BLUEPRINT SERIES 30

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Georgios Petropoulos, J. Scott Marcus, Nicolas Moës and Enrico Bergamini

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Digitalisation and European welfare states

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Contents

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Foreword

Rapid technological progress and innovation can destroy jobs. This is not a new concern. Throughout history, with a great speeding-up during the Industrial Revolution, automation of production processes has led to efficiency gains and to the displacement of labour. But history has also shown that, in the longer run, gains in efficiency pay off and new jobs are created. Overall the balance has been broadly positive. Currently, in the post-crisis European Union, employment rates are high, signalling good news for the bloc's welfare states, which largely rely on taxes and levies on employment for their funding.

But the past is not necessarily a guide to the future. The unprecedented digitalisation of our economies continues. Artificial intelligence has become a reality and machines are able learn how to outperform humans in some cognitive tasks. Once again, workers fear their jobs will be lost to machines, and the digital revolution has still to play out, meaning their fears cannot be dismissed. The way work is performed is also changing, with jobs allocated via online platforms and people matched to tasks in a way that means they are neither full-time employees, nor self-employed workers in the traditional sense.

This all has practical implications for welfare states. The European Union, where welfare-state spending is a substantial part of the economy, faces the major challenge of redefining the nature and functioning of its welfare states in the context of the fundamental changes brought about by digitalisation, artificial intelligence and the changing status of workers. EU policymakers must find answers to pressing questions: if technology has a negative impact on labour income, how will the welfare state be funded? How can workers'

welfare rights be adequately secured?

A team of Bruegel scholars, with the support of the Mastercard Center for Inclusive Growth, has taken on these questions. They find that the risk digitalisation poses to jobs should not be overstated. For sure, it will change the nature of work, but will lead to the reallocation of workers from existing jobs and tasks to new ones, with the potential for an overall positive effect. However, the share of national income going to labour appears to be falling and the funding of welfare systems needs to be rethought. EU countries will have to make critical choices about their welfare systems in the next few years. This volume will help them to focus on the core issues.

Guntram Wolff, Director of Bruegel
Brussels, June 2019

1 The future of work: an introduction

Rapid technological progress and innovation can threaten employment. This is not a new concern. John Maynard Keynes in 1930 postulated his technological unemployment theory[1] on the loss of jobs caused by technological change. He noted that "*from the earliest times of which we have record – back, say, to two thousand years before Christ – down to the beginning of the eighteenth century, there was no very great change in the standard of life of the average man living in the civilised centres of the earth.*" But in the sixteenth century, scientific progress started to enable the development of new theories and technologies that would eventually lead to the Industrial Revolution.

Morris (2011) considered the most important of these technologies to be James Watt's steam engine in the second half of the eighteenth century. Prior to Watt, steam engines were highly inefficient, harnessing only about one percent of the energy released by burning coal. Watt managed to increase the efficiency of steam engines more than threefold between 1765 and 1776. That was the beginning of a period of technological progress that saw the birth of an industrial sector

1 Similar concerns have existed since at least the fourth century BC, when Aristotle, in his *Politics* said that the human condition largely depends on what machines can and cannot do: "*If every instrument could accomplish its own work, obeying or anticipating the will of others, like the statues of Daedalus, or the tripods of Hephaestus, which, says the poet, 'of their own accord entered the assembly of the Gods'; if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves.*"

that absorbed much of the workforce that left the agricultural sector – the first Industrial Revolution. Then, during the second Industrial Revolution, which is typically dated from around 1870, electricity, petroleum and steel became dominant. Telephones, lightbulbs, the radio and combustion engines are a few examples of inventions from this period.

During the Industrial Revolution, humanity overcame the limitations of human and animal muscle power and began to generate massive amounts of energy in a more efficient manner. That led to the development of mass production techniques, well-organised and efficient factory units, and railways and mass transportation systems – and to exploding populations, GDP, energy intensity, transport systems and greenhouse-gas emissions. Through these developments, standards of living were significantly improved and the foundations for modern life and the modern economy were built. But, such technological developments also created concerns about their impact on work. The Luddites, a group of English textile workers afraid of losing their jobs because of new labour-saving technologies, were the first to organise against technological advancements. Active in the second decade of the eighteenth century, they were suppressed by the British government, including through use of troops.

Keynes' technological unemployment theory is based on the increase in technical efficiency place faster than the problem of labour absorption can be dealt with. Nevertheless, Keynes concluded that this would be only a temporary misalignment because in the long-run the mankind is solving its economic problems.

Keynes, in fact, managed to correctly interpret the implications of such technologies. The experience of the Industrial Revolution showed that automation of production processes led to extraordinary efficiency gains but also resulted to the displacement of labour. The underlying pattern suggested that while in the short-run the displacement effect might dominate, in the longer run, the gains in efficiency pay off through the creation of more jobs. The introduction

of automobiles in daily transportation led to a significant decline in horse-related jobs. However, new industries emerged resulting in a positive impact on employment. It was not only that the automobile industry itself grew rapidly, increasing the available jobs in the sector. Jobs were also created in different sectors because of the growing number of vehicles on the roads. For example, new jobs were created in the motel and fast-food industries that arose to serve motorists and truck drivers[2].

After the second world war and the subsequent period of extraordinary growth and widespread welfare improvements, low levels of unemployment perhaps seemed to confirm Keynes' optimism about the solution to the economic problem, making the threat of technologic unemployment seem less urgent. But in the 1960s, automation and joblessness returned as a primary issue. In 1961, TIME magazine published 'The Automation Jobless', an article focusing on the possibility that automation would not create enough new jobs, in particular for unskilled workers increasingly replaced by machinery[3]. In 1962, US president John F. Kennedy said *"the major domestic challenge … of the 1960s* [is] *to maintain full employment at a time when automation … is replacing men"*[4]. In 1964, his successor Lyndon Johnson established the Blue-Ribbon National Commission on Technology, Automation and Economic Progress, to study the reciprocal interactions between productivity, labour and automation. The 14 members of the commission concluded that technological progress did not pose a crucial threat to American employment, on the basis that, as its chairman Howard R. Bowen reckoned, *"technology eliminates jobs, not work"* (Bowen and Mangum, 1966).

2 For further examples, see *The Economist* (2016) 'Automation and Anxiety', *Special Report*, 23 June.

3 *TIME*, 24 February 1961, available at http://content.time.com/time/subscriber/article/0,33009,828815-1,00.html.

4 Comments at a 14 February 1962 news conference; see https://www.jfklibrary.org/archives/other-resources/john-f-kennedypress-conferences/news-conference-24.

We are now going through an unprecedented digitalisation of our economy, in which computers and information technologies play a primary role. Thanks to rise of computing power we have been introduced to an era in which artificial intelligence has become a reality and machines are able learn how to become better and outperform humans in a series of cognitive tasks. Scientific development has progressed quickly, and combinations of different scientific fields have led to progress that was hardly thinkable by previous generations. While the transition from horses to automobiles as a means of transportation created plenty of jobs with the development of a new industry, we are now in a new transition phase towards self-driving cars. The crucial question is whether the efficiency gains from the new technologies will, as they did in the past, dominate this time or whether displacement of jobs will prevail.

Since the development of personal computers in the early 1980s, we have seen their transformative power in almost every sector of the economy. We are now at the beginning of an even larger and more rapid transformation because of recent advances in machine learning, which is capable of accelerating the pace of automation itself. While machine learning, a basic ingredient of the artificial intelligence (AI) era, is a general purpose technology, as was steam engine technology that led to the Industrial Revolution, it is not fully clear yet what its implications will be for workers and employment.

Will robots and AI steal our jobs? How far into the new technological revolution are we? Are we on the verge of it, or has it already changed the economy substantially? If the nature of our production processes is changing, what will work look like in the future? Will the welfare state be able to cope in the face of the digital revolution? In this Blueprint, we attempt to answer these questions from an economic perspective. Our focus is on the European Union and on the impact of digitisation, digitalisation and AI on the welfare state.

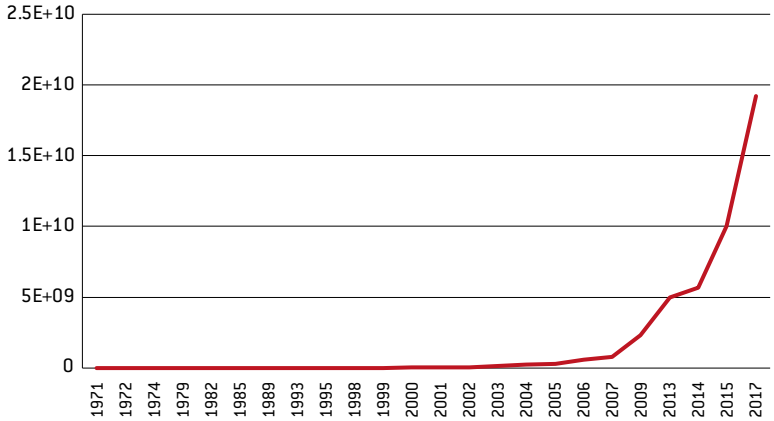
1.1 The speed of technological progress

In 2018, every minute of every day, there were 3.9 million Google searches, more than four million videos viewed on YouTube, twelve million text messages sent, 50,000 pictures uploaded to Instagram, almost half a million tweets written and more than a thousand items bought on Amazon[5].

Many technologies that were once unthinkable are now creating and destroying industries. They are so pervasive and ubiquitous they have changed the way we access information, communicate and work.

A number of well-known laws help to explain the pace of technological progress. Moore's Law has provided an accurate indicator of how many transistors, the semiconductors that serve as the building blocks of any electronic system, can be installed in the same space. Moore predicted that the number of transistors per circuit would double every two years. Figure 1.1 shows how the number of transistors per circuit has grown exponentially.

