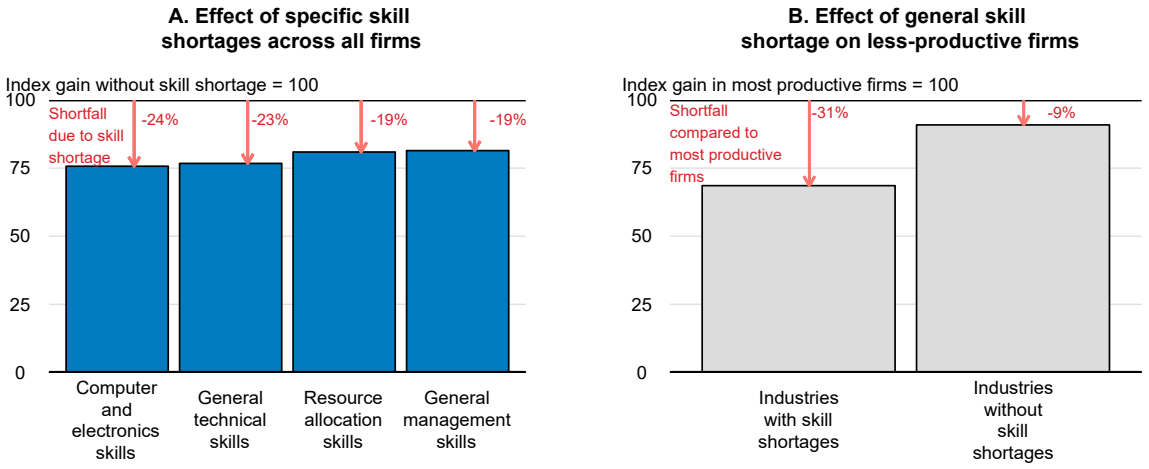
Good managerial skills are associated with greater and more efficient diffusion of digital technologies (Andrews et al., 2018; Gal et al., 2019). This is probably because digitalisation generally requires changing business processes, for which good management is crucial. For example, High-Performance Work Practices (HPWP) can increase firms' internal flexibility to adapt to technological change (OECD, 2016c).[14] While policies cannot directly affect the managerial and organisational performance of firms, good management practices can be promoted indirectly, for example by encouraging their adoption in public administrations and government-owned enterprises. Enhancing product market competition can also encourage firms to improve their management practices and contribute to the exit or restructuring of certain firms that are very poorly managed. The quality and accessibility of relevant education and training (e.g. business schools) and more flexible job transitions across and within firms are also likely to support average management quality. Finally, avoiding tax rules overly favourable to family transmission of firms may also help if family transmission is associated with poor management quality.[15]

[14] HPWP include an emphasis on teamwork, autonomy, task discretion, mentoring, job rotation and applying new learning. They also encompass management practices – bonus pay, training provision and flexibility in working hours – that provide incentives for workers to deploy their skills at work more fully (OECD, 2016c).

[15] Openness to trade and foreign investment can also be beneficial for management practices since multinationals are, on average, better managed than other firms (Bloom and Van Reenen, 2010).

Figure 2.10. Skill shortages reduce digitalisation gains, especially among less productive firms

Productivity gain associated with digitalisation



Note: The situation with (without) skill shortages is defined as the 75th (25th) percentile of the distribution of skill shortages across industries and countries (source: OECD Skills for Jobs database, www.oecdskillsforjobsdatabase.org). In Panel A, "Computer and electronics skills" refers to the knowledge of circuit boards, processors, chips, electronic equipment, computer hardware and software, including application and programming. "General technical skills" refer to the capacity to design, set-up, operate and correct malfunctions, involving application of machines or technological systems. "Resource allocation skills" capture the ability to allocate resources efficiently. "General management skills" refer to how well managers motivate, develop and direct people as they work, and identify the best people for each job. In Panel B, "most productive firms" are the 25% most productive firms in each industry and "less productive firms" are those between the 25th and the 50th percentile of the productivity distribution in each industry (i.e. firms with below-median productivity, but not among the least productive) and skill shortages are measured with a broad indicator covering both managerial and technical skills. All results are based on the estimated link between the adoption of a mix of selected technologies (high-speed internet, cloud computing, ERP and CRM software) and multifactor productivity among EU firms over 2010-15.

