ACHIEVING INCLUSIVE GROWTH IN THE FACE OF DIGITAL TRANSFORMATION AND THE FUTURE OF WORK

OECD report to G-20 Finance Ministers

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Key messages

Rapid innovation is reshaping the way goods and services are produced and consumed, with profound implications for the dynamics of productivity, jobs, trade and investment. Emerging technologies have potential to bring considerable economic benefits but entail disruptive adjustments and require ambitious policies for the future world of work.

- The confluence of technological breakthroughs – such as digital technologies, 3D printing, bio-based production, nanomaterials – will transform the production and distribution of goods and services over the next 10 to 15 years.
- These technologies can bring large productivity gains, but this will require technology adoption and diffusion to accelerate, with complementary investments in workers and organisational skills and framework conditions that are conducive to experimentation and competition.
- Emerging economies face particular uncertainties as new technologies may challenge the traditional development path. However, they can also have opportunities to "leapfrog" dependent on scaling up technology adoption and building the necessary talent pool and digital infrastructure.
- Automation has so far not created massive job losses, but does lead to reallocations of employment between tasks, sectors and regions.
- Technological change shifts labour demand towards more cognitive skills for which many current workers are not adequately trained, contributing to the polarisation of the labour market and the hollowing out of middle-skill jobs.
- To help workers adapt and gain from the digital transformation, policies should focus on investing in skills at all levels, especially life-long learning, supporting transitions to new jobs, and adapting social protection systems and labour market institutions to new forms of work.
- Structural policies should also facilitate innovation and entrepreneurship to foster innovation and technology diffusion, ensure that competitive conditions prevail and avoid erecting barriers to cross-border digital markets.
- Rising interconnectedness calls for international dialogue in the design of policies for the future world of work in areas such as taxation, competition, R&D incentives and standard-setting.

This report first reviews the main trends in new technologies and their effects on productivity, business models and growth. It provides an overview of the implications of transformative innovations for the future of work, jobs and skills, before drawing the main policy implications.

New technologies will have major impacts on future employment, productivity and incomes

The path of the global economy is undergoing significant changes in the rate and composition of productivity growth, investment and employment gains since the crisis, including from digitalisation and globalisation, with potential for large economic gains but also major reallocation of activity between sectors and countries. This note focuses on the current and future impacts of technological change itself, keeping in mind that it could amplify or mitigate the effects of other ongoing "megatrends", including global economic integration as well as demographic and environmental challenges.

Digitalisation and technological innovations are changing the nature of production

A **confluence of new technologies** are already transforming the production and distribution of goods and services. Rapidly evolving technologies create considerable opportunities for productivity growth and improvements in well-being; but they also create considerable challenges for skills, employment, productivity diffusion and income distribution.

Among the main emerging technologies (Box 1; OECD, 2016a; OECD, 2017a):

- Digital technologies and data-driven innovation, based on big data analytics, increasingly permit machine functionalities that rival human performance in tasks such as pattern recognition. Cloud computing and the Internet of Things enable the development of autonomous machines and intelligent systems.
- Robots are set to become less costly, smaller, more intelligent, autonomous, and agile.
- Bio-based production brings the life sciences closer to engineering. This has already transformed the chemicals industry and could bring new solutions to dependence on oil and petrochemicals.
- Nanotechnology, through which new properties are being imparted to materials, makes them stronger, lighter, more electrically conductive, more versatile, etc.
- 3D printing has potential to revolutionise vast segments of manufacturing from mass production to customisation and already permits printing of complex objects made from different materials.

Most of these technologies have not yet reached widespread industrial application. The diffusion of new innovations tends to be "S shaped", with few early adopters followed by a rapid wave of adoption. Some innovations are reaching households at increasing speed: for instance, it took 35 years for a quarter of the US population to use the telephone after it was invented and 15 years for the personal computer, but only 7 years for the internet and 4 years for the smartphone. But, the adoption of new technologies by firms remains uneven. This suggests that we may be at the cusp of a new era of radical transformation if the take-up of new technologies rapidly expands beyond pioneering firms, but there is **high uncertainty** about the evolution of technology itself and how quickly and widely innovations will be put to commercial use.

Box 1. Disruptive production technologies

Many technological breakthroughs will disrupt the way goods and services are produced and distributed over the next 10 to 15 years, requiring potentially radical adaptation in business models, skills systems and policies. New advances in digital technologies, data science, new materials are already used in production and more transformational technologies are on the horizon in a range of industries (OECD, 2016a; OECD, 2017a).

The ***Internet of Things*** (IoT) is spreading rapidly and promises a hyper-connected, digitally responsive society. By 2030, it is estimated that 8 billion people and maybe 25 billion active "smart" devices will be interconnected and interwoven in one huge information network (OECD, 2015d). The largest impacts are expected in healthcare, manufacturing (with sensors enabling comprehensive supply chain intelligence) and network industries. According to Vodafone (2015), the IoT reduces industrial costs among industrial adopters by 15% on average. How fast and how effectively the IoT will evolve over the next 15 years depends to a large extent on the roll-out of fixed and mobile broadband and the decreasing cost of devices, as well as on the ability of businesses to build data analytics capacity.

Big data analytics is a set of techniques and tools to process and interpret large volums of data, including data mining, profiling, business intelligence, machine learning and visual analytics. The exploitation of big data, in combination with sensors and the IoT, will become a key determinant of innovation and competitiveness for individual firms. It allows firms to closely monitor and optimise their operations, not only by gathering large volumes of data on their production processes or service delivery, but also on how customers approach them and place orders, allowing them to eliminate errors, reduce inventories and speed up delivery. It also provides consumers with more personalised products and services that are specifically tailored to their needs. Firm-level evidence suggests that using data-driven innovation can raise labour productivity by 5 to 10% relative to non-users (OECD, 2015d).

Artificial intelligence (AI) refers to the ability of machines and systems to perform a broad variety of cognitive tasks, such as sensing, processing oral language, learning, making decisions and manipulating objects accordingly – using a combination of big data analytics, cloud computing, IoT and machine-to-machine communication. AI is expanding the roles of robots, which have been traditionally limited to monotonous tasks requiring speed, precision and dexterity; more autonomous and agile AI-enabled robots are set to become increasingly central to logistics and manufacturing. Sectors that are likely to experience radical transformations include agriculture, chemicals, oil and coal, rubber and plastics, shoe and textile, transport, construction, defence, and surveillance and security. For instance, autonomous drill rigs could increase mining productivity by 30% to 60% (Citigroup-Oxford Martin School, 2015). AI will also be increasingly deployed in a wide range of services including entertainment, medicine, marketing and finance.

Nanomaterials display unique optical, magnetic and electrical properties that can be exploited in various fields, from healthcare to textile ("smart fabrics"), construction (functional building materials such as self-cleaning concretes) and energy technologies. Areas of application already encompass medicine, imaging, energy and hydrogen storage, catalysis, lightweight construction and UV protection, and the spectrum of commercially viable applications is expected to increase over the next few years. However, both the development of nanomaterials and their commercialisation have expanded much more slowly than initially anticipated in the 1980s. Technical constraints and uncertainties over their toxicity to humans and the environment continue to hinder the development of cost-effective, large-scale commercial applications of nanomaterials.

Synthetic biology draws on engineering principles to manipulate genetic materials in living organisms. It allows for the design and construction of new biological parts and the re-design of natural biological systems. It is expected to have a wide range of applications in energy (e.g. relatively low-cost transport fuels), medicine (e.g. vaccine development), agriculture (e.g. engineered plants) and chemicals (bio-based production of new materials), but it also raises major legal and ethical issues.

3D printing or additive manufacturing encompasses different techniques that build products by adding material in layers, often using computer-aided design software. 3D-printing processes are primarily used for rapid prototyping, models and tools. More recently, as materials, accuracy and the overall quality of the output have improved, 3D printing has widened its scope of application. The technology allows for design flexibility, the personalisation of highly complex samples and components, reduced waste, and can remove the need for assembly in some stages of production. It is set to bring about new products in health, medicine and biotechnology, as well as metal processing in the automotive, defence and aerospace industries. However, this technology must overcome both technical and regulatory challenges if it is to permeate industrial processes on a large scale.

These technologies build on and feed into each other. For instance, cloud computing enables the IoT, which generates large amounts of data for big data analytics, in turn fuelling advances in machine learning and AI, etc. Many of these technologies are still at an early stage of commercial application compared to the potential they offer, but the IoT, big data analytics and artificial intelligence are – or will likely become in the near-future – pervasive enabling technologies, which could accelerate the pace of change. Besides technical constraints, some of the challenges that will need to be met are dealing with privacy and security risks and filling gaps in IT and data science skills.