Figure 1.1: Moore's Law – number of transistors per circuit



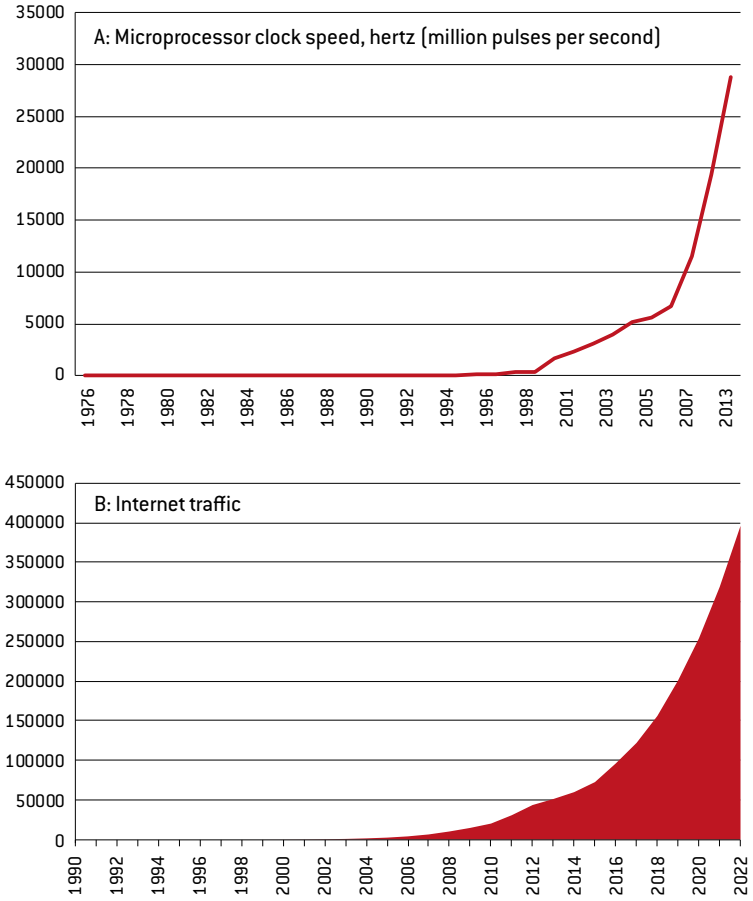
Source: Roser and Ritchie (2019).

5 *Domo*, 'Data never sleeps 6.0', available at https://www.domo.com/learn/data-never-sleeps-6.

The speed at which we can send information has also skyrocketed. Since the late 1990s, increased connectivity and broadband capacity have made it possible to exchange huge volumes of data in fractions of seconds.

Panels A and B of Figure 1.2 show the speed of microprocessors (measured in hertz) and the internet traffic volume, forecast to 2022.

Figure 1.2: Exponential growth in microprocessing speed and internet traffic

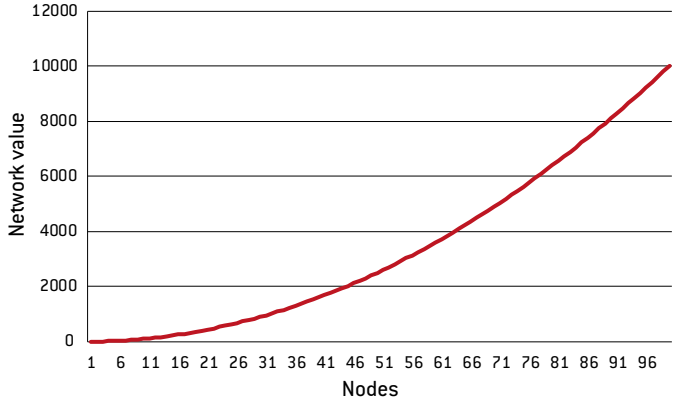


Source: Top panel: Roser and Ritchie (2019). Lower panel: Cisco (2018).

Since the invention of the internet, the number of connected devices has increased, and will increase much more with the development of the Internet of Things. Devices communicate thanks to the Internet Protocol (IP), which identifies and locates them on the network. The major version of this protocol, IPv4, set the theoretical limit for IP addresses to more than 4.2 billion (2^{32}). In 2017, to avoid the exhaustion of IP addresses, the latest version of the Internet Protocol (IPv6) was ratified as a standard, allowing for 2^{128} (or 3.4×10^{38}) IP addresses.

A further law, Metcalfe's Law states that being connected to a network becomes more valuable, in terms of possible numbers of connections to each node, with the square of the size of the network, while the cost of joining falls. As a result, online networks tend to get very big, very fast. Figure 1.3 shows the quadratic expansion in network value for each increase in the number of nodes.

Figure 1.3: Metcalfe's Law



Source: Bruegel.

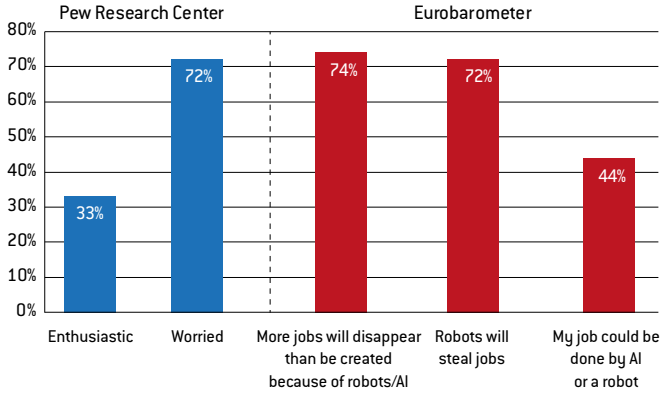
Another law shaping the Information Age has been dubbed Varian's Law after the chief economist of Google, Hal Varian: "*Digital components are free, while digital products are highly valuable. Innovation*

explodes as people try to get rich by working through the nearly infinite combinations of digital components in search of valuable digital products" (Baldwin, 2018). In this context, open-source software and open data are the staple building blocks of the value-generation chain for the digital economy.

1.2 Perceptions of technological change in Europe and the US

As we noted at the beginning of this chapter, technological development brings with it human concern about what the impacts will be. A 2017 Pew Research Center survey on technology and society found that 72 percent of Americans said they were worried when asked about a future in which robots and computers can do many human jobs. According to Eurobarometer data, 74 percent of Europeans feel that because of robots and AI, more jobs will disappear than will be created, while 72 percent think robots will steal their jobs. However, interestingly, a far smaller percentage believes that their own job is at risk: only 44 percent think that their job could be done by a machine or artificial intelligence (Figure 1.4).

Figure 1.4: Results of public opinion surveys, EU and US

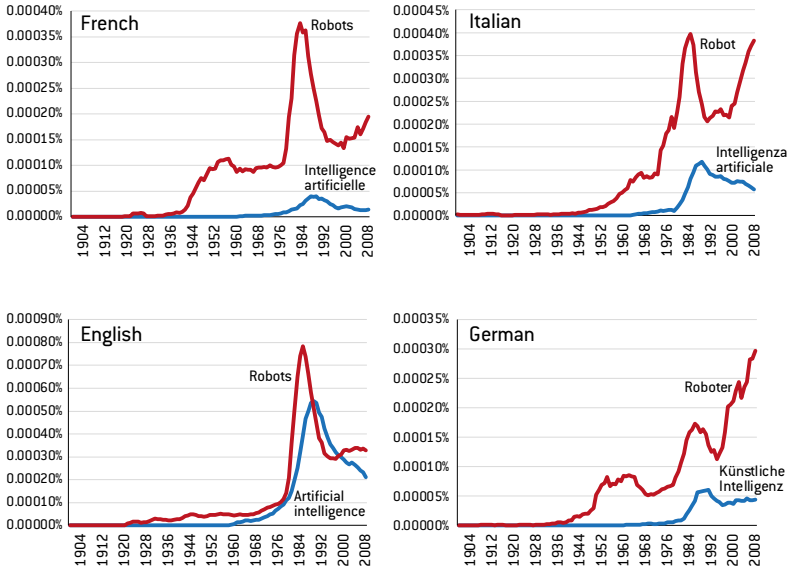


Source: Bruegel based on European Commission (2017), and Pew Research Center (2017).

Fast and Horvitz (2017) studied the perception of AI using the *New York Times* archives as a proxy for public opinion. They found an explosion of articles about AI after 2009, most containing optimistic perspectives. However, they also showed that concern about *"loss of control"* and a negative sentiment in articles about AI mentioning *"work"* increased after 2005.

We queried *Google Books*, which permits full text searches of all indexed works, for the terms 'artificial intelligence and 'robots' in four different languages (English, French, German, Italian). We found the frequency of use of the terms has risen since the 1970s, with spikes in the late 1980s (Figure 1.5). In the English-language books, the two terms were used with similar frequency, while for books in the other three languages, 'robots' is more common. In Italian and French-language books there was a relatively big spike for 'robots' in the late 1980s, followed by a sharp decline and a slower increase from the beginning of the 2000s. In Germany use of the term 'roboter' continued growing rapidly since the middle of the 1990s.

Figure 1.5: Frequency of the terms 'artificial intelligence' and 'robots' in books in selected languages



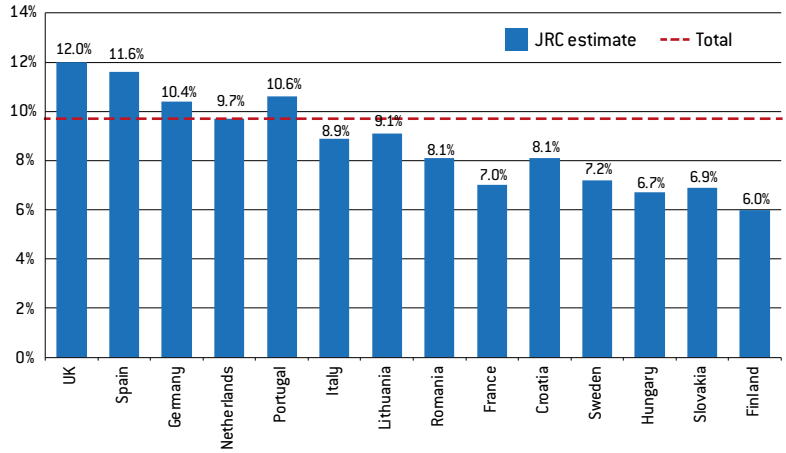
Source: Bruegel based on Google Ngram Viewer.