Source: Gal, P., G. Nicoletti, T. Renault, S. Sorbe and C. Timiliotis (2019), "Digitalisation and Productivity: In Search of the Holy Grail – Firm-Level Empirical Evidence from EU Countries", *OECD Economics Department Working Papers*, No. 1533, OECD Publishing, Paris; Sorbe, S., P. Gal, G. Nicoletti and C. Timiliotis (2019), "Digital Dividend: Policies to Harness the Productivity Potential of Digital Technologies", *OECD Economic Policy Papers*, No. 26, OECD Publishing, Paris.

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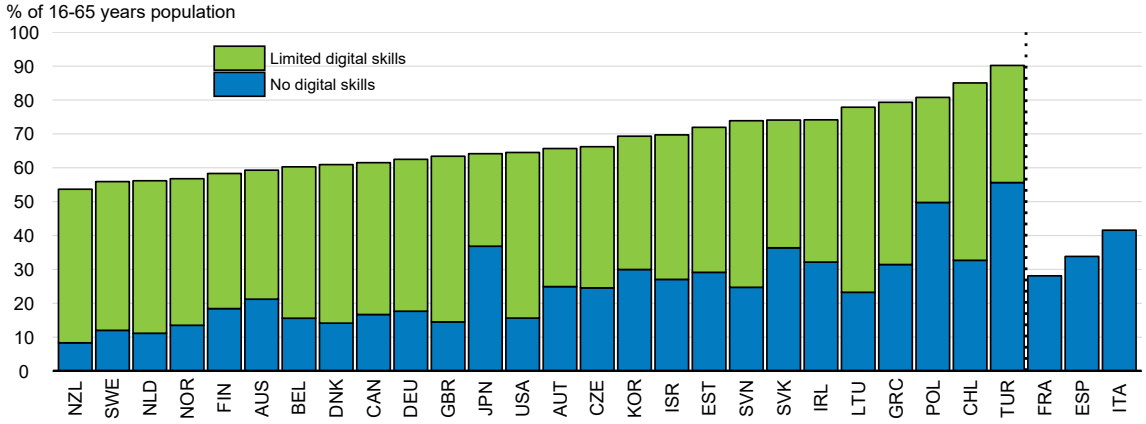
Digital-related technical skills are lacking among adults in many OECD countries (Figure 2.11). Both initial education and subsequent training have a role to play to enhance these skills. Addressing gender gaps in STEM field studies (science, technology, engineering and mathematics) would help in this respect. For example, women account for less than 20% of entrants into tertiary level computer science programmes in OECD countries (OECD, 2017a).

More broadly, "foundation skills" such as literacy and numeracy are important prerequisites for the development of the skills demanded in the digital economy (OECD, 2016b). Looking ahead, it is essential for individuals to have sufficiently strong and versatile initial skills to be able to strive in an environment of fast-changing technologies and increasingly long working lives. Interestingly, digital technologies have the potential to enhance education outcomes, but this requires not just investing in the technologies themselves, but also in complementary skills for teachers and in re-thinking teaching practices to make the best of existing technologies (OECD, 2016a).

Figure 2.11. Many adults lack digital skills in OECD countries

Share of adults lacking digital skills, 2015



Note: "No digital skills" includes adults who have had no computer experience, failed the ICT core test (e.g. capacity to use a mouse or scroll through a web page) or opted out of taking the test (their ICT skills could not be assessed directly, but indirect evidence suggests that they are likely to be poor). "Limited digital skills" includes adults scoring below or at level 1 of proficiency in problem solving in technology-rich environments, which involves use of widely available and familiar technology applications, such as e-mail software or a web browser, to complete simple tasks requiring little or no navigation or commands. Data are missing for countries that did not participate in the PIAAC Survey. Data for the United Kingdom refer to England, and data for Belgium refer to Flanders. Data on limited digital skills are missing for France, Italy and Spain, as they did not participate in the problem solving in technology-rich environments assessment.
Source: OECD Survey of Adult Skills (PIAAC).

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Higher participation of workers in training, especially among low-skilled workers, supports the adoption of digital technologies, attesting to the importance of lifelong learning. Beyond training quantity, its quality is also important. Increasing participation of low-skilled workers in training can be challenging since their propensity to participate is about three times lower than for higher-skilled workers, but it can offer the double dividend of increasing productivity while reducing inequalities. Along with broader active labour market policies, including job matching services, good training can also reduce personal costs of job displacement due to technological disruptions.