The **digital transformation** is affecting the way the economy and societies operate, propelling changes in the scale, scope and speed of businesses and the structure of markets. The storage of information in digital binary form – bits rather than atoms – has made data easy to store and costless to share. As a result, digitalisation has considerably reduced several costs of economic exchange, changing the models for value creation (Golfarb and Tucker, 2017; OECD, 2015d):

- *Search costs*: low search costs facilitate exchange (often enabled by digital platforms) improve the quality of matches and enable unused capacity to be filled more efficiently, but have not eliminated price dispersion. The ease of finding and comparing information online could either facilitate the discovery of new, unknown products or generate "superstar" effects depending on the industry.
- *Replication costs*: digital goods have close to zero marginal costs and are non-rival. Their availability and pricing therefore depends on legal and technical tools to make them excludable.
- *Transportation costs*: as the costs of long-distance communication and the costs of distributing digital goods approach zero, distance should matter less for economic transactions.
- *Tracking costs*: low costs of tracking consumer behaviour enable personalisation and targeting, while raising privacy issues. This has led to widespread use of personalised targeted advertising, but there is limited evidence to date that it may have resulted in price discrimination among consumers.
- *Verification costs*: low costs of verifying identity and reputation of online and offline businesses (e.g. rating systems) may have reduced the value of brands to convey information about quality.

In turn, these changes affect the structure and operation of markets. A **digital platform economy** has been growing rapidly, providing online marketplaces for information (e.g. Google, Facebook), goods (e.g. Amazon, eBay) and services (e.g. Uber, Airbnb). The digital economy gives prominence to **intangible capital** (intellectual property, algorithms, software, data) over tangible capital (OECD, 2018). The falling cost of gathering, storing and managing data has made it easier to extract usable meaning from vast quantities of data – leading to an increasingly "data-driven" economy where data itself is a more valuable asset at the same time as it feeds into improvements in algorithmic intelligence and machine learning.

This intangible nature and the fact that digital products are replicable at low or no cost affect the **dynamics of entry and competition in digital markets** (OECD, 2018). On the one hand, it reduces the cost of innovation and creates opportunities for small-scale producers, for instance in the "app economy". In particular, cloud computing has given small firms access to computing power without large upfront investments; and online advertising and distribution drastically reduces marketing costs. This gives rise to **"scale without mass"** (Brynjolfsson et al., 2008) where digital players can grow large networks and markets in a short time with a small number of employees and few physical assets. It also creates opportunities for creative destruction at an accelerated pace; some formerly major digital players have exited the market after losing large market shares to new entrants. On the other hand, the digital economy features massive economies of scale, potentially creating **winner-take-most dynamics** in a range of industries. This may be reinforced by strong reputation and network effects, which foster digital market concentration, as well as economies of scope in data collection and analysis which may favour incumbents over new competitors where access to data is a driver of competitiveness.

Emerging technologies will profoundly affect the dynamics of productivity, investment and trade

The economic and policy ramifications of new technologies are far-reaching. The digital transformation is already shaping investment, trade, jobs and skills. The influence of further disruptive innovations is bound to rise as technological change accelerates, in confluence with other "megatrends" such as demographic changes and globalisation. However, the productivity benefits of new technologies may not accrue without efforts by firms and policymakers to speed up their adoption, foster productivity diffusion from the most innovative firms to the rest, and enable highly productive firms to grow. Policy conditions that favour experimentation and reallocation, as well as the availability of a high-quality talent pool for managers and workers, are critical conditions for technologies to spread and yield wide-ranging improvements in productivity and incomes.

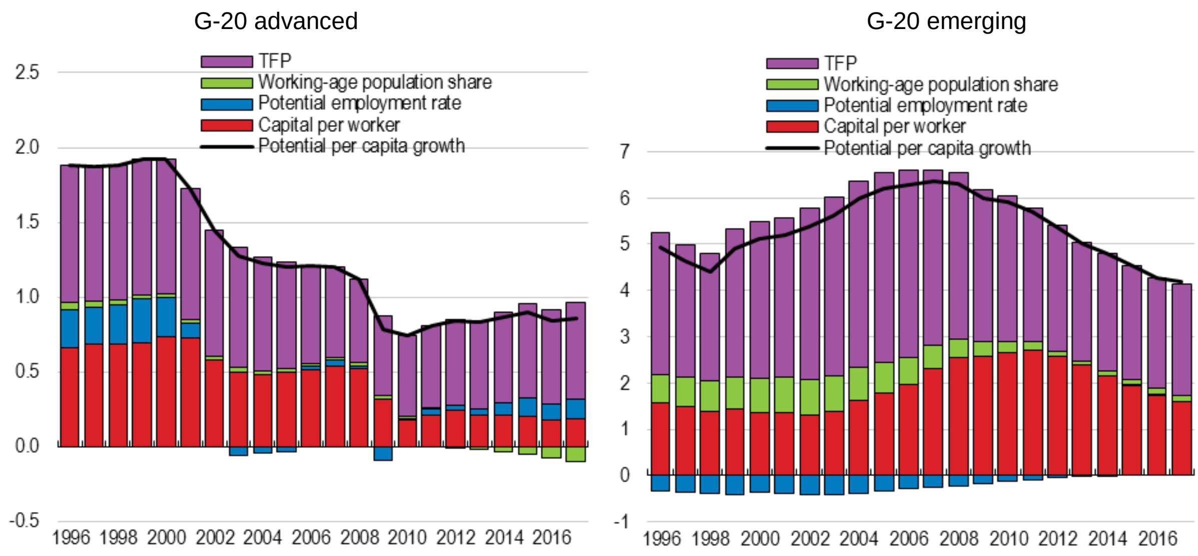
The productivity puzzle

Innovation is a catalyst for long-term productivity and income growth. The digital transformation and the new wave of transformative production methods are based on general purpose technologies, like electricity or the steam engine in past industrial revolutions, that can radically improve methods of production, but require a potentially long period of adaptation and adoption as well as a successful process of "creative destruction".

Information and communication technologies (ICT) have been a driver of productivity growth since the 1990s in the United States, but at a slower pace since the crisis and less so in other economies (OECD, 2015a; Bloom et al., 2012). As advanced economies converge towards the frontier, growth should become increasingly innovation-driven; while for emerging economies that have come less far along the convergence process, the ability to successfully absorb already developed technologies is key to raise productivity and speed structural change.

However, new technologies do not appear to have materialised in the aggregate productivity numbers so far. Instead, recent decades have witnessed a **"productivity slowdown"**, reflecting both slower capital deepening and weaker growth in total factor productivity (Figure 1). A pessimistic view holds that this reflects a permanent slowing pace of innovation and a less drastic impact of the ICT revolution compared to previous waves of general-purpose technologies (Gordon, 2012). The more optimistic view is that the underlying rate of technological progress has not slowed, but the potential of emerging technologies has yet to be exploited as realising its productivity benefits requires adaptation in organisational structures (Brynjolfsson and McAfee, 2011). Mokyr (2016) argues that the discoveries of the past decades, starting with advances in computing, will fuel a positive feedback loop between scientific and technological progress that will result in accelerating innovation and sustained growth. Measurement challenges related to the digital economy, in particular for the accurate measurement of intangible capital services and knowledge-based inputs, could also have led to misestimate the rate of productivity growth. The debate between these arguments is far from settled. The potential of advances in ICT to propel growth in the future remains uncertain in part due to the uncertain outlook for sustained innovation at the frontier, but more importantly depending on adoption lags and long-term penetration rates of such technologies.

Figure 1. Contribution to potential output growth per capita



Note: G-20 advanced includes Australia, Canada, France, Germany, Italy, Japan, Korea, the United Kingdom and the United States. G-20 emerging includes Argentina, Brazil, China, India, Indonesia, Mexico, Russia, South Africa and Turkey. Decomposition based on a Cobb-Douglas production function, using the population aged 15-74 years. The productive capital stock excludes housing investment.

Source: OECD Economic Outlook database; and OECD calculations.