1.3 Platform work

Platform work, or work allocated via online applications, is an important emerging aspect of the digital revolution. With platform work, supply and demand for certain tasks are matched digitally. Pesole *et al* (2018) estimated the number of platform workers in Europe based on survey results from 14 member states. Figure 1.6 shows the fraction of the adult population that has ever performed platform work[6].

6 Any respondent who said that he or she had ever gained income from one of the two following online sources was deemed to have participated in platform work: *"providing services via online platforms, where you and the client are matched digitally, payment is conducted digitally via the platform and the work is location-independent, web-based"*; or *"providing services via online platforms, where you and the client are matched digitally, and the payment is conducted digitally via the platform, but work is performed on-location*".

Figure 1.6: Share of platform workers in the total labour force in EU countries



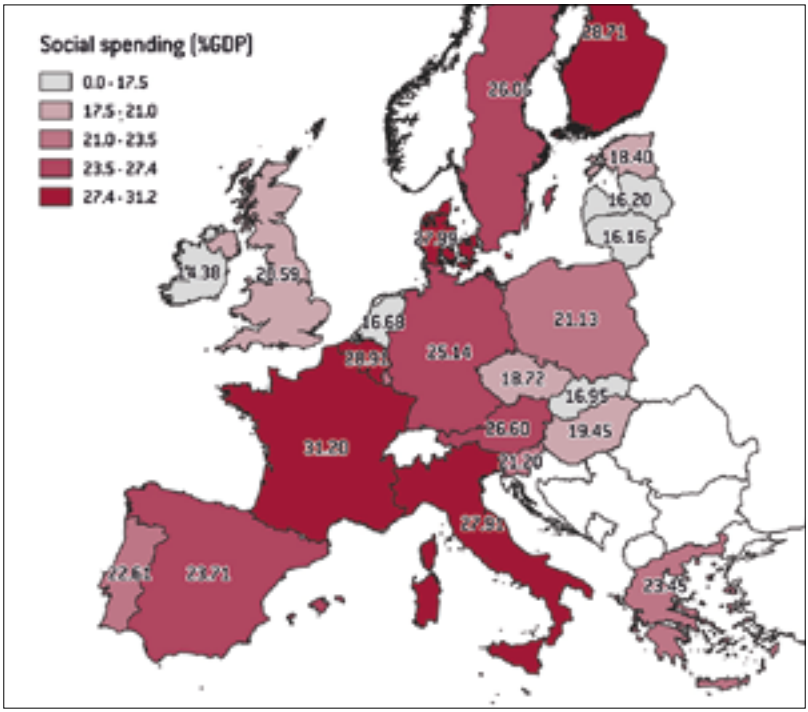
Source: Pesole *et al* (2018). Note: Fraction of the adult population that has ever gained income from platform work in surveyed EU member states, 2017 Data from the 2017 COLLEEM Survey.

Knowing that an individual gained income at least once from platform work tells us nothing about how important platform work is to the individual. Pesole *et al* (2018) estimated that only 6 percent of those who have gained income from platform work earn more than 25 percent of their income via platforms, and only 2 percent of those who have gained income earn more than 50 percent of their income via platforms.

1.4 The labour market

Chapters 4 and 5 examine the debate on the impact of these new technologies on the labour market and on welfare states. Current technology-related developments should be viewed in the context of the numbers for general employment in Europe returning to pre-crisis levels. Employment rates at the time of writing are exceptionally high, which is good news because welfare states are to a significant degree funded from taxes and levies on employment. Welfare state spending is a substantial share of GDP in the European Union, amounting to 31.2 percent in France, 27.9 percent in Italy and 25.1 percent in Germany (Figure 1.7).

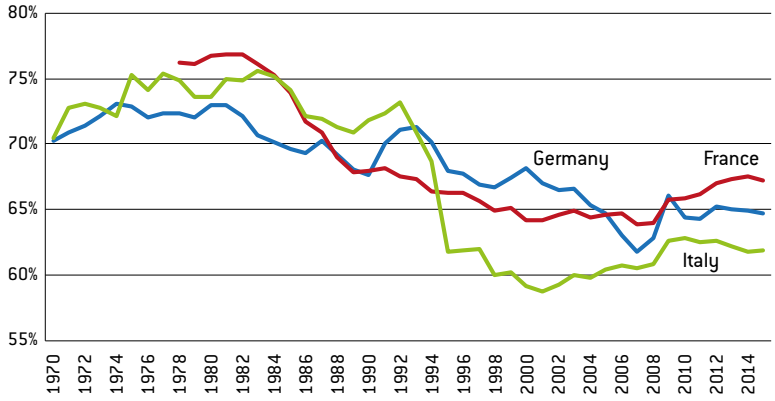
Figure 1.7: Social spending in Europe in 2018 (percent of GDP)



Source: Bruegel based on OECD data.

But despite high employment, the share of national income going to labour appears to be falling around the world and in the EU (Figure 1.8). The trend is clear for Germany, Italy and France. This distribution of national income raises the question of who is taxed to fund the state and the welfare state in particular.

Figure 1.8: The declining labour share of national income



Source: Bruegel based on EU KLEMS (http://www.euklems.net/).

In fact, revenues from taxation of capital income have been quite constant for the past forty years – despite a rising share of capital income. Accordingly, the average and the marginal tax rates on capital income have fallen quite significantly. Overall, labour income taxation and value added taxation continue to make up the bulk of state finance.

The labour market is changing, and the very nature of work is transforming under the pressures of scientific and technological progress and of globalisation. How will changes to employment contracts affect the welfare state? And if technology has a negative impact on labour income, how will the welfare state be funded? The key question then becomes how taxation of capital income should be rethought. It is exactly in this context that there is a growing need for a debate on the

readiness of welfare states to adapt.

One of the key challenges of the twenty-first century will be to redefine the nature of welfare states, the way they are constructed and function, in light of the fundamental changes brought about by AI and other aspects of the so-called Fourth Industrial Revolution. This book aims to make a contribution to this debate.

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2 Automation and employment

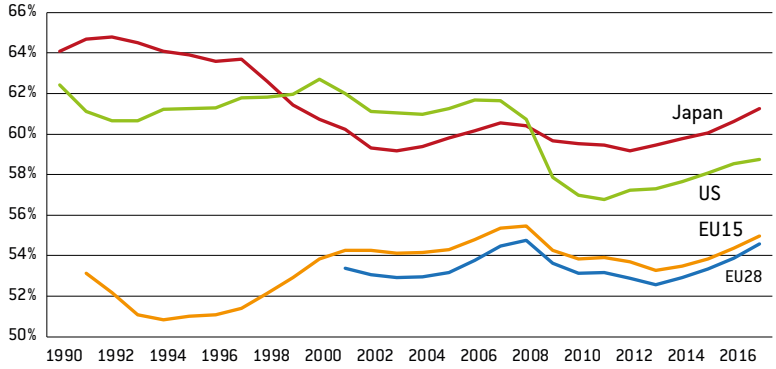
Technological development, and in particular, digitalisation, or the use of digital technologies to change a business model and provide new revenue and value-producing opportunities, has major implications for labour markets. Assessing the impact of digitalisation on employment is very important as a basis for deriving specific policy recommendations that can lead to the efficient functioning of the labour market for the benefit of workers, employers and society as a whole.

In this chapter we review the impact of automation on labour markets so far. We begin by reporting some relevant empirical facts on labour markets and technological progress and we then provide insights from general equilibrium theory and its empirical counterparts on the impact of automation on employment.

2.1 Underlying trends in EU labour markets

The employment rate in Europe and in the world has been volatile depending on macroeconomic factors that have impacted the economy. In Europe specifically, after the major overturn during the euro-area crisis, the employment rate is again increasing towards the pre-crisis levels (Figure 2.1).

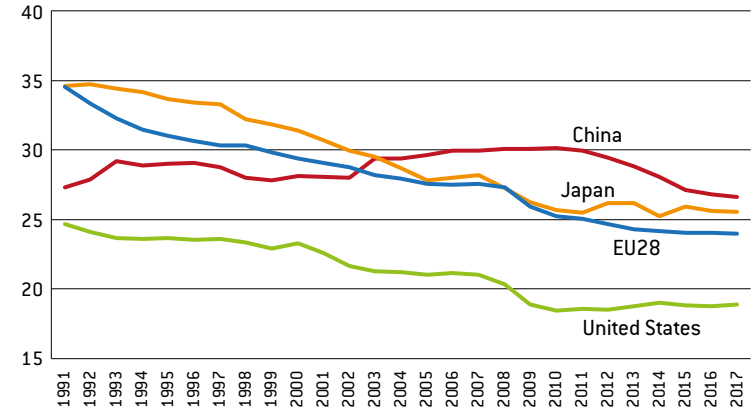
Figure 2.1: Total employment (% of population 15 years old and over), 1990-2016



Source: Bruegel based on AMECO (NETD, NPAN and NPON).

However, the same does not apply in the industrial sector, including manufacturing, mining and quarrying and supply of electricity, gas and water.