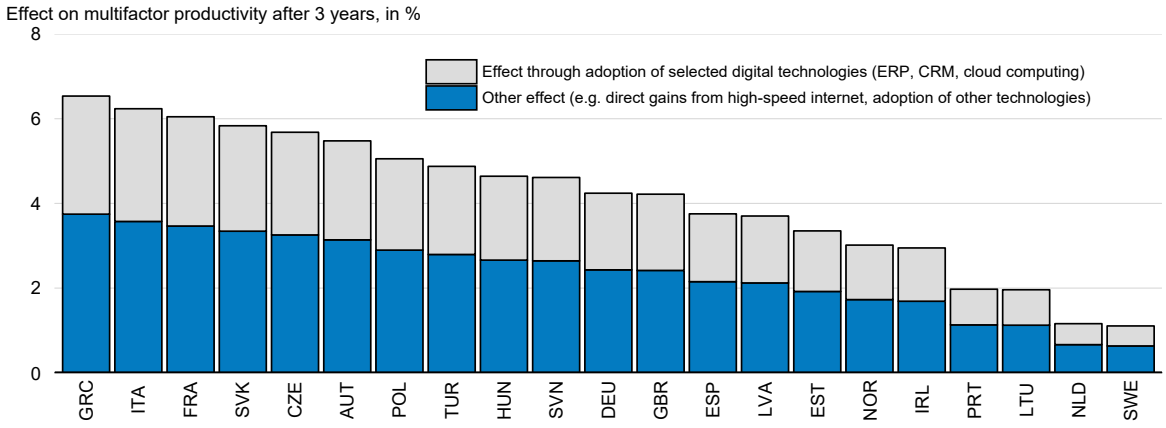
In many OECD countries, adult learning systems need to be improved to prepare for the challenges ahead. The following priorities stand out: (i) improving coverage and inclusiveness by helping adults make informed choices, tackling barriers to participation and encouraging employers to offer training; (ii) better aligning training content with the skill needs of the labour market; (iii) enhancing incentives to improve training quality by publicly assessing the quality of providers; (iv) ensuring adequate financing, including through public funding and incentives for employers and individuals to contribute; and (v) strengthening governance mechanisms to improve coordination between different actors involved in the adult learning system (OECD, 2019j).

Promoting affordable access to high-speed internet can support productivity

A number of policies are relevant to increase the availability of high-speed internet and make it more affordable, which in turn should enhance take-up by firms. To improve coverage, including in rural and remote places where market failures may lead to suboptimal private investment, governments may invest directly in high-speed networks or subsidise private investments in networks, using call for tenders to identify the providers best able to deliver the infrastructure needed (OECD, 2018d). These decisions should be informed by socio-economic cost-benefit analyses. Governments should also ensure that technical enablers are in place (e.g. spectrum, internet protocol and exchange points). In addition, pro-competitive reforms in telecommunication sectors (e.g. encouraging the emergence of new entrants or enabling infrastructure sharing) can reduce prices and in many cases also spur investment (OECD, 2019a). Overall, greater access to high-speed internet is associated with higher productivity, notably because it enables the adoption of productivity-enhancing technologies (Figure 2.12).

Figure 2.12. Increased access to high-speed internet is associated with higher productivity

Effect associated with closing half of the gap in high-speed internet access to the best-performing EU country



Note: Estimated effect on multi-factor productivity (MFP) of the average firm after three years associated with increasing high-speed broadband internet access to close half of the gap with the best performing country in the sample (Denmark). The estimation sample used to assess the elasticity of productivity to high-speed internet access covers EU firms with at least ten employees over 2010-15. Cross-country differences in high-speed internet access correspond to 2018 values, or latest available data.

Source: Sorbe, S., P. Gal, G. Nicoletti and C. Timiliotis (2019), "Digital Dividend: Policies to Harness the Productivity Potential of Digital Technologies", *OECD Economic Policy Papers*, No. 26, OECD Publishing, Paris.