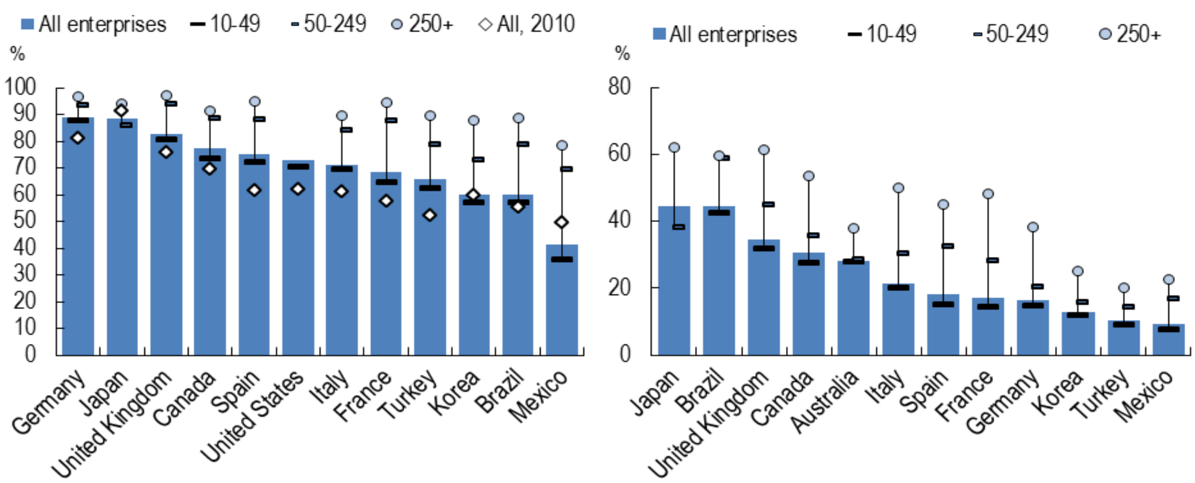
Adoption and diffusion of new technologies and complementary investments

The **pace of adoption and diffusion** will drive the extent to which the emergence of breakthrough innovations can lead to accelerating productivity. While the use of ICT tools has steadily progressed in recent years, **the uptake of new technologies by firms remains uneven** (Figure 2). Most firms in advanced economies now have a broadband connection and a webpage or a website, but advanced ICT applications such as enterprise resource planning software, cloud computing and big data are used in only a minority of businesses, usually the larger enterprises (OECD, 2017b).

Figure 2. The uptake of digital technologies is uneven across firms and countries

% of enterprises in each employment size class, 2016

Enterprises with a website or home page | Enterprises using cloud computing services

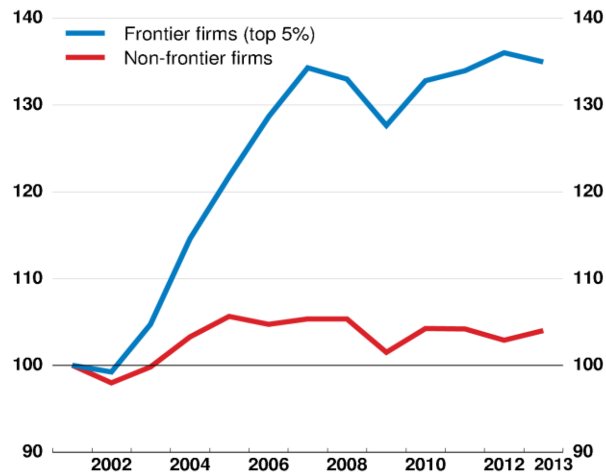


Note: Data refer to manufacturing and non-financial market services enterprises with ten or more persons employed

Source: OECD ICT Access and Usage by Businesses database, http://oe.cd/bus.

Figure 3. A widening labour productivity gap between global frontier firms and other firms

Labour productivity: value added per worker, index 2001=100



Note: Based on 24 OECD countries for manufacturing and business services, excluding the financial sector, for firms with at least 20 employees. Frontier firms are the 5% of firms with the highest labour productivity by year and 2-digit industry.

Source: Andrews et al. (2016).

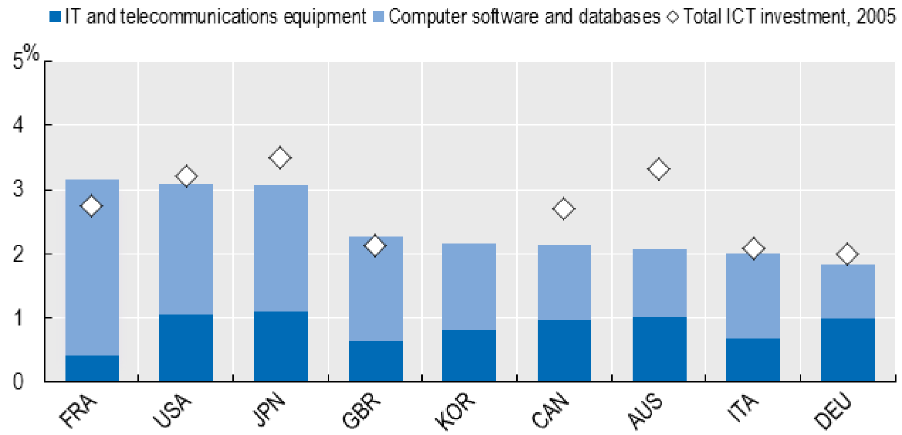
The slow pace at which innovations spread from early adopters throughout the economy is likely to fuel the growing divergence between firms that are global leaders and the rest (Andrews et al., 2016). While frontier firms have been forging ahead with innovation and robust productivity growth since the early 2000s, the productivity of non-frontier firms has largely stagnated, weighing on aggregate productivity growth (Figure 3).

Harnessing the potential of new technologies to galvanise economies requires closing the divide between frontier and lagging firms, with enterprises investing in complementary assets, including intangible capital, and adapting their business models; workers acquiring new skills; and countries developing their digital infrastructure and adopting favourable framework policies.

- ***An enabling environment*** that facilitates the entry and growth of highly productive firms as well as the exit of unproductive ones. Firms are better able to learn from the global frontier in more open trade and investment regimes, where they can build and leverage global connections. As market scale helps firms grow in the digital economy where marginal costs are close to zero, lifting barriers to cross-border transactions can contribute to fostering innovation. Policies that enhance competition mitigate the productivity divergence between leading firms and laggards, whereas entry barriers in product markets stifle the diffusion process (Andrews et al., 2016). Successful adoption is also helped by policies that do not stand in the way of firms experimenting and scaling up, such as flexible labour market policies and tax regimes that encourage early-stage equity finance (Andrews et al., 2018).

- ***Physical and intangible capital***. New technologies are in part embodied in physical assets as well as intangible assets, and require practical investigation and tacit knowledge to implement. Investments in knowledge-based capital – such as R&D, databases, intellectual property and organisational capital – underpin innovations and facilitate the absorption and implementation of new ideas. For instance, local R&D is key to incorporate and adapt foreign technologies to local conditions. However, the accumulation of knowledge-based capital has slowed down since the early 2000s (OECD, 2015a). Following the onset of the financial crisis, fixed asset investment sharply declined although KBC investment was somewhat more resilient.

Figure 4. ICT investment by asset, % of GDP, 2015



Source: OECD, Annual National Accounts Database, http://www.oecd.org/std/na, Eurostat and national sources.

- ***Organisational change and managerial skills***. Realising the gains from general-purpose technologies often entails restructuring organisational forms and rethinking business models. In turn, this requires considerable managerial skill. Empirical evidence suggests that an economy's speed of productivity convergence is positively related to the quality of its managerial capital (Andrews and Westmore, 2014; Bloom et al., 2012). The scarcity of managerial skills can be a serious constraint to successful uptake of technologies, particularly in emerging markets.

- ***Access to talent and complementary skills*** is a critical condition for the successful adoption of new technologies and best practices. Upgrading ICT skills of the workforce, including for non-ICT specialists, favours the adoption of digital technologies, with targeted training for the low skilled being particularly effective (Andrews et al., 2018).

- ***Digital infrastructure***. Fully benefitting from digital technologies requires comprehensive, reliable and secure telecommunications infrastructure, including high bandwidth broadband, wireless networks and mobile and landline telecommunications networks. Providing coverage to remote rural areas, particularly in large countries, will facilitate the development of integrated domestic markets (OECD, 2017b).

In sum, the invention and dissemination of new technologies that transform the nature of production have tremendous potential to lift global productivity growth, but there are large unexploited opportunities, particularly among smaller firms, and it could take considerable time for such technologies to spread. This creates high uncertainty about how much their productivity potential can yield tangible gains in the next 10-15 years.

Learning how to use technologies, as well as accessing the complementary skills, will be a particular challenge for firms in developing economies that stand further from the technological frontier or where **technologies developed elsewhere may need to be adapted to local conditions** (such as limited telecommunications infrastructure or unreliable power supply, but also availability of skilled operators and local demand). Over a long time period, adoption lags for major new technologies have converged across countries, but long-run penetration rates once technologies are adopted have diverged between advanced and developing countries (Comin and Mestieri, 2017).

Emerging markets with large **informal sectors** may also face particular challenges to harness the potential of new technologies. Informal firms are typically characterised by low managerial skills and face particularly acute difficulties in access to finance (La Porta and Shleifer, 2014). The lack of access to credit may constrain their ability to invest in physical and intangible capital as well as training of their workers. On the other hand, some aspects of the digital transformation, for instance e-payments and mobile payments, may encourage businesses to formalise (McKinsey Global Institute, 2016).

The international division of labour and development paths

Technological progress and **globalisation** have in the past reinforced each other, with trade facilitating the diffusion of innovation and technological advances lowering trade costs. The fragmentation of production in **global value chains** (GVCs) since the 1990s has been enabled by drastic reductions in the costs of ICT and has in turn reinforced channels for international knowledge-sharing. For small enterprises, digital technologies reduce the cost of finding buyers abroad, making it easier to grow through exports at early stage and enabling some firms to be “born global”.