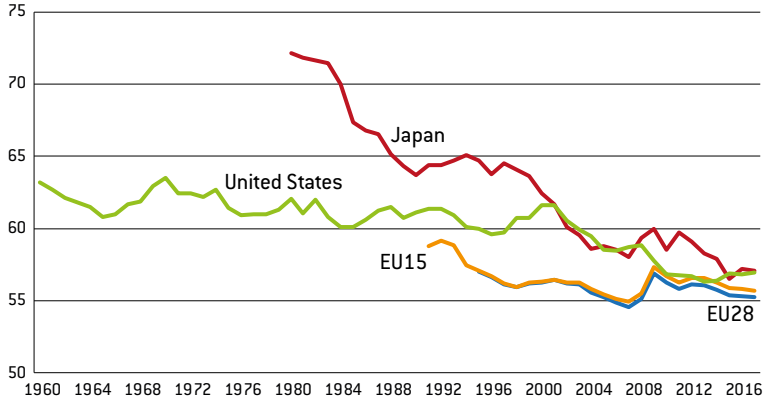
Figure 2.2: Industrial employment (% of total employment), 1991-2017



Source: Bruegel based on World Bank, World Development Indicators (SL.IND.EMPL.ZS). Note: Industry includes manufacturing, mining and quarrying and electricity, gas and water supply.

In fact, there is a consensus that labour's share of national income is declining[7]. Labour's income share in the EU15 is now almost 5 percentage points lower than in 1960 (Figure 2.3).

Figure 2.3: Wage share in total economy (% of GDP), 1960-2017



Source: AMECO (ALCD0). Note: Wage share is defined as compensation per employee as a percentage of GDP at market prices per person employed.

An alternative explanation for labour's decreasing income share was proposed by De Loecker and Eeckhout (2017, 2018) who reported that mark-ups[8] have substantially increased since 1980. This is particularly true for Europe and US. From an examination of the financial statements of more than 70,000 firms in 134 countries, the authors showed that the mark-up that European businesses charge over their marginal costs increased from roughly zero in 1980 to 64 percent in 2016. The jump – particularly pronounced in Denmark, Italy and

7 See Karabarbounis and Neiman (2014) and OECD (2012, 2015) for a global analysis; Elsby *et al* (2013) for a discussion of the US labour share; and Arpaia *et al* (2009) for Europe. See also Berger and Wolff (2017) for relevant discussion and an illustration of the potential shortcomings behind the method for calculating labour shares.

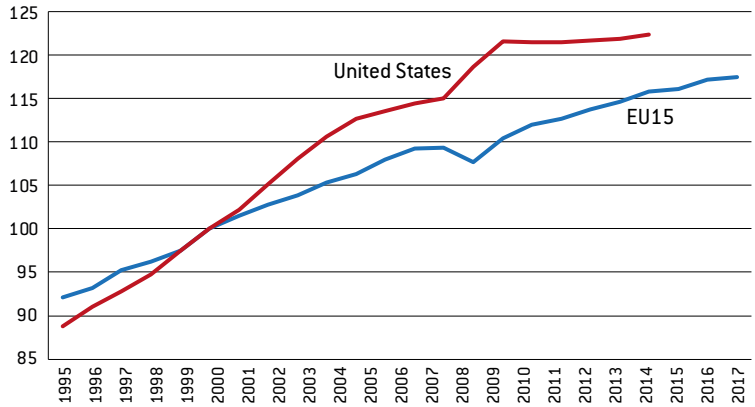
8 Defined as the ratio of the price of output goods and the marginal cost of production, or in other words, as the margin of revenue over variable costs.

Belgium – is even higher than in the US.

In the same vein, Autor *et al* (2017) built a 'superstar firm' model in which industries are increasingly characterised by 'winner takes most' competition, resulting in a small number of highly profitable (and low labour-share) firms commanding growing market shares. Autor *et al* (2017) evaluated and confirmed two core claims of the superstar firm hypothesis: the concentration of sales among firms within industries has risen across much of the private sector; and industries with larger increases in concentration exhibit a greater decline in labour's income share.

Since wages are the outcome of the bargaining game between firms and workers, greater market power on the part of firms could also imply greater bargaining power when they negotiate wages with workers and worker organisations, potentially shifting wages away from labour productivity. Labour productivity (measured by gross value added per worker) is rising both in the EU and the US (Figure 2.4).

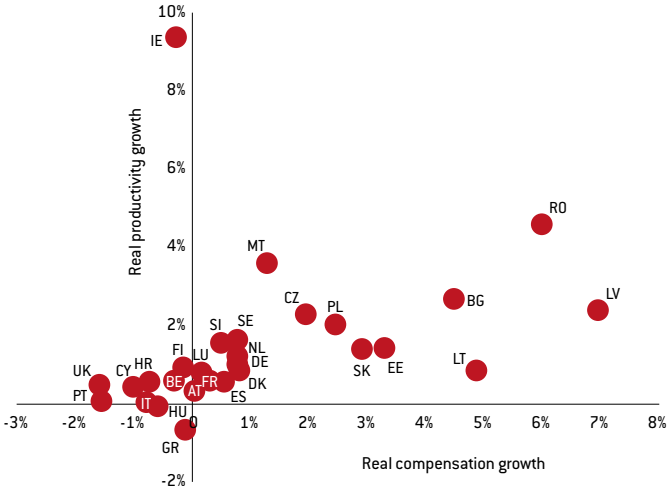
Figure 2.4: Gross value added per hour worked in total economy (2000=100), 1990-2017



Source: Bruegel based on AMECO (OVGE and NLHT). Note: no data available for EU28 before 2000.

However, by comparing wage growth and productivity for the period 2014-16 for EU countries (Figure 2.5), we see that real wage growth has lagged behind average productivity growth in several countries. Ireland's productivity growth is much higher than average because of a revision to GDP statistics. In Slovakia, Estonia, Latvia, Lithuania, Romania and Bulgaria real compensation growth exceeded productivity growth. In Greece, productivity and wage growth were both negative for the period, whereas for the United Kingdom, Portugal, Italy, Cyprus and Croatia, real compensation growth was negative but general productivity stagnated or increased. This gap is present, though less pronounced, for Hungary, Belgium and Finland.

Figure 2.5: Wage growth and productivity growth for EU countries, 2014-16

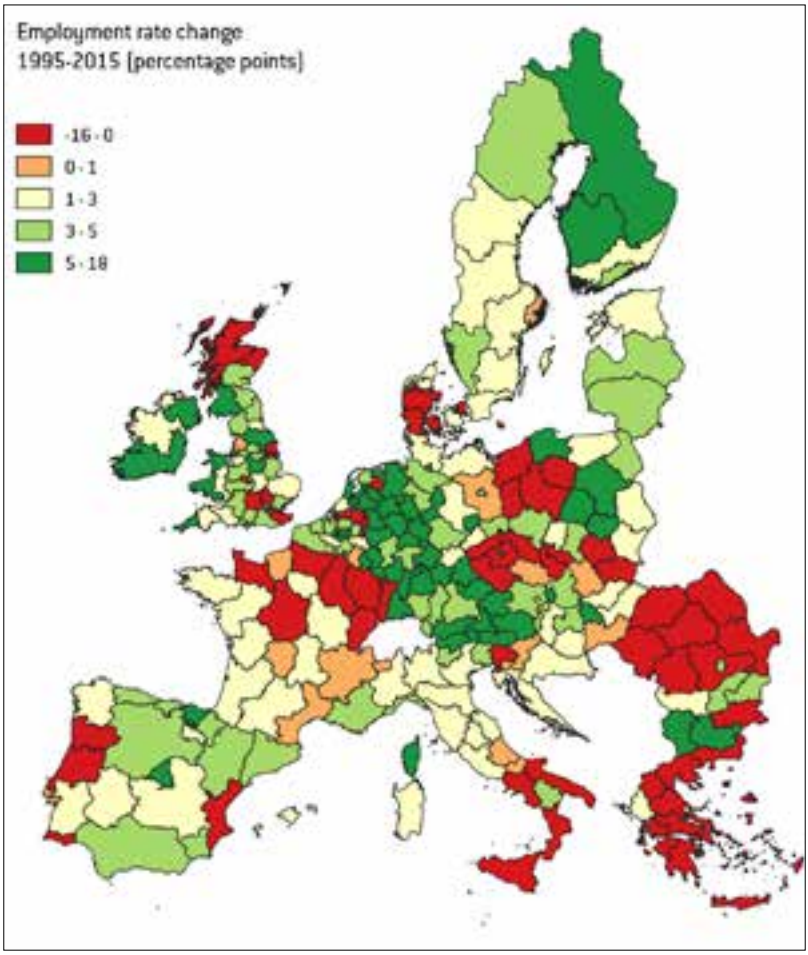


Source: Bruegel based on European Commission (2017).