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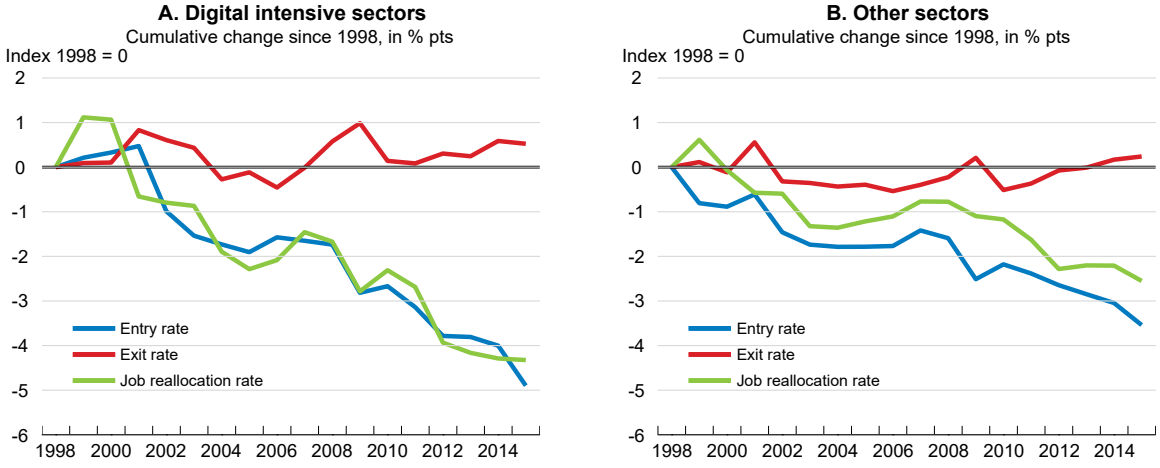
The regulatory environment should promote the efficient reallocation of resources

Digitalisation can profoundly change production structures as new firms and activities emerge and grow, while others disappear or become less labour-intensive. Reaping the full benefits of this transformation requires the efficient reallocation of labour and capital across firms, industries and regions. This is especially important since business dynamism appears to have declined over the past decades across OECD countries (Figure 2.13) although recent data on firm entries have been encouraging.[16] Even though business dynamism is generally higher in digital intensive sectors, it has declined more in these sectors than in the rest of the economy.

Enhancing business dynamism requires reducing barriers to entry and growth of young innovative firms, facilitating a smooth exit of the least productive firms, and enabling fluid movements of labour and capital from declining to growing firms and industries. This involves a range of policies in labour and product markets. For example, lowering administrative barriers to start-ups, facilitating labour transitions by ensuring that employment protection is not overly restrictive, and improving insolvency regimes have been found to support productivity-enhancing resource reallocation generally, and the diffusion of digital technologies specifically.[17] Promoting residential mobility and improving the recognition of skills and qualifications across jurisdictions can also help to reduce labour market mismatches (Andrews et al., 2011; Sorbe et al., 2018).

Figure 2.13. Business dynamism has been trending down



Note: This figure reports average within-country-industry trends of job reallocation, entry and exit rates for the period 1998-2015 in a sample of 15 mostly OECD countries. Each point represents the cumulative change in percentage points since 1998. The figures are based on the year coefficients of regressions within country-sectors, with and without interaction with a dummy variable capturing digital intensity of the sector. The dependent variables are alternatively job reallocation rates of incumbents, entry rates or exit rates.
Source: Calvino, F. and C. Criscuolo (2019), "Business Dynamics and Digitalisation", *OECD Science, Technology and Industry Working Paper*, No. 62, OECD Publishing, Paris.

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[16] On the decline in business dynamism, see for example Decker et al. (2018), Bijnens and Konings (2018), Akcigit and Ates (2019) and Calvino and Criscuolo (2019). On recent data on entries, see OECD (2019h).

[17] See, for example, Haltiwanger et al. (2014), Andrews et al. (2018) and Calvino and Criscuolo (2019).

Financial constraints can hinder the growth of young, innovative and digital intensive firms, and more broadly firms' investments in digital technologies. This is because digitalisation often involves transition costs, which can be difficult to overcome because intangible capital is harder to collateralise than physical capital (Demmou et al., 2019). As a result, ensuring sound and well-functioning financial systems and preventing potential legacies from past crises from crowding out financing to new projects and firms would generally support digitalisation.