The structure of GVCs has shifted in the past two decades, with some manufacturing value chains pivoting away from traditional high-income centres of production towards increasingly being centred around emerging economies in Asia. Advanced economies remain central in services value chains, though IT services have become more influential in production networks for all countries. Being a hub in GVCs with access to a large variety of foreign inputs remains associated with faster diffusion of knowledge and productivity catch-up of non-frontier firms (Criscuolo and Timmis, 2017).

Technological trends such as digitalisation, automation and 3D printing are likely to bring further changes to the landscape of global trade. **The reconfiguration of global value chains could create disruptions for emerging economies** that rely on industrialisation as a path to catch-up. There are concerns that the digitalisation of production could reverse the importance and length of GVCs and reorient global production and trade back towards advanced countries (**"reshoring"**). Evidence of reshoring is limited to date, but concerns are rising that robotics, automation, computerised manufacturing and artificial intelligence could in the future reduce the advantages of production in emerging economies, at the same time as technologies such as 3D printing could tilt the scales towards small-scale localised production. As a result, **new technologies could erode the cost advantage of emerging economies in low-tech manufacturing** as a source of jobs and growth along their development path. The risk of premature deindustrialisation may challenge the feasibility of catch-up through climbing the manufacturing ladder. A forward-looking exercise based on the formulation of different scenarios for the next 10-15 years indicates that the future of GVCs may be different than in the past (DeBacker and Flaig, 2017).

On the other hand, the digital economy and new production technologies could offer large emerging economies new **opportunities to "leapfrog" the traditional development path**. Leapfrogging technologies could be facilitated where some emerging economies may not be encumbered by existing (legacy) regulations or large incumbent players that may create obstacles to the growth of the digital economy and new business models in more advanced economies. Some successful examples are mobile banking in Africa or digital IDs in Estonia, and the jump to optic fibre and mobile internet access skipping over the copper stage. Kenya and Nigeria are more advanced in mobile banking than many OECD countries. In 2015, 45% of Kenya's GDP was transacted through M-PESA, a mobile money transfer and financing service (AfDB/OECD/UNDP, 2017) and formal banking in Kenya has tripled from around 26% in 2006 to 75% in 2016 (Central Bank of Kenya, Kenya National Bureau of Statistics & FSD Kenya, 2016)

Proficiency in new production technologies, particularly those most suited to conditions in developing countries, may in fact be the only way to avoid a widening gap between technologically advanced countries and others. For example, certain state-of-the-art robots are relatively inexpensive and do not require highly skilled operators; China is already one of the world's largest users of industrial robots. Digitalisation is also widening the scope of services trade and creating new models to connect businesses to overseas clients. It has allowed, for instance, India to grow an internationally competitive IT and business services sector before d[eveloping a strong manufacturing base. But, **developing countries will face numerous challenges to avail themselves of these new opportunities**. It will be critical to upgrade production systems, skills and telecommunications infrastructure on which future competitive advantages will build, in order to speed structural transformation and avoid falling behind in the absorption of new technologies.

The technologically-driven shift of global businesses may challenge growth and job prospects around the world, but particularly in some developing regions with lower technological readiness. Latin America, Southeast Asia and many developed regions, which have ageing and often relatively well-educated populations, may be better placed to jump on the bandwagon of new generation supply chains. On the other hand, consolidated and technologically-enhanced value chains create a particular challenge for regions with fast-growing working age populations, such as sub-Saharan Africa or South Asia (OECD, 2017j). Despite significant improvements in technological readiness in Africa (especially mobile phone penetration), gaps with advanced economies and ASEAN are large and have been growing. Africa is lagging on broadband speed as only 1.4 percent of Africans have a fixed broadband connection. Lack of high-speed connectivity is a critical bottleneck for developing new models of production, which are inevitably built on the infrastructure of the digital revolution. Even the most tech-savvy countries in the region – South Africa, Mauritius, Botswana, Namibia, and Kenya – are still far behind in adopting ICT technologies (AfDB/WB/WEF, 2017).

This will impact the world of work as activities evolve, new business models emerge, returns to skills change and the structure of employment adapts

New production technologies will play an important role in determining the **availability, nature and quality of jobs**. How widely the dividends from higher productivity are shared when they arise will be critical in a context where inequalities have increased in many countries over the last decades. The future of work will undoubtedly generate unparalleled opportunities for new and more productive jobs, but also wide-ranging disruptions and risks for the inclusiveness of growth, as some skills become obsolete while others are in high demand, and as jobs are destroyed in some industries and regions while others emerge elsewhere. This section focuses on the consequences of automation and digitalisation as the two technological trends most likely to impact the future of work.

Trends in inequality and labour compensation

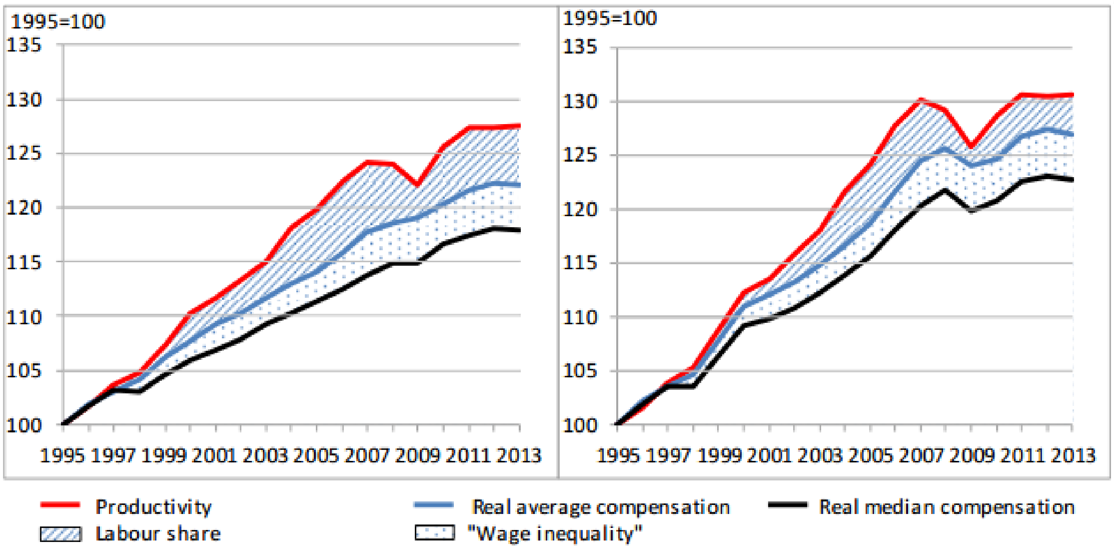
Income inequality has risen over the last three decades in advanced economies, with a broad pattern of rapidly rising incomes at the very top and stagnation at the bottom. In OECD countries, the top 10% of the income distribution earned about seven times the income of the bottom 10% in the mid-1980s; this ratio has increased to almost ten times by the mid-2010s, and the Gini coefficient for the area increased over the same period. In emerging economies, the picture is more contrasted: since the 1990s, income inequality has risen in South Africa and China, but it has declined in several large Latin American economies albeit from high levels.

Technological change is likely to have contributed to widening labour earnings inequality by shifting labour demand towards the high-skilled ("skill biased technical change") and towards less automatable low-skill tasks. It may also have contributed to the **reduction in the share of labour in income**, the failure of wage growth to keep up with productivity growth in both manufacturing and services (Figure 5). Evidence on the drivers of the decline in the labour share remains limited, but some studies suggest that advances in ICT lowering the cost of investment goods (Karabarbounis and Neiman, 2014), as well as "scale without mass" and "superstar" dynamics unleashed by digitalisation and globalisation (Autor et al., 2017) have played a role. Regional inequalities may also be exacerbated by the adoption of technology; for instance in the United States, regions most exposed to the adoption of robots saw large negative effects on employment and wages (Acemoglu and Restrepo, 2017).