Figures 2.6 and 2.7 show the changes in employment rate and wages adjusted for inflation for the different EU regions (NUTS-2 level, as defined by Eurostat), between 1995 and 2015. Because of data limitations, Malta, Luxembourg, Cyprus and Croatia are not included. The figures show that the employment rate has been particularly reduced

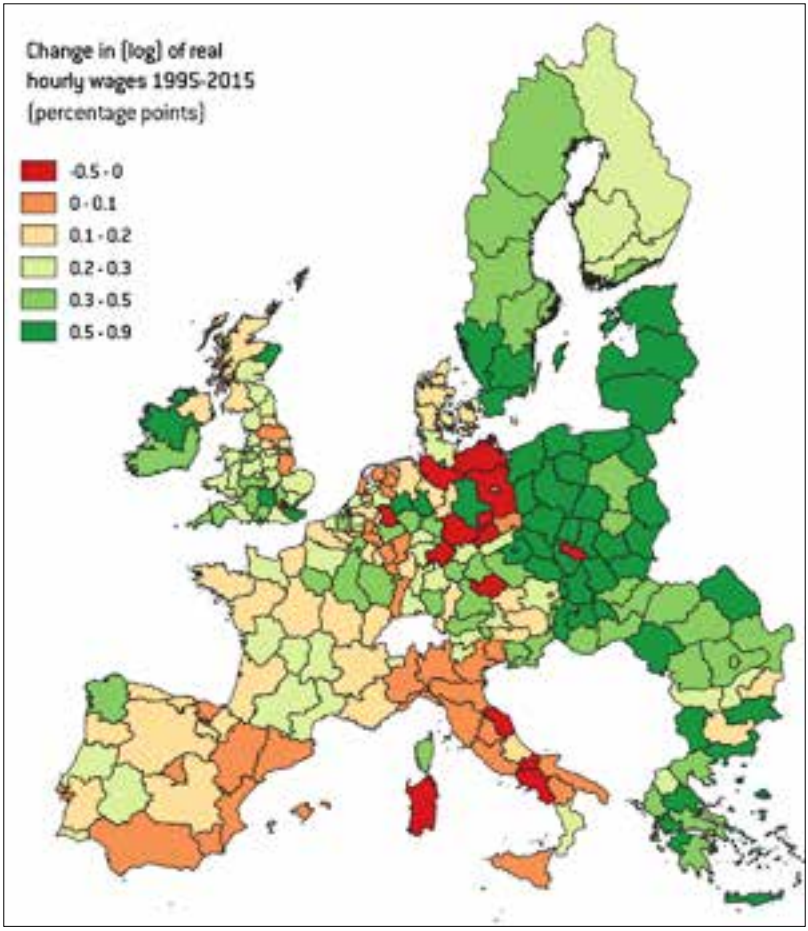
in south-east EU regions (with the notable exception the southern regions of Bulgaria), which are little automated. Real wages have increased particularly in eastern Europe, achieving some convergence with central and western Europe where increases (on average) are more moderate.

Figure 2.6: Change in employment rates between 1995 and 2015



Source: Bruegel based on EU KLEMS (http://www.euklems.net/).

Figure 2.7: Change in real wages between 1995 and 2015



Source: Bruegel based on EU KLEMS (http://www.euklems.net/).

2.2 Trends in technology adoption in Europe

Technological advancement requires the adoption of new efficient technologies by industry. Two main indicators of automated technologies have featured extensively in the literature: the number of industrial robots and information and communication technologies (ICT).

An industrial robot is defined as *"an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications"* (International Federation of Robotics, 2016). In line with this definition, a classification test would have required a positive answer to the following three questions:

- Does it have multiple purposes?
- Can it be reprogrammed to perform another task?
- Can it perform its tasks without requiring human control?

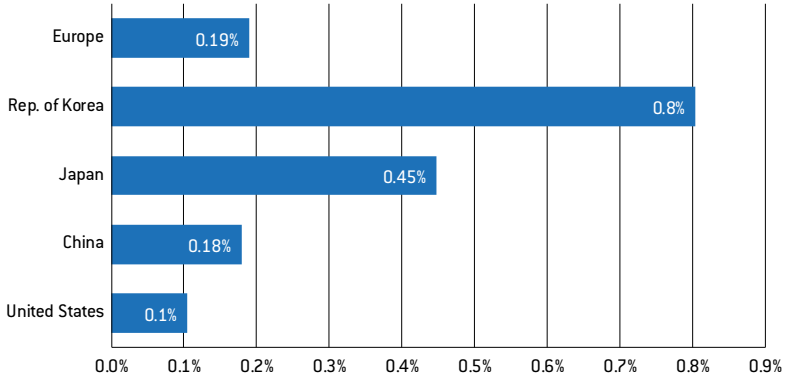
While our coffee machine, or the elevator at an apartment building, would not pass this classification test, fully autonomous machines that do not need a human operator and that can be programmed to perform several manual tasks, such as welding, painting, assembling, handling materials or packaging, are classified as industrial robots. The same applies for a robot used in car production that satisfies these criteria.

The number of industrial robots used in production globally is increasing with a significant upward trend. More than 1 million robots are at work in the Asian markets, mostly concentrated in China and Japan (with 2016 being the first year in which the number of active industrial robots in China exceeded the respective number in Japan). However, the robots market is still quite small compared with the general picture. Investment in robots, expressed as a percentage of total gross-fixed capital formation, is 0.19 percent in Europe, compared to 0.8 percent in South Korea, 0.45 percent in Japan, 0.18 percent in China and 0.11 percent in the United States.

For the five largest European economies, we estimated the investments in robots by calculating a global average market price for a single robot, and deriving the market size in each country by multiplying this price by the number of industrial robots in the country. Germany scored highest with investments in robots taking a 0.31

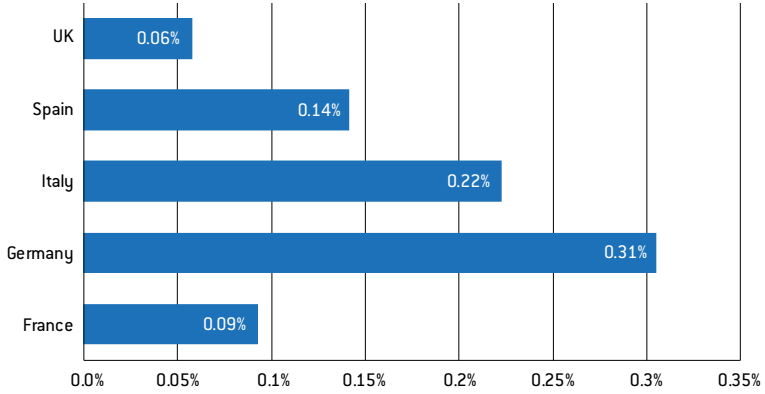
percent share of total gross fixed capital formation, followed by Italy, Spain, France and the United Kingdom.

Figure 2.8: Investments in industrial robots as a percentage of total gross fixed capital formation



Source: Bruegel based on IFR (2018) and OECD.

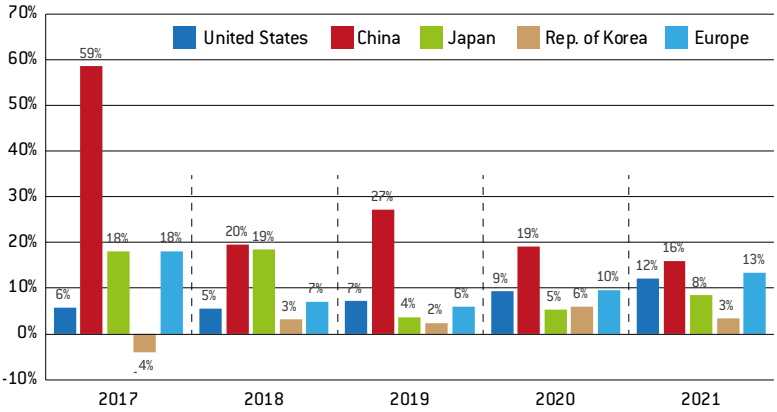
Figure 2.9: Investments in industrial robots as a percentage of total gross fixed capital formation, selected countries



Source: Bruegel based on IFR data (2018).

Although these numbers testify that investments in robots are still very modest, estimates of market growth (Figure 2.10), are larger than for investment overall, with a positive general increase, in particular for China, where investment in robots is expected to increase by 20 percent between 2017 and 2018, and by 27 percent between 2018 and 2019.

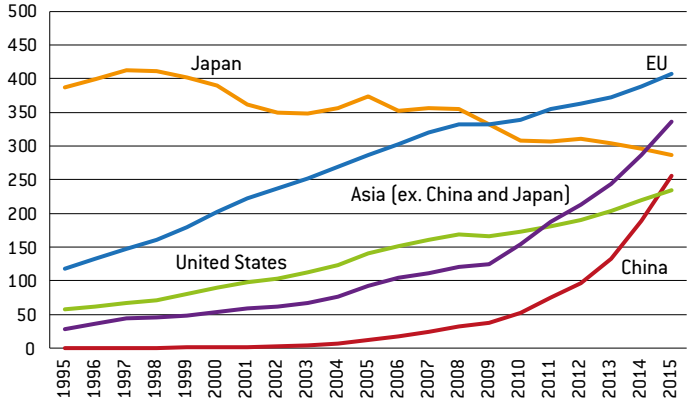
Figure 2.10: Investments in robots



Source: Bruegel based on IFR data (2018).

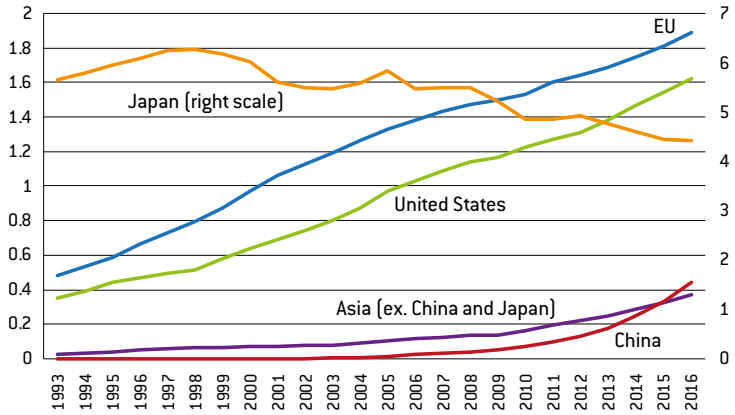
In terms of the density of robots (ie the number of industrial robots per thousand workers), we can see that the EU is ahead of the US in the use of robots in industrial production, with 1.90 robots per thousand workers in 2016 (Figure 2.12). The density of robots is steadily increasing as EU industries introduce more and more robots into their production chains. The density of robots is decreasing in Japan, the first economy to be significantly robotised in 1980s. By the early 2000s, Japan had been significantly robotised, so the rate of introduction of new robotic systems decreased. In combination with population growth, this led to a decrease in robot density.