In addition, policies should aim to address market failures in the financing of young innovative firms. Many countries have put in place schemes to support access to a range of financing instruments, especially equity.[18] Nevertheless, equity financing remains less favourable for tax purposes than debt financing in most OECD countries. A more level treatment would further help firms relying on hard-to-collateralise intangible assets. In addition, gender gaps in the financing of start-ups should be further investigated (Lassébie et al., 2019).

Interestingly, there is evidence that the development of online platforms, especially "aggregators", can stimulate efficiency-enhancing labour reallocation across firms, possibly because firms with better reviews and ratings tend to attract more demand (Bailin et al., 2019). There is also evidence that the effects of online platform development on the productivity of service firms are more favourable when employment protection and administrative barriers to entrepreneurship are less strict. This is possibly because less strict rules allow firms to adjust more flexibly to rapid changes in demand. Indeed, platform development can lead to rapid demand increases, for example for firms with good user ratings, or declines, for firms having bad ratings or facing competition from new types of providers enabled by "disruptor" platforms.

Regarding these new types of activities (e.g. ride hailing and home sharing), the way to regulate them also raises important questions. These activities sometimes start in a regulatory vacuum and benefit from tax and regulatory arbitrage compared with existing activities. At the same time, they can offer a way to circumvent regulations that are overly favourable to incumbents (e.g. taxis in certain countries). Overall, offering new activities a temporary window to experiment in a controlled environment (e.g. with "sandbox" policies) can stimulate innovation and allow new business models to emerge. At the same time, policymakers should, in the long term, aim to ensure a level tax and regulatory playing field between competing activities to avoid distorting the allocation of resources in the economy.

Such a level playing field can be achieved by relaxing certain rules on existing activities (e.g. eliminating certain licensing requirements that have become obsolete and create undue entry barriers) while gradually submitting the new types of activities to tax rules and product and labour market regulations equivalent to those in existing activities. In particular, this can involve more protection for gig economy platform workers, such as introducing minimum standards for removal from a platform, considering allowing self-employed platform workers to bargain collectively when the platform is their de facto employer[19] and giving them access to social protection and training. The first collective agreement of this kind was signed in 2018 between a Danish platform for cleaning in private homes (Hilfr.dk) and the largest trade union in the country (3F).

[18] See for example OECD (2018e) and OECD (2019i).

[19] This is generally prohibited under current antitrust rules to avoid cartel behaviour by self-employed workers. Potential changes to these rules to reflect the economic situation of platform workers would have to avoid undermining broader antitrust policy.

Digitalisation poses new challenges regarding competition

Digitalisation is a mixed blessing for competition. Positively, certain digital technologies allow firms to gain scale without mass and information to spread more easily, which can help young innovative firms entering markets and challenging larger incumbents. In contrast, many digital activities (e.g. online platforms) are characterised by low marginal costs, strong multi-sided network effects and a central role of data and algorithms as sources of value, which can result in winner-takes-most dynamics. For example, the median market share of the largest online platform across the industries and countries considered in Bailin et al. (2019) is 64%. In the large majority of cases, the leading platform was already the largest one in the two previous years.

The overall implications of this situation are difficult to assess. On the one hand, concentration could enhance efficiency to the extent that a larger pool of users and data on transactions can enable a platform to improve its algorithms and the reliability of its ratings. In addition, a certain degree of market power can reflect a legitimate rent for past innovation and even be the sign of healthy competition (OECD, 2018f). On the other hand, market power can – if it is too entrenched – allow firms to use strategic patenting or buy smaller innovative firms to stifle competition (OECD, 2018g) and ultimately undermine innovation, living standards and inclusiveness.

Recent OECD work points to signs of increasing market power, especially in digital intensive industries. Mark-ups have been increasing since the early 2000s, especially in digital intensive industries (Calligaris et al., 2018). In addition, the number of global mergers and acquisitions (M&A) has more than doubled since 2003 – with the largest increases in digital intensive sectors – contributing to increasing concentration at the industry level both in North America and in Europe (Bajgar et al., 2019a,b).

While these issues deserve more analysis, preliminary empirical evidence suggests that rising market power is in some cases becoming detrimental to economic efficiency. Díez et al. (2018) find evidence of higher mark-ups being correlated initially with increasing and then decreasing investment and innovation rates, especially in highly concentrated sectors, consistent with the inverted U-shape relationship between the intensity of competition and innovation described by Aghion et al. (2005).