Figure 5. The decoupling of wages and productivity

A. Total Economy

B. Excl. primary, housing and non-market sectors[1]



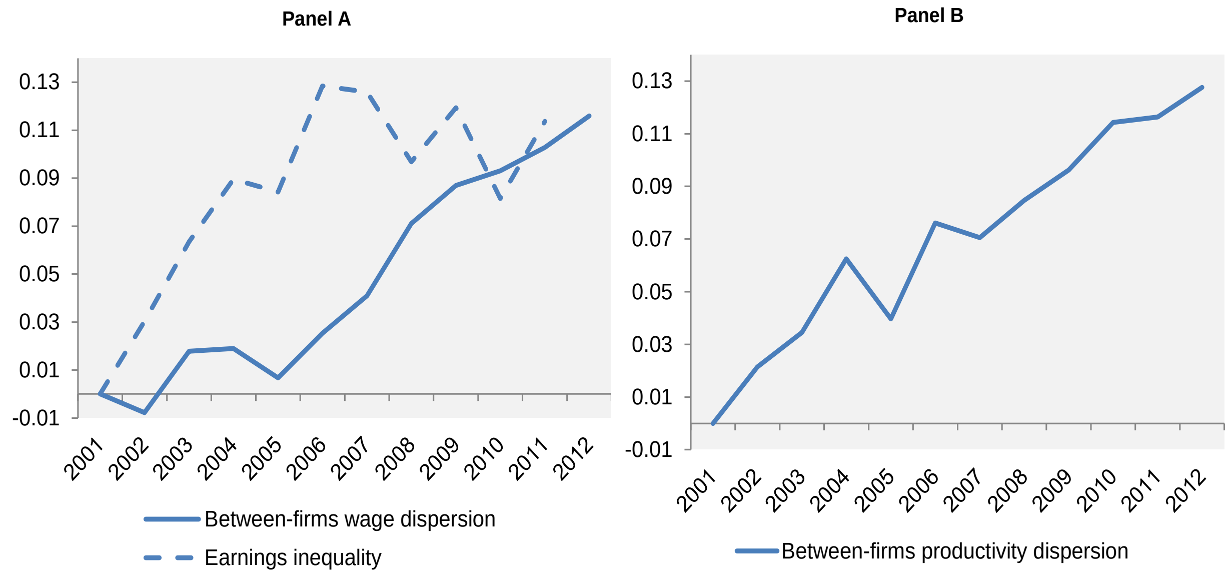
1. "Wage inequality" refers to total economy due to data limitations.

Note: Unweigthed average of 24 OECD countries. In Panel A, all series are deflated by the total economy value added price index. In Panel B, all series are deflated by the value added price index excluding the primary, housing and non-market sectors.

Source: Schwellnus et al. (2017).

Hence, it will not only be a challenge to realise the productivity benefits of new technologies throughout the economy; it will also be necessary to ensure that workers widely share in these benefits. These challenges are interwoven in a **"productivity-inclusiveness nexus"** (OECD, 2016g): OECD research suggests that wage dispersion is linked to the productivity dispersion between firms (Figure 6; Berlingieri et al., 2017) with both globalisation and digitalisation strengthening this link. Some features of the digital economy that may lead to higher market concentration could potentially exacerbate this trend. Frontier firms have been better placed to lock-in superior productivity performance, which may have translated into larger wages paid to their employees, accounting for part of the increased earnings inequality across firms. Higher income inequality in turn constrains the ability of low-income groups to contribute to economic growth, hindering their ability to invest in quality education and skills throughout their lives and that of their children. Unequal countries also do show larger skill mismatch, with significant negative effects on productivity. In addition, large inequalities jeopardise future growth and productivity potential through low labour force participation, low employability as well as marginal attachment to the labour market.

Figure 6: Wage and productivity dispersion



Note: The line plots the average additional dispersion (log difference between 90th and 10th percentile) in a given year compared to 2001, controlling for specific country-sector fixed effects, using data from AUS, AUT, BEL, CHL, DNK, FIN, FRA, HUN, ITA, JPN, NLD, NOR, NZL, SWE for wages and productivity; and AUS, FIN, FRA, HUN, ITA, JPN, NLD, NOR, NZL, SWE for overall earnings.

Source: Berlingieri, Blanchenay and Criscuolo (2017).

Shifts in the demand for skills

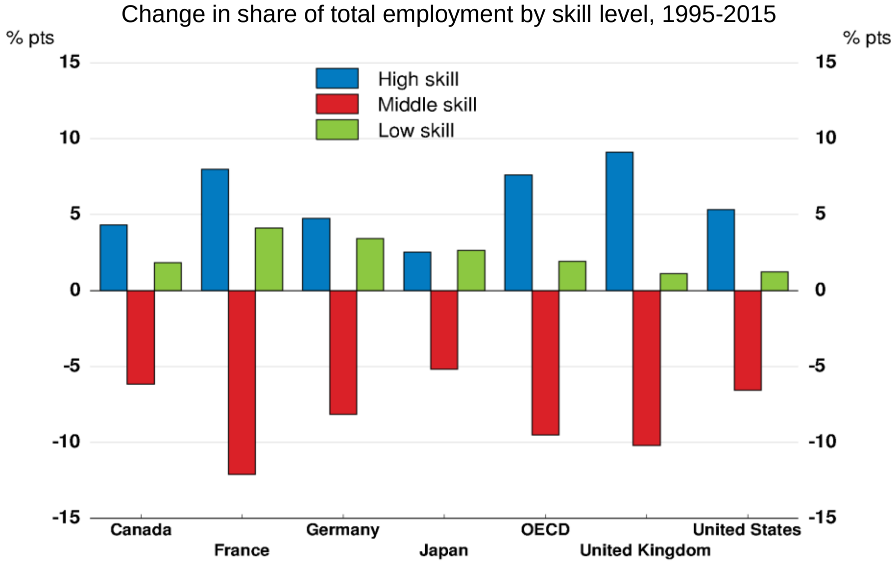
Digitalisation and automation will alter the demand for skills as some tasks and jobs are automated, jobs are created in new activities and employment shifts between firms and across sectors. **Technological advances increasingly require cognitive skills**, such as the interpretation, analysis and communication of complex information and problem-solving, while automation is reducing the demand for basic and manual skills in the manufacturing sector. Workers performing "routine" tasks tend to be at higher risk of losing their jobs to automation.

Using micro-level indicators on tasks actually performed by individuals in their jobs (which accounts for the large variation in task content within occupations), it is estimated that 14% of jobs on average in the OECD are at a **high risk of automation** in the next 15 years, with more than 70% automatibility.. A much larger share of jobs – around one third – will see significant change in tasks and how tasks are carried out. Among G-20 countries covered by these estimates, the share of jobs thwt could see more than half of their tasks automated ranges from about 37% in the United States and the United Kingdom to 54% in Germany and Japan and close to 60% in Turkey. Automatibility strongly decreases in the level of education and income of the workers. At the same time, **the pace and depth of change are uncertain**, as they depend on the speed of technological change and of diffusion of technologies throughout the economy as well as on policy reponses. On the one hand, job automatibility may be overestimated insofar as the methodology (based on Arntz et al., 2016) reflects expert assessment of technological capabilities rather than the actual utilisation of such technologies, and workplaces may also adjust the content of jobs to a new division of labour where with workers increasingly perform tasks that are complementary to new technologies. On the other hand, faster than anticipated advances in machine learning and artificial intelligence may expose a wider range of tasks than expected to automation risk. The extent to which task automatibility translates into job losses will also depend on whether workplaces are able to adjust the mix of tasks performed by workers to new demands as much as in past episodes, where workers tended to shift within occupations to new tasks that are complementary to machines.

OECD evidence suggests that to date, **job losses have centred on people with mid-level skills who perform routine tasks** (Figure 7; OECD, 2017f). Shifts in skills demand, whether due to technology, trade or consumer preferences, thus lead to labour market polarisation in advanced economies with a decline in the share of middle-skill jobs, relative to high-skill jobs that are complementary to technology and low-skill service activities. Empirical research has confirmed that so far ICT, while having largely neutral effects on total employment, has played a role in job and wage polarisation in advanced economies (Autor and Dorn, 2013; Autor et al., 2015; Michaels et al., 2014). The trend is less clear for emerging economies, where middle-wage occupations such as service and construction jobs are likely to see net job growth, although in China alone more than 100 million workers could need to learn new skills and switch occupations if automation is adopted rapidly (McKinsey Global Institute, 2017).

Figure 7: Job polarisation by country

Change in share of total employment by skill level, 1995-2015

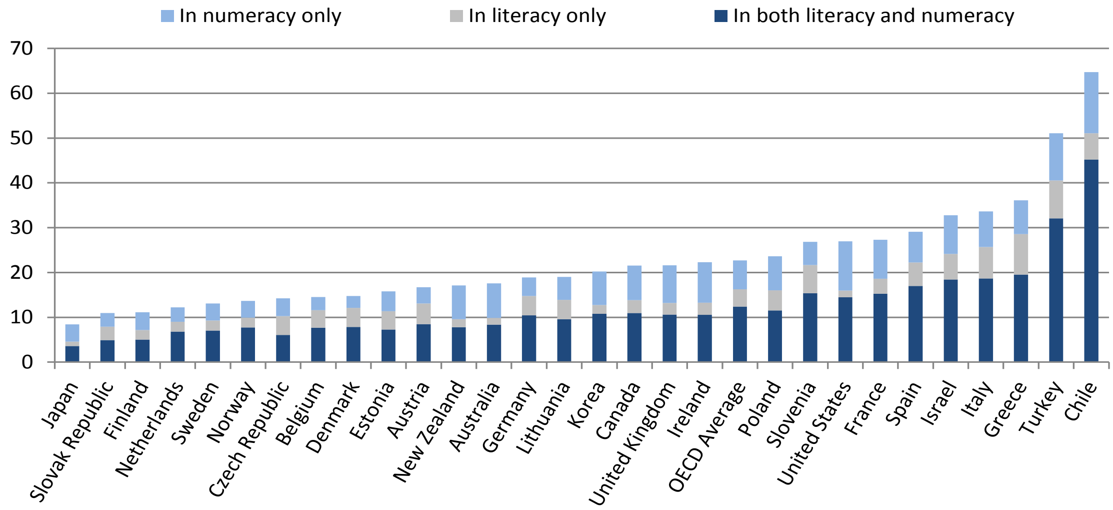


Note: OECD is the unweighted average of 24 countries. For Japan, 1995-2010.