Figure 2.11: Industrial robots by country (in thousands)



Source: IFR.

Figure 2.12: Industrial robots per thousand workers by country

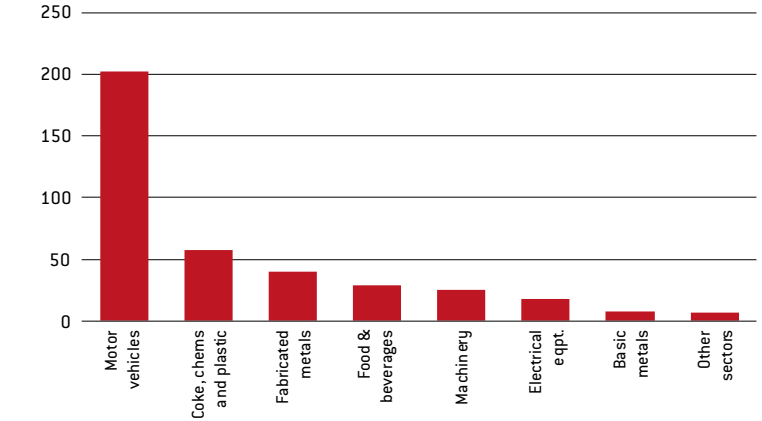


Source: IFR and ILO.

The EU's lead in comparison to other regions of the world can be attributed to its strong automobile sector, where more than 200,000 robots take part in the production process (Figure 2.13). Nevertheless, when we take into account recent trends, it can be seen that the

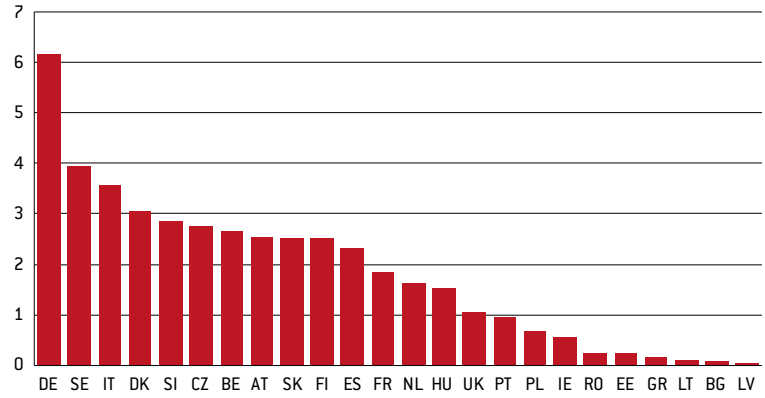
intensity of robotisation has shifted beyond motor vehicles, into sectors that are less 'mature' in terms of automation, such as machinery, food and beverage and utilities (Figure 2.15).

Figure 2.13: Industrial robots by sector in thousands, 2015



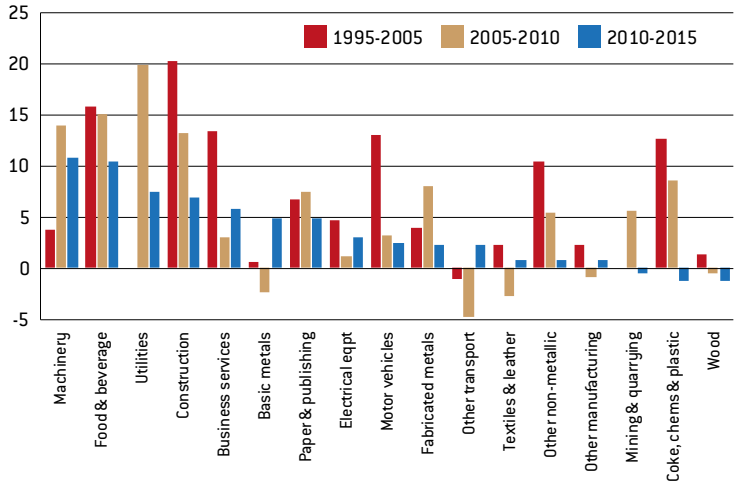
Source: IFR (2017).

Figure 2.14: Robots per 1000 workers by country, 2015



Source: IFR (2017) and Eurostat.

Figure 2.15: Median annual growth rate of operating industrial robots, by industry

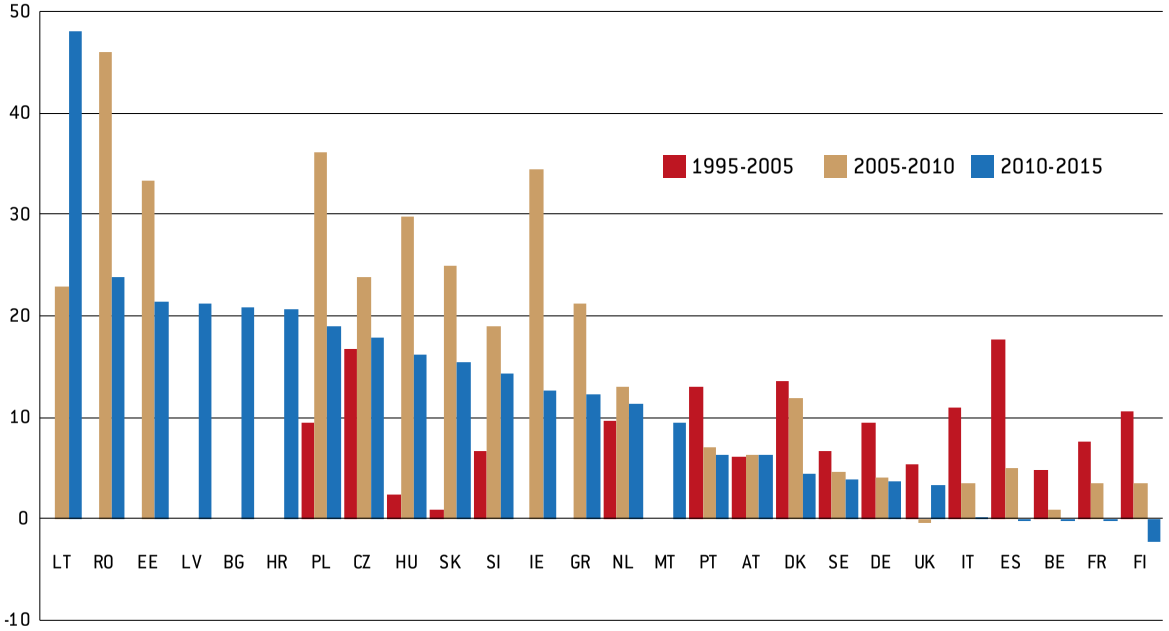


Source: Bruegel based on IFR (2017).

Countries with a strong automotive presence, including Germany, Italy and Sweden, are the champions in terms of employment of industrial robots (Figure 2.14). But, interestingly, it was in Romania, Lithuania, Estonia and Poland where growth in the number of industrial robots was fastest between 2010 and 2015 (Figure 2.16), suggesting moves in these countries towards more efficient production lines.

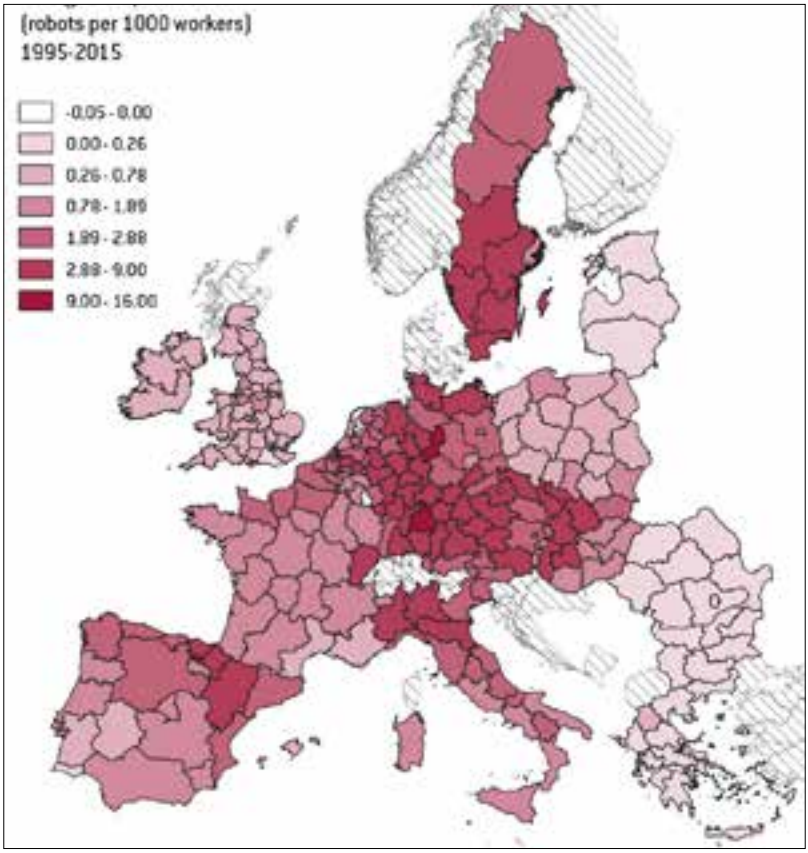
Figure 2.17 shows the change in the number of robots per thousand workers between 1995 and 2015. As expected, the density of robots was highest in regions that are heavily industrialised, especially in regions that specialise in the production of automobiles. The most significant increases were found for the NUTS-2 regions of Braunschweig (Volkswagen), Stuttgart (Audi, Porsche, Mercedes Benz), Piedmont (FIAT), Navarre (Seat), Franche-Comté (a big industrial region in France) and Střední Čechy (Central Bohemia, Skoda).