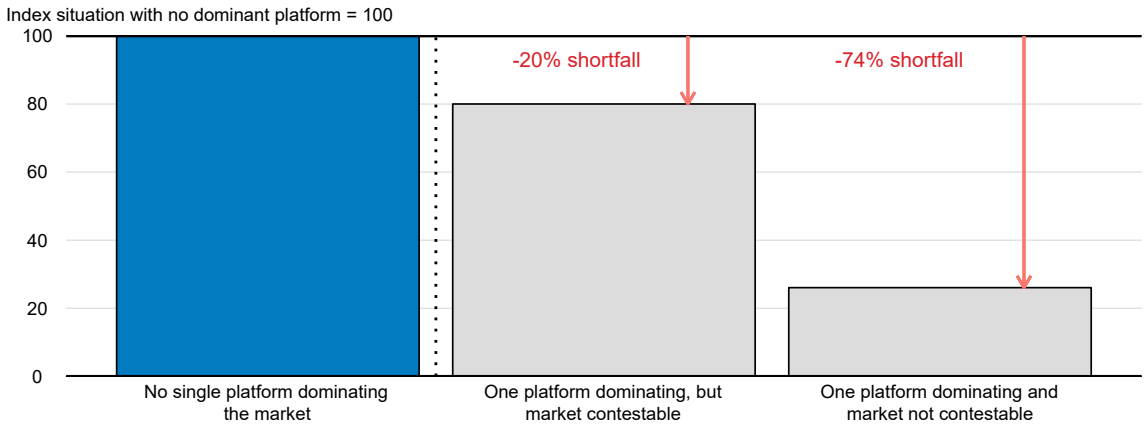
In line with this, the productivity gains associated with online platform development are found to be weaker when a platform market is dominated by a single platform and when this domination is persistent over time (Figure 2.14). Thus, beyond concentration, it is the contestability of platform markets that matters for efficiency. For example, a dominant platform missing pressure from potential competitors may lack incentives to innovate and invest in trustworthy ratings and reviews.[20] It may also use its monopoly or monopsony position to extract economic rents from service providers or users, for example by charging high fees or offering unfavourable conditions to certain users.

Digitalisation creates other challenges for competition policy. One arising issue is algorithmic collusion. In situations where algorithms are left in charge of pricing decisions, they may maintain prices above the competitive equilibrium level without being explicitly programmed to collude or directly communicating with each other (OECD, 2017b; Calvano et al., 2018). This is a challenge since competition law infringement is generally assessed based on evidence of an agreement to collude. Another potential issue is that certain online platforms act both as direct sellers and as marketplaces where other providers can sell their products. As a result, these platforms are in a position to offer a preferential treatment to their own products (e.g. higher visibility) and also have access to valuable data about their competitors and market trends.

[20] The existence of user review and rating systems is probably an important productivity-enhancing feature of online platforms. However, as discussed in Box 2.1 of Bailin et al. (2019), building and maintaining trustworthy user review and rating systems can be difficult and costly, due notably to cognitive biases and strategic actions in rating behaviour.

Figure 2.14. Non-contestable platform markets generate weaker productivity gains

Effect of platform development on average service firm productivity, depending on the structure of the platform market



Note: "No single platform dominating the market" is defined as the situation where the market share of the largest platform in a given industry and country is below the median in the sample (i.e. a market share of 64%). "One platform dominating, but market contestable" is defined as the situation where the largest platform has a market share above the median in the sample, but was not consistently the largest in the two previous years. "One platform dominating and market not contestable" corresponds to the remaining case, i.e. where the largest platform has above-median market share and was already the largest over the two previous years (a proxy for lack of contestability). The first two bars are not statistically different from each other at the 1% level, whereas the third one is significantly lower than the first one. The effects are estimated over 2004-16 in a sample of ten OECD countries and four industries (hotels, restaurants, taxis and retail trade).
Source: Bailin, A., P. Gal, V. Millot and S. Sorbe (2019), "Like It or Not? The Impact of Online Platforms on the Productivity of Service Providers", *OECD Economics Department Working Papers*, No. 1548, OECD Publishing, Paris.