Source: OECD Employment Outlook 2017; European Union Labour Force Survey; Labour force surveys for Canada, Japan and the United States; and OECD calculations.

This phenomenon and the associated squeezing of the middle class have been sources of major anxieties in a number of advanced economies. **Many current workers are not equipped with the adequate skill set** for technologically advanced activities. Data from the PIAAC Survey of Adult Skills show that, on average across the 33 participating countries and regions, 55% of workers lack the basic problem-solving skills that are needed in a technology-rich environment. More than 20% of workers in OECD countries lack the basic literacy and numeracy skills that provide the basis for future learning (Figure 8). In advanced economies, 42% of the workers using office productivity software at work every day lack the ICT skills required to use these technologies effectively (OECD, 2017b). This makes reskilling and upskilling crucial for new production technologies to bear fruits for workers. It will be a particular challenge for emerging economies to upgrade education and workforce training, in order to meet skills needs that shift from manual dexterity and basic functional skills towards more cognitively intensive abilities such as data analytics, problem solving and critical thinking.

Figure 8. The proportion of low performers in literacy and/or numeracy, workers



Source: OECD, *2017 Skills Outlook*, calculations based on the Survey of Adult Skills (PIAAC) (2012 and 2015), www.oecd.org/skills/piaac/publicdataandanalysis.

In the absence of such efforts, the future of work risks turning into a missed opportunity with rising inequalities and deepening skills mismatches. Improvements in workforce training to adapt to emerging skill needs only help diffuse the benefits of technology if these skills are effectively used in the workplace. Evidence based on the OECD Survey of Adult Skills shows that on average across countries, **one-quarter of workers report a mismatch between their skills and those required for their jobs** (Adalet McGowan and Andrews, 2015). A better alignment of skills and jobs will therefore be critical to realise productivity gains from new technologies.

Shifts in the structure of employment

In advanced economies, new technologies as well as globalisation have created fears of massive job dislocation as manufacturing sectors, former purveyors of "good jobs" for low and mid-skilled workers, have shrunk. Empirical analysis indicates that so far, **ICT and robotisation have led to restructuring but have not resulted in greater unemployment** (OECD, 2016d; Autor et al., 2015; Dauth et al., 2017). A permanent decrease in the cost of ICT capital reduces labour demand per unit of output, but progressively leads to lower prices and new products, higher aggregate demand and higher employment, thus offsetting at least some of the initial job displacement. More generally, **automation** is likely to lead to job losses in the short-term and in the directly exposed industries as new technologies makes some jobs redundant, but in the longer term, through productivity spillovers and aggregate income gains, raise the demand for other jobs and encourage the creation of new labour-intensive tasks (Acemoglu and Restrepo, 2016, 2017; Autor and Salomons, 2017; Gregory et al., 2016).

However, automation and the digital revolution shifts overall labour demand from manufacturing to services. In advanced economies, OECD analysis indicates that **technology and shifts in consumer preferences** have been the main drivers of losses in manufacturing jobs (OECD, 2017e). In emerging economies, the manufacturing share of employment appears to be now peaking at levels well below those that were experienced by advanced economies in early stages of development. Rapid advances in automation may further limit the potential of manufacturing to provide jobs for the young people entering the labour market every year. The challenge of absorbing workers in increasingly digitalised and automated manufacturing and services sectors is compounded in countries that experience large shifts of the workforce out of a modernised agricultural sector.

It follows that technological disruptions imply a significant **reallocation of employment between activities**. This may give rise to complicated transitions for workers and create distress in some regions where there are fewer opportunities to adapt. The regional concentration of manufacturing employment makes regions less resilient when hit by sector-specific shocks to the manufacturing sector, whether originating from technological change or import competition. **Adjustment costs** for workers are likely to be significant and may be borne disproportionately by the low-skilled, compounding the social costs of adapting to change. There is no guarantee that the benefits of stronger productivity, when they materialise, will be broadly shared unless an ambitious policy response is undertaken (OECD, 2016g).

Shifts in the nature of jobs

New technology is also facilitating new forms of **non-standard employment**, such as in the 'gig' economy. Non-standard employment is not a new phenomenon: involuntary part-time employment accounts for about 5% of total G20 jobs and self-employment 17%. More than half of new job creation since the mid-1990s in advanced economies has taken the form of non-standard work, including temporary contracts, part-time employment and on-call work, and self-employment (OECD, 2015b). The share of informal employment in emerging G20 economies remains close to 50% and the share of casual work is high in some of them (ILO, 2016). But new digital technologies and applications are reducing the transaction costs of linking workers with employers on a global scale, thus facilitating the creation of new forms of work.

Job platforms such as TaskRabbit provide a marketplace for low-skill physical tasks, mostly carried out on an occasional basis. Others, like Upwork, Freelancer or Nubelo, enable digital services online, matching demand and supply across different countries and over a wider range of tasks, from data entry or administrative support to high-skill tasks like programming, legal advice or business consulting. Internet job platforms could dramatically change traditional work arrangements and labour market relationships, though the few existing estimates suggest that the share of workers engaging in such work remains low to date (OECD, 2016h) and may be levelling off as traditional labour markets strengthen (JP Morgan Chase & Co, 2016). Platforms have contributed to job creation in a time of economic crisis and may create further job opportunities in lagging regions while mitigating skills shortages in dynamic areas. Internationally, the reduction of information barriers in online platforms appears to disproportionately benefit developing countries' workers (Agrawal et al., 2016). For platform employers, the main advantages are the access to a larger pool of skills and experience, faster execution of the tasks contracted out and lower costs for hiring, administration and facilities. Looking ahead, increased flexibility may give workers more control over how much, when and where they work, providing greater opportunities for under-represented groups such as women and senior workers to participate in the labour market.

There is however large heterogeneity among workers in the platform economy, and these benefits may come with costs. Platform-based workers may work longer hours to do many tasks in parallel, may have lower work satisfaction, fewer work-related benefits, less access to training as well as experiencing earnings losses between contracts (OECD, 2016h; ILO, 2016). These new forms of work therefore raise serious **questions about the quality of future jobs**, and will challenge existing social protection systems and labour institutions.

Policy needs to evolve and adapt to meet these challenges

Improving investment in skills at all levels, especially life-long learning

The ongoing digital transformation, together with advances in automation technologies, is deeply affecting the labour market and is **changing skill needs**. In OECD countries, around one in two workers has very basic or no problem-solving skills to work in a technology rich environment. Rapidly changing skills needs raise the risk of skills mismatch and shortage, both of which have significant economic costs. Education systems will need to provide higher levels of non-routine cognitive skills, complex problem solving, creativity, as well as foster stronger socio-emotional skills.

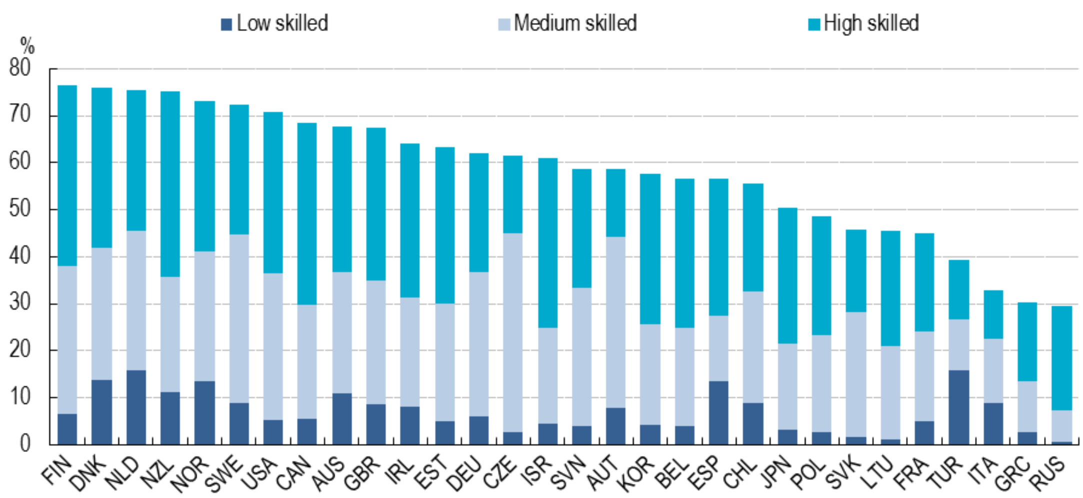
Longer working lives and technological change will make **adult learning** even more important to give workers – and especially low-skilled workers – opportunities to upskill and reskill. Countries should encourage on-the-job training, certification of skills acquired through work experience, better skills use in the workplace and improved skills assessment and anticipation systems. The digital transformation may also provide new education, training and learning opportunities, especially online. However, the share of Internet users who followed an online course in 2016 was below 15% in 30 out of 35 countries for which data are available (OECD, 2017b). It will be important for governments to promote digital literacy, soft skills and generic skills – to foster adaptability to the jobs of the future.