Figure 2.16: Median annual growth rate (%) of operating industrial robots, by country



Source: Bruegel based on IFR (2017). Note: Bars not displayed due to missing data, especially for central and eastern European countries before 2005.

Figure 2.17: Change in density of robots between 1995 and 2015, per thousand workers

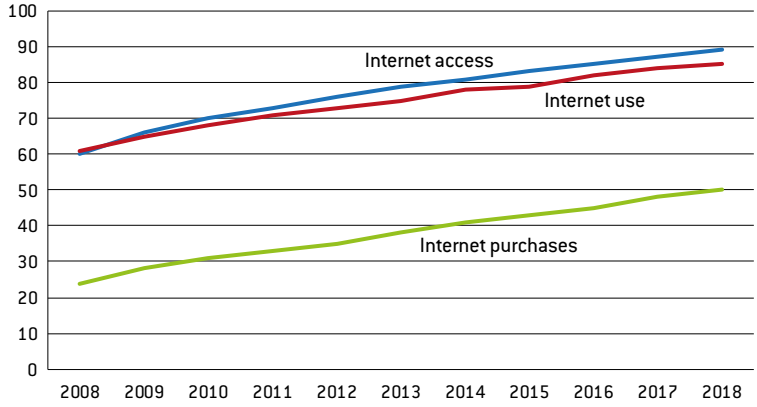


Source: Bruegel based on IFR (2017).

As for ICT, we use relevant data from EU KLEMS (http://www.euklems.net/). For our ICT capital measure we combine information and communication capital with software and databases asset value, at the industry level.

A first observation is that the percentage of Europeans that access, use and purchase through the internet has significantly increased in the last decade (Figure 2.18).

Figure 2.18: Percentage of EU population accessing, using and purchasing via the internet in the last 12 months

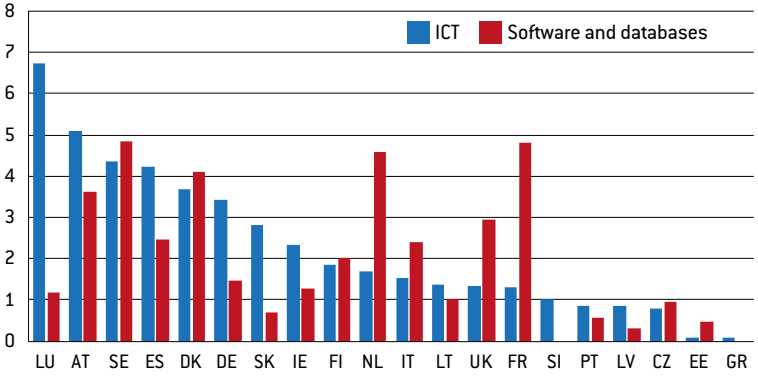


Source: Bruegel based on Eurostat.

There is a difference in the level of investment in information and communication technologies and in software and databases in different EU countries (Figure 2.19). The real fixed capital stock of ICT is highest in Luxembourg, while the respective stock of software and databases is highest in France.

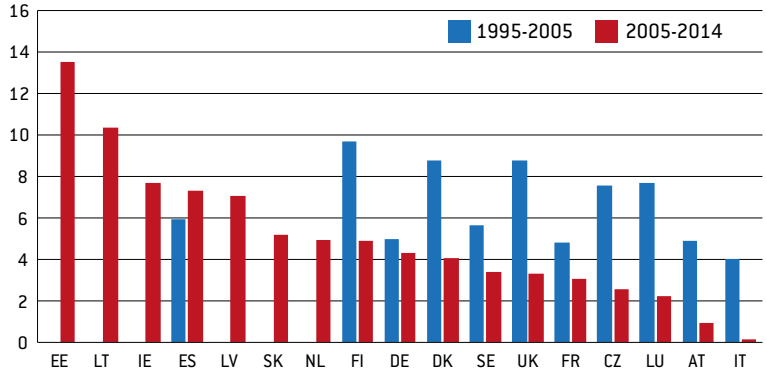
The Baltic states, especially Estonia and Lithuania, have grown their investments in ICT while northern EU countries including Finland and Denmark adopted a considerable amount of databases and software technologies between 2005 and 2014 (Figure 2.20).

Figure 2.19: Real fixed capital stock (thousand € per worker), 2014



Source: Bruegel based on EU KLEMS (http://www.euklems.net/). Note: 2010 prices.

Figure 2.20: Average annual growth rate in ICT, software and databases capital stock (%)



Source: Bruegel based on EU KLEMS (http://www.euklems.net/). Note: capital stock expressed in real terms (2010 prices); missing bars due to unavailable data.

World Economic Forum (2018) reported the results of a survey in which companies from eastern and western Europe were asked what types of technologies they are likely to adopt by 2022. Since the survey mainly focused on multinationals we do not observe different patterns

between eastern and western Europe. The vast majority of companies operating in Europe indicated that they are likely or very likely to adopt big data analytics (more than 90 percent), machine learning (77 percent in eastern Europe and 79 percent in western Europe) and cloud computing technologies (more than 70 percent).

2.3 The impact of automation on EU labour markets: theory

To assess the impact of automation on labour markets we first look at the predictions of general equilibrium theory, and then at empirical work related to European markets. Theoretical models have built on Autor *et al* (2003). In particular, Acemoglu and Restrepo (2018a) derived specific predictions and insights about the different impacts of automation. These models use a task-based approach to illustrate how computer systems and intelligent machines effect employment and wages. The central unit of production is a task. Production takes place through the simultaneous completion of a range of tasks. Some of these tasks have to be done by labour, while other tasks can be done either by labour or by capital. Also, for different tasks, labour and capital have comparative advantages, meaning that the relative productivity of labour varies for different tasks. Automation is modelled as an expansion in the set of tasks that can be carried out by capital. If capital is sufficiently cheap or sufficiently productive at the margin, then automation will lead to the substitution of capital for labour for these tasks. This substitution results in a displacement of workers from the tasks that are being automated, creating the so-called displacement effect. This could trigger a decline in the demand for labour and the equilibrium wage rate. With an elastic labour supply, this decrease in demand for labour also leads to lower employment.

However, automation also feeds into other economic mechanisms that can typically positively influence employment and wages (Acemoglu and Restrepo, 2018a, 2018b, 2018c):

1. Productivity effect: the demand for labour in non-automated tasks

can increase as the cost of performing routine tasks falls as a result of automation. This productivity effect can lead to an increase in the demand for labour in the sectors undergoing automation and in non-automating sectors. In this way, greater real incomes can be achieved and therefore greater demand for goods, including those not experiencing automation. A good example (Bessen, 2016) is the employment growth among bank workers that happened after automated teller machines (ATMs) were introduced. ATMs reduced costs and, because demand for banking services was elastic, more branches could open and more sophisticated non-routine services could be rolled out. Other examples of occupations in which employment surged after major technological innovation include check-out cashiers and paralegals.

2. Capital accumulation: automation triggers more capital investment which increases labour demand because more workers are needed to work with the machines. According to Allen (2016), rapid capital accumulation might have been an important channel for the adjustment the British economy in the face of the mechanisation of agriculture during the Industrial Revolution.
3. Deepening of automation: technological improvements can increase the productivity of capital in tasks that have already been automated. In that case, labour will not be displaced further but the productivity effects of this type of 'intensive margin' automation can increase labour demand (productivity effect through already-automated tasks). An example is the vast improvements in the efficiency of numerically-controlled machines used for metal cutting and processing during the 1970s (earlier vintages were controlled by punched cards and were not fully computerised). While the improvements are not considered to have significant displacement effects because such tasks were already automated, they increased the productivity of operators and other workers in the industry.

These three effects are unlikely to counterbalance the negative displacement effect (Acemoglu and Restrepo, 2018c): automation makes the production process more capital intensive and tends to increase productivity more than the wages (Figure 2.5), with the consequence of reducing the labour's share of national income (Figure 2.3). This implies that because automation entails the substitution of capital for tasks previously performed by labour, thus squeezing labour into a narrower set of tasks.

IMF (2017) reported that in advanced economies, about half of the decline in labour's income share could be traced to the impact of technology – a combination of rapid progress in information and telecommunications, and a high share of occupations that could be easily be automated[9].

This is is also consistent with historical observations as, for example, Allen (2009) shows: in Britain from the beginning of the Industrial Revolution until the middle of the nineteenth century, wages stagnated and the labour share of income fell, even as technological advances and productivity growth continued, a phenomenon called *"Engel's pause"*.

However, from the start of the twentieth-century, the mechanisation of the economy led to a great increase in employment as new industries and factories were created and the era of mass production got underway (Kuznets, 1966). Also, as documented by Acemoglu and Restrepo (2018a), from 1980 to 2010, the introduction and expansion of new tasks and job titles explained about half of employment growth. So, a fourth important effect, which might be the most powerful force

9 Karabarbounis and Neiman (2015) linked the global decline of the labour share to the global decline in the relative price of investment goods, and argued that this could explain about half of the fall. The decline of labour's income share in advanced economies has been particularly sharp for middle-skilled labour. Routine-biased technology has taken over many of the tasks performed by these workers, contributing to job polarisation toward high-skilled and low-skilled occupations.

to balance the rapid growth of automation, is the so-called:

4. Reinstatement effect: automation in some areas can open up the space for new, labour-intensive tasks to be created. This is because labour is needed to work adjacent to, and to service, more sophisticated machines and because technology can create entire new classes of jobs. It always generates additional labour demand, which notably increases the labour share of national income. Consequently, one powerful way in which technological progress could be associated with a balanced growth path is through the balancing of the impacts of automation with the creation of new tasks.