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Existing competition policy tools can already do a lot to address these challenges. Digitalisation calls for using them with increased vigilance and further taking into account the characteristics of digitalised markets, including the need for timely decisions as markets can evolve fast. For example, mergers must be carefully scrutinised for their impact on dynamic competition, including innovation (OECD, 2018h). Merger notification thresholds could be modified, as recently done by certain countries (e.g. Austria, Germany) to ensure that the potential anticompetitive acquisition of nascent competitors (e.g. small, but innovative and data-rich) is not overlooked. Ex-post assessments of merger decisions can also help to develop lessons learned and evaluate the evolution of post-merger markets. More broadly, competition policies could also make more frequent use of market studies, to make holistic assessments of how competition is functioning in markets, and how to improve it. Competition authorities must also remain vigilant to ensure that dominant firms do not abuse their position, for example with exclusionary practices that prevent competitors from entering the market. The nature of competition in so-called "zero price markets" (including dimensions such as privacy and innovation) should also be further explored (OECD, 2018i). Finally, there is scope for greater international co-operation among competition authorities, for example through enhanced information sharing and investigation assistance.

Regulatory policy can also help enhance competition by reducing entry barriers for start-ups and switching costs between online platforms. For example, switching costs can be influenced by rules on data portability (e.g. can the reputation earned on a platform be transferred to another platform?), multi-homing (i.e. the possibility for service providers to use several platforms at the same time) and best-price clauses (i.e. clauses where platforms guarantee to their users that they get the best available price for a service, reducing consumers' incentives to test other platforms). However, these rules can be complex to design and involve trade-offs. For example, the lack of data portability may undermine platform market

contestability, but too much portability could pose privacy concerns, and practical aspects of portability entail important challenges (e.g. lack of standard formats in the context of fast-evolving business models of platforms; Digital Competition Expert Panel, 2019).

Another avenue to promote competition in digitalised markets and to enable greater benefits from digitalisation is to reduce cross-border barriers to digital trade (Figure 2.15). Similar to "traditional" trade, digital trade can be expected to bring productivity benefits by enhancing specialisation and competition, enabling access to cheaper and better quality inputs for firms, and supporting the diffusion of digital technologies. As most international agreements on trade pre-date the emergence of digital trade, supporting its development will require continued international dialogue to improve the interoperability of differing regulatory regimes, including on sensitive issues such as cross-border data flows, but also ensuring coherence between trade, competition and taxation policies (López González and Ferencz, 2018).

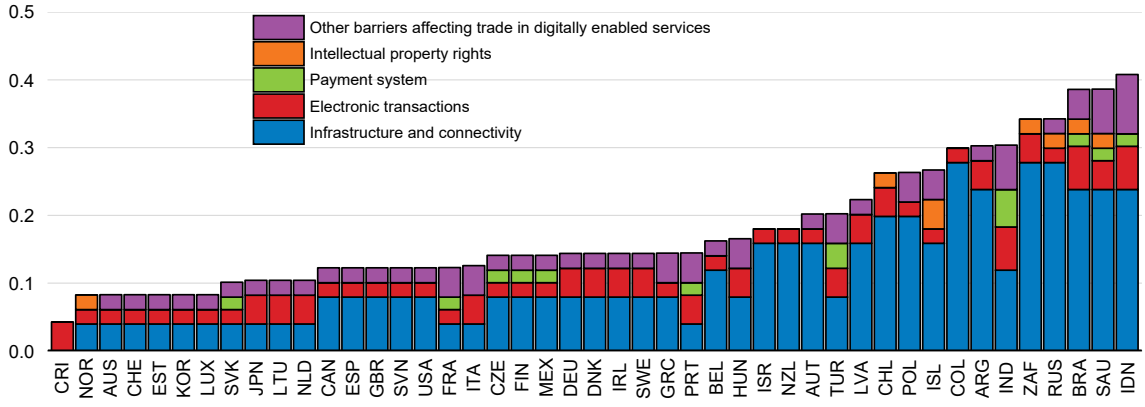
Digital government should be further advanced

Countries across the OECD are increasingly relying on digital government (Figure 2.16). Digital government entails the use of digital technologies in the provision of government services (e.g. administrative procedures for individuals and firms, e-procurement) but also more broadly the promotion of innovation in the public sector and expanded civic engagement including through open government data initiatives. Similar to digitalisation in businesses, experience suggests that successful shifts to digital government involve complementary investments in rethinking and reorganising government processes and services (OECD, 2018j).