In addition, governments need to make sure that **right people are trained**. Individuals who are in most need of life-long learning are the low-skilled, who are most likely to lose their job as a result of the trends described above, least likely to find a new job once displaced, and least likely to take advantage of new job opportunities that arise. But the **least-skilled are also those receiving least training**. (OECD, 2017c; Figure 9).

Fiscal policies can also encourage skills development. Recent OECD analysis finds that the use of tax expenditures to encourage skills formation, while widely used in different forms in most OECD countries, often come with significant efficiency costs and are generally regressive. Funding skills through direct government spending and student loans will generally be the most efficient and equitable approach (see OECD, 2017g).

Figure 9. Workers receiving firm-based training, by skill level

As a percentage of total employed persons



Source: OECD (2017c) based on the Survey of Adult Skills (PIAAC) (2012 and 2015).

Supporting the transition of displaced workers and affected regions

As with previous major technological innovations, the digital transformation will be economically and socially disruptive. In particular, it will lead to significant reallocation in the labour market, with important job gains and job losses in sectors and regions.

Governments need an **effective activation framework** which: (i) motivates jobseekers to actively pursue employment; (ii) improves their employability; and (iii) expands the set of opportunities for them to be placed and retained in appropriate jobs (OECD, 2015c). Intervening early is particularly important, since this has been found to be the most cost-effective way to provide support to displaced workers. Strong activation policies can help countries mitigate some of the inevitable adjustment costs of moving towards more globalised and technologically advanced economies. The new forms of work that are emerging may, however, hinder the ability of countries to enforce the principle of mutual obligations given that monitoring work activity will become much more difficult. In many ways, this parallels the challenges that many emerging economies already encounter due to the existence large informal sectors.

Adapting social protection systems and labour market institutions

Countries will also need to adapt or design social protection policies for emerging forms of work. While many countries were already struggling to provide adequate cover for workers on non-standard work contracts, the advent of the platform economy has added to these difficulties as an increasing number of workers only work occasionally and/or have multiple jobs and income sources, with no statutory working hours or minimum wages. Many of them do not even have worker status. Current social security systems are still largely based on the notion of a unique employer-employee relationship. Adapting social security systems to the new world of work may require a fundamental paradigm shift, where **entitlements are linked to individuals rather than jobs**, and where they are portable from one job to the next.

New approaches may include individual accounts, universal basic income programmes, and new technological tools that enable better service delivery, administration, and identification of needs. Such an approach would also encourage labour mobility, since current arrangements may lock individuals in to their existing job out of fear that moving would result in a loss of their entitlements. Because this is an area where policy makers may have to go back to the drawing board, **emerging economies might have an advantage** in that they may be able to skip an entire stage in the development of their social protection systems. Some emerging economies have already been doing this by introducing social protection mechanisms which break the traditional link between entitlement to benefits and specific patterns of work (usually full-time on a permanent contract) and job search (e.g. Bolsa Familia in Brazil and Prospera in Mexico).

The emergence of new forms of employment also raise questions about the future role and coverage of labour market institutions, like the minimum wage, employment protection legislation, working time regulations and regulations to safeguard occupational health and safety. It will therefore be critical that countries examine their legal framework to determine whether it needs to be updated and adjusted in order to provide some form of minimum employment protection for all workers (including those in new forms of employment). The trick, however, is to do this without unnecessarily stifling innovation in the way work is organised and carried out.

Structural policies to facilitate innovation, entrepreneurship and reallocation of workers and capital

The widening of productivity differences across advanced economies between leading and lagging firms suggests that many firms are not yet able to turn the potential of new technologies into stronger productivity performance.

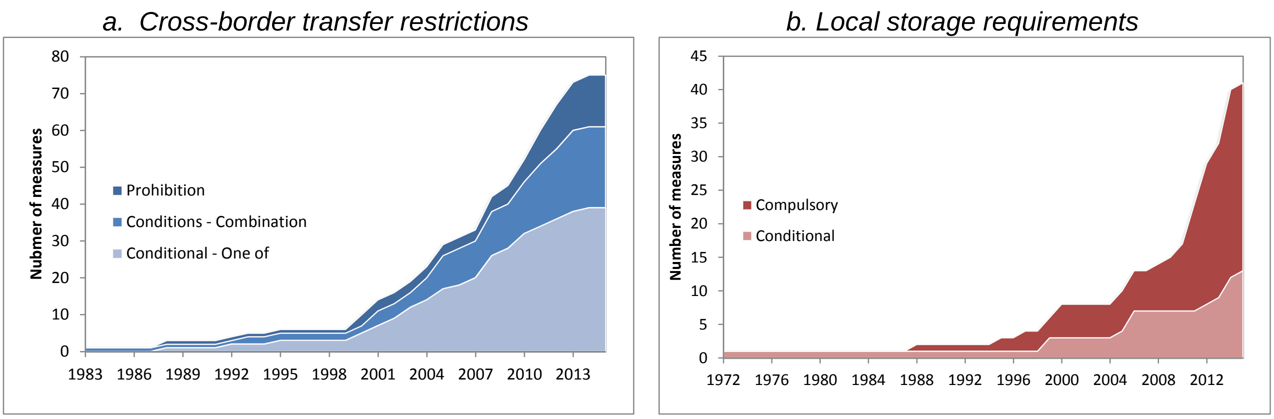
Making sure that the benefits of innovations are more broadly shared in the economy will require **facilitating the diffusion of technology**. The challenge is twofold. First, it is about increasing new-firm entry and the growth of firms which are major carriers of new technology. Secondly, it is about increasing productivity in established firms which face obstacles to implementing technology. Ensuring sound competition is key in allowing new firms to challenge incumbents, efficient firms to grow, and inefficient ones to exit. This in turn requires **open trade, well-designed product and labour market regulations, and insolvency regimes** that do not unduly inhibit corporate restructuring and penalise entrepreneurial failure. Effective use of new technology also requires that workers have appropriate skills to use the technology; that firms invest in new business models, organisational change and innovation. SMEs face particular challenges in the use of ICT, while having important opportunities, such as the development of "born global" small firms. Comprehensive national digital strategies that take into account policies that facilitate access to finance, engagement with competency centres and/or technology extension services, can be helpful for SMEs. In some emerging and developing economies, overcoming "supply side" (e.g. lack of broadband access, competition) and "demand side" (e.g. income and skill levels) obstacles is important to fully reap the benefits of digitalisation for inclusive growth.

For emerging economies, receiving foreign direct investment has been a vector of technology diffusion and job creation. A challenge will be that **the drivers of FDI attractiveness are likely to shift**, as labour costs become less important while digital infrastructure, intellectual property protection, regulation on data and cybersecurity, availability of local services become more decisive (OECD, 2017a). MNEs in sectors relying more on digital activities and intangible assets may at the same time become more critical for countries and workers to learn from the frontier and more "footloose", leading to increasing competition between countries to attract FDI. Countries may need to adapt their investment policies to this new environment, as well as to update international investment agreements for newly emerging industries.

Trade policies for the digital economy

The digital transformation is enabling firms to adapt their business models to respond rapidly to changing demand, increasingly tailoring solutions that combine goods and services. The distinction between goods and services is becoming increasingly difficult and porous, with consequences for how we think about trade and market openness in a digital world. Data now form an integral part of the production process in many industries and firms, are an asset that can be traded and a means to deliver services. The growing volume of data exchanged across borders has given rise to concerns about security, the protection of privacy, and audit and regulatory reach. This has in turn led to restrictions on cross-border transfers of data, or requirements that data be stored locally (Figure 10). Digital technologies change trade relationships, between and within goods and services. There can be substitution effects – as when streaming services replace DVDs (goods). Or combinations of goods and services, as when a business sends plans for a toy to a consumer who 3D prints it abroad – in which case, a design service crosses the border, but ultimately produces a good. This raises questions for trade policy about whether trade rules covering goods (more liberal) or services should apply.

Figure 10: Stock of identified data measures



Source: OECD.

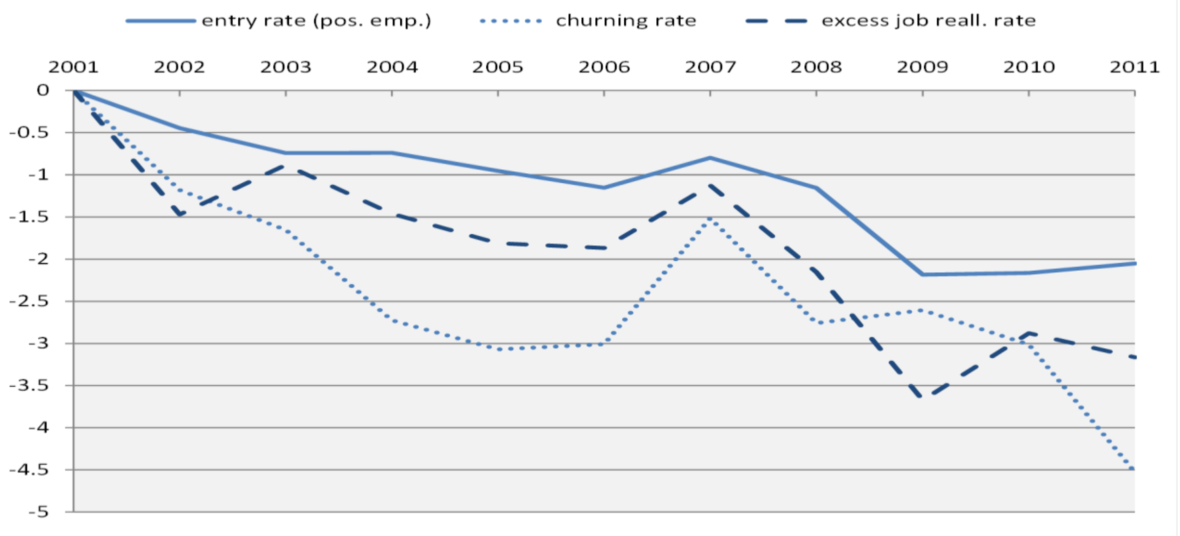
Competition policies and regulation

Well-functioning competition is key for the diffusion and adoption of new technologies. The digital transformation has enabled the creation of new markets, has blurred the boundaries between sectors and has the potential of increasing cross-border transactions, increasing competition and yielding substantial consumer benefits. These gains are not only likely to be captured by countries that control high-tech industries. For instance, thanks to cloud computing even less developed countries can benefit from the computational power across borders from advanced software developed in other countries. But new technologies and globalisation can only bring their full benefits in an inclusive manner if competition is fair in a well-functioning market.

Other trends led by the transformation may have unclear effects on competition**. Some features of the digital sector, such as economies of scale and scope and network effects, can favour the emergence of dominant firms** (e.g. related to big data, platforms, computer algorithms)**.** There is some evidence suggesting that economies of scale and scope and network effects may be a greater challenge for maintaining competition than previously realised. Recent OECD research shows that business dynamism has decreased and that this decline has been stronger in ICT manufacturing and services (Figure 11). Moreover, there is evidence that mark-ups have been increasing (De Loecker and Eeckhout, 2017). While higher mark-ups could indicate an abuse of dominant positions, other more benign factors such as temporary restrictions to competition due to granted patents for innovators or higher quality products may also play a role. Therefore, care should be taken not to confuse market gains by more competitive companies and abuse of dominant positions.

Whether and how regulations and enforcement tools should be adapted in light of digital transformation is an open question. It will be important to remain vigilant and ensure a level playing field is maintained. Some regulations designedfor the offline economy may hinder efficient entry and exit of firms. In addition, different regulatory frameworks across countries can make it difficult and costly for companies to expand internationally, and regulations often restrict the circulation of data. International cooperation will be key to tackle enforcement challenges from cross-border digitalisation. This may include reinforcing information-sharing and investigation assistance, notably in order to prevent businesses from taking advantage of jurisdictional inconsistencies.

Figure 11. Business dynamism has decreased



Source: OECD (2017h).

Addressing growing interdependencies in innovation and knowledge diffusion

Firms at the productivity frontier are global in nature, creating **challenges for national innovation policies**. R&D incentives and intellectual property regimes may need to be better coordinated at the international level to provide a level playing field and incentivise frontier innovation which has public good characteristics. Innovation at the frontier partly depends on basic research, which drives fundamental advances in technological knowledge; however, **basic research may be underprovided** due to difficulties in appropriating the full benefits (Akcigit et al., 2014). Governments, both as buyers of technology – e.g. through defence projects – and as funders – e.g. of research in universities and public research centres – provide significant knowledge spillovers to private innovation.

Rising international connectedness and the key role of MNEs in driving frontier R&D imply that the benefits from public basic research and support to private R&D will become more widespread globally. This may weaken incentives for national governments to support these activities. Global mechanisms to support basic research, such as joint funding and mechanisms to facilitate cross-border and cross-field collaboration, may become increasingly relevant to push the frontier. It is also important to promote **open voluntary standards and standards-based interoperability**, particularly for the development of technologies such as the IoT and smart manufacturing where machines need to be able to communicate with each other seamlessly (OECD, 2017d).

Tax policies

Technological advances and the changing world of work will change the functioning of tax systems and its impact on the income distribution. It will be crucial for tax policy to strike the right balance between inclusiveness, incentives and fairness. In addition, international tax policy will have to ensure a level playing field between firms.

Technological change will likely have profound impacts on the distribution of income. Tax policies will have to be adapted to ensure **inclusive growth** and to deliver sustainable revenues. Tax policy has the potential to address some of the underlying components of rising inequalities for example through its impact on skills development and use, on savings behaviours and on business dynamism. There are also opportunities to make growth-enhancing shifts in tax mixes (Akgun, Cournède and Fournier, 2017).

In addition, the effectiveness of progressivity of the tax system needs to be looked at again with respect to both labour and capital income (Causa and Hermansen, 2017). Depending on the current levels of personal income taxes, countries may need to raise marginal tax rates and lower tax wedges for low-skilled workers (including through earned-income tax credits) in case there is still leeway in that direction. In reforming personal income taxes, countries need to counter the risks associated with the mobility of high-income earners as well as tax avoidance. Stronger progressivity of taxation could also be achieved by increasing effectiveness of capital income taxation and by broadening tax bases. In addition, the potential of other taxes on wealth and property could be further explored.

Insofar as the digital transformation is changing forms of work within countries, policymakers should examine the tax treatment of non-standard forms of work compared to that of standard, full-time employment, in order to ensure equity and fairness. The same can be said of social contributions in order to ensure the viability of social insurance programs into the future.

Digitalisation has given tax administrations new opportunities to modernise and increase efficiency, raising tax compliance and creating the means for more inclusive spending policies. There are two sides to this. First, digitalisation has led to the greater collection of data in electronic form, including on payments and parties to transactions. Where tax administrations can access this information (which may require greater international cooperation) it can lead to the recovery of previously unpaid tax, increases in taxpayer registration and the shrinking of the informal economy. Second, tax administrations can also benefit from new technologies and tools in their own operations, both by improving efficiency and effectiveness and enabling the reduction of administrative burdens on taxpayers, in particular through embedding tax compliance into taxpayers' natural systems (such as happens with personal income tax for employees in many jurisdictions through pay-as-you-earn processes).

The emergence of new business models and changes in the value chain as a result of digitalisation of the economy raises important questions for **international taxation.** Digitalised businesses rely on the intellectual property for their business models, enabling them to be very big in a market even if they have little physical presence in that market – scale without mass. Identifying how and where value creation takes place is necessary to align the location where profits are taxed with the location where the underlying economic activities generating those profits take place. Some of these aspects may exacerbate the risks of base erosion and profit shifting (BEPS) for tax purposes. Purely domestic firms are not able to take advantage of the same tax planning strategies facilitated by BEPS as Multinational Enterprises, tilting the playing-field against local businesses and non-tax aggressive MNEs. The long-term solution is through **international tax co-operation**.

Better measurement of digitalisation and the changing world of work

Designing better policies for the future world of work requires further efforts to improve measurement and evidence, including on the spread of digital technologies and their impact on labour markets. G-20 economies can usefully work together to further develop cross-country comparable metrics on business use of sophisticated digital technologies (e.g. cloud computing, big data analytics and emerging areas such as the IoT). Some areas where enhanced data collection could help better assess the effects of new technologies on workers include the measurement of ICT skills across G-20 countries, the evolution of non-standard employment including platform work, tracking shares of workers in growing and declining jobs, as well as shortages and surpluses in skills most affected by technological change. G-20 economies could consider cooperating to further develop internationally comparable statistics and fill the data gaps in those areas, particularly for emerging markets. This would provide a better evidence base for international dialogue and for the the identification and prioritisation of reforms taking into account each economy's level of development.

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