Greater reliance on digital government can enhance the productivity of the public sector and also tends to stimulate firms' adoption of digital technologies (Andrews et al., 2018). This may be because digital government can foster the development of digital skills among the population, encourage firms to adopt digital technologies to facilitate their interactions with public authorities, and help them to improve their services thanks to the wider availability of data.

Figure 2.15. There are large cross-country differences in barriers to digital trade

OECD Digital Services Trade Restrictiveness Index (Digital STRI), 2018



Note: Higher values indicate higher barriers to digital trade. The underlying methodology is described in Ferencz, J. (2019), "The OECD Digital Services Trade Restrictiveness Index", *OECD Trade Policy Papers*, No. 221, OECD Publishing, Paris.
Source: OECD Digital STRI.

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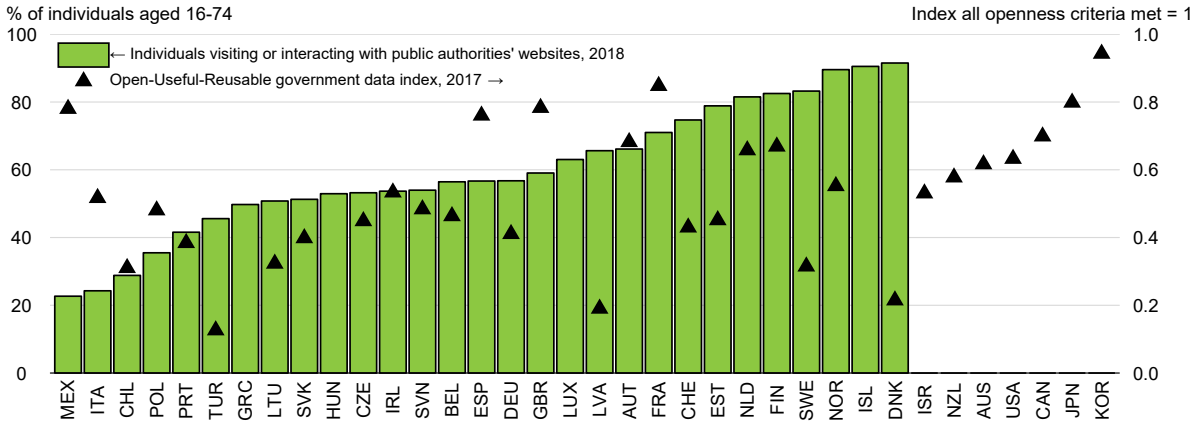
Figure 2.16. The uptake of digital government services differs significantly across countries

Use of digital government services by individuals and government data openness



Note: For Chile, Colombia, Costa Rica, Mexico and Switzerland, data on use of online government services refer to 2017. Data on the use of online government services are missing for Australia, Canada, Israel, Japan, Korea, New Zealand and the United States. Data on government data openness are missing for Greece, Hungary, Iceland and Luxembourg.
Source: OECD, ICT Access and Usage by Households and Individuals, OECD.stat; and OECD, *Open Government Data Report 2018*, OECD Publishing, Paris.

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There are important complementarities between policy areas

The general policy recommendations above have to be tailored to countries' characteristics to address the main bottlenecks to efficient diffusion of digital technologies and development of online platforms. For example, certain countries may need to prioritise physical infrastructure, while others should focus primarily on skills.

At the same time, the existence of positive complementarities between policies should not be overlooked. For example, the positive effects of upskilling can be magnified by a business environment encouraging firms to put these skills to their best use. Acting on several policy fronts can increase the benefits of reforms by about 20% beyond the cumulated impact of the same policies if they were implemented in isolation (Sorbe et al., 2019). Overall, these complementarities highlight the importance of having a consistent transition agenda and a whole-of-government approach to policies related to the digital transformation. In practice, many countries already have a digital economy strategy or an equivalent policy in place, but most of these are still rather narrow in scope and more can be done to establish a governance approach that supports effective co-ordination across relevant government bodies.

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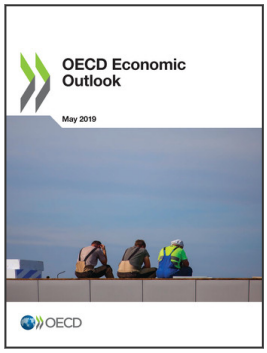

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