So, in terms of its productivity and reinstatement effects, automation should be viewed as a technological force that changes the nature of existing jobs, and leads to the reallocation of workers from existing jobs and tasks to new ones. But, as Acemoglu and Restrepo (2018a) explain, this is a complex and often slow process. First, it takes time for workers to adjust to the new reality and find new jobs and tasks in which they can be productive. Second, local and national labour markets can be depressed at the time workers are fired from their existing jobs (during the adjustment period). So, adjustment costs increase because of the impact of automation. This explains why historically we can separate (through Engel's pause) the effects of automation on labour markets in the short and long runs[10].

2.4 The impact of automation on EU labour markets: empirical evidence

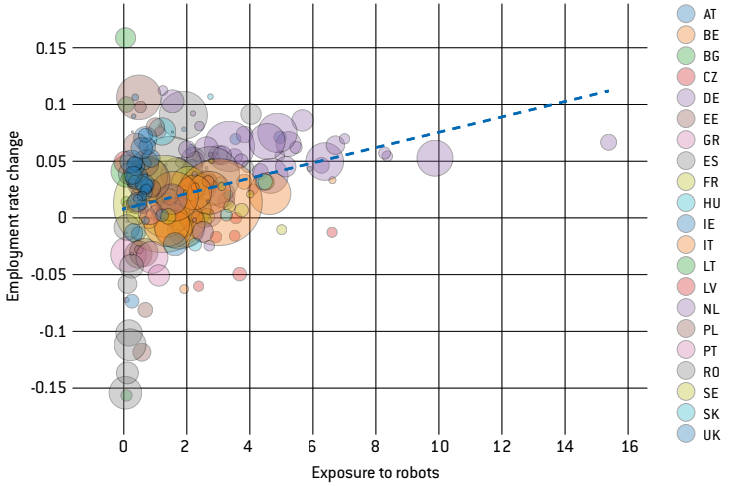
While theory outlines the different forces of technology, empirical facts illustrate the overall impact of automation on employment and indicate which of the opposing effects dominate.

10 In chapter 6 we discuss policy initiatives to reduce such adjustment costs and make the transition process weaker.

We built a dataset with information about employment rates, real wages, industrial robots (per thousand workers) and ICT capital (per thousand workers) at regional level (NUTS-2 level) in the EU. We defined exposure to robots as the ratio between the number of industrial robots and the number of workers. The ICT measure was constructed in the same manner: ICT capital per thousand workers; for ICT capital, we used the asset value of ICT, software and databases in each region.

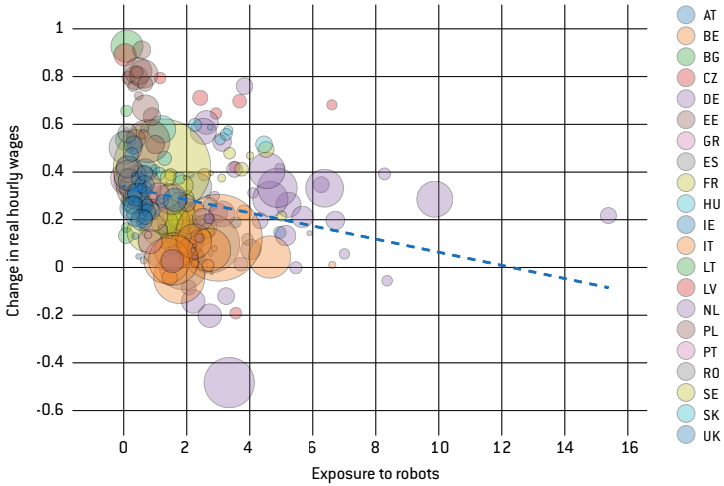
We examined the relationship between the change in the regional employment rate and real wages between 1995 and 2015, and the change in regional exposure to the two technology variables during the same period (Figures 2.21-2.24).

Figure 2.21: Exposure to industrial robots relative to employment rate in EU regions for the total economy



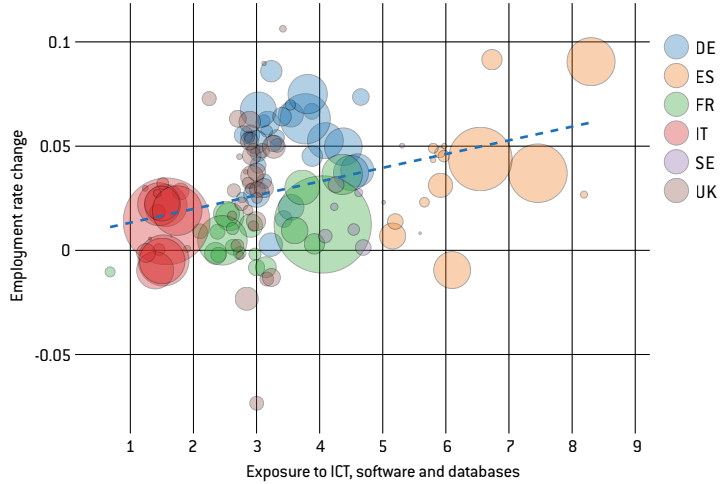
Source: Bruegel. Note: Each circle depicts a distinct region (NUTS-2 level). The diameter of each circle indicates the size of working population within the region.

Figure 2.22: Exposure to industrial robots relative to wages in EU regions for the total economy



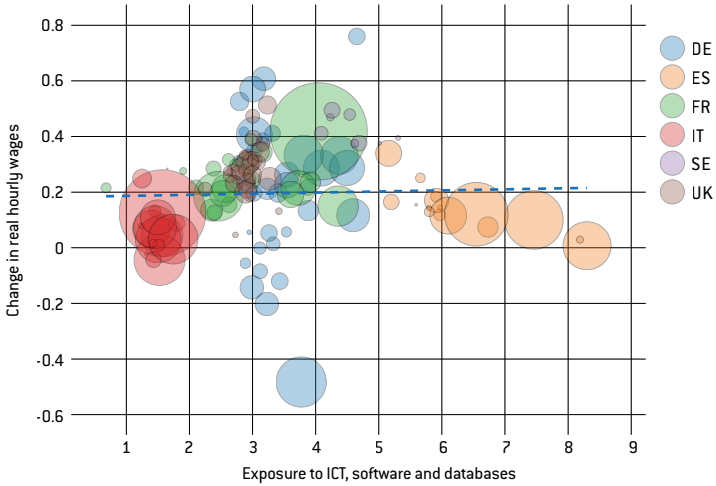
Source: Bruegel. Note: see note to Figure 2.21.

Figure 2.23: Exposure to ICT capital, software and databases relative to employment rate in EU regions for the total economy



Source: Bruegel. Note: see note to Figure 2.21.

Figure 2.24: Exposure to ICT capital, software and databases relative to wages in EU regions for the total economy



Source: Bruegel. Note: see note to Figure 2.21.

Exposure to industrial robots and ICT capital are both positively correlated with employment rates. On average, a marginal increase in a region's exposure to industrial robots is associated with an increase in the employment rate of 1 percentage point. A marginal increase in the exposure to ICT capital has a similar effect on employment rates.

As for real wages, there is a negative correlation with exposure to industrial robots, suggesting that an additional robot per 1000 workers corresponds to a reduction of 3 percentage points in the growth rate of real hourly wages. However, the correlation with exposure to ICT is positive, suggesting that different automated technologies interact with wages in different ways. Robots by nature reduce labour demand for specific physical tasks and therefore can potentially reduce wages. ICT, on the other hand, appears to be more complementary to labour tasks, increasing the efficiency with which these tasks are performed and thus increasing employment opportunities.

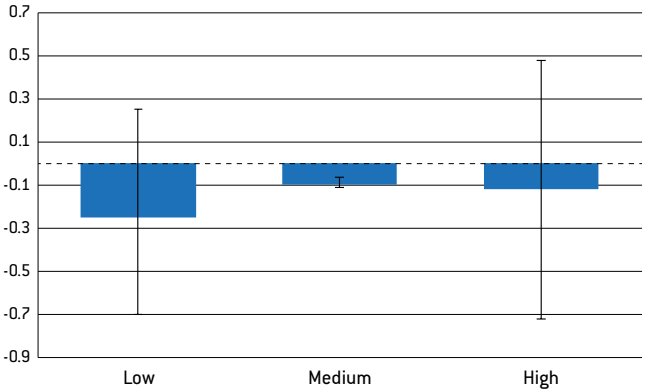
The same methodology is applied here as in Chiacchio *et al* (2018),

but Chiacchio *et al* (2018) found the overall impact on employment rates of exposure to robots to be negative. In trying to explain this difference, we would point out that we incorporated more recent data up to 2015, while Chiacchio *et al* (2018) considered 2007 as a final year because of data limitations. Moreover, while in Chiacchio *et al* (2018) only six countries were covered, we extended the study by incorporating up to 21 EU countries (Figures 23-26), using a dataset of 245 NUTS-2 regions, to study the relationship between employment rates and exposure to robots.

Chiacchio *et al* (2018) also assessed the impact of exposure to industrial robots on different demographic groups. They found, in particular, that the take-up of industrial robots has a greater displacement effect on men and young people (aged 15-24 years), indicating that use of robots raises small barriers in terms of entry into EU labour markets and for more physical activities. In addition, Chiacchio *et al* (2018) divided the educational level of workers into three categories: (i) L, or lower secondary education; (ii) M, or at least upper secondary education; and (iii) H, or tertiary education. Chiacchio *et al* (2018) estimated that middle-skilled (or educated) workers are more likely to be adversely affected by technological change (statistically significant negative impact): the adoption of industrial robots leads to a negative statistically significant impact on middle-educated EU workers of more than 0.2 percentage points (Figure 2.25).

That partially confirms studies done in the United States (Autor *et al*, 2006) and the United Kingdom (Goos and Manning, 2007) which have shown that there is growth in employment in the highest-skilled (professional and managerial) and lowest-skilled (personal services) occupations, with declining employment in the middle of the distribution (manufacturing and routine office jobs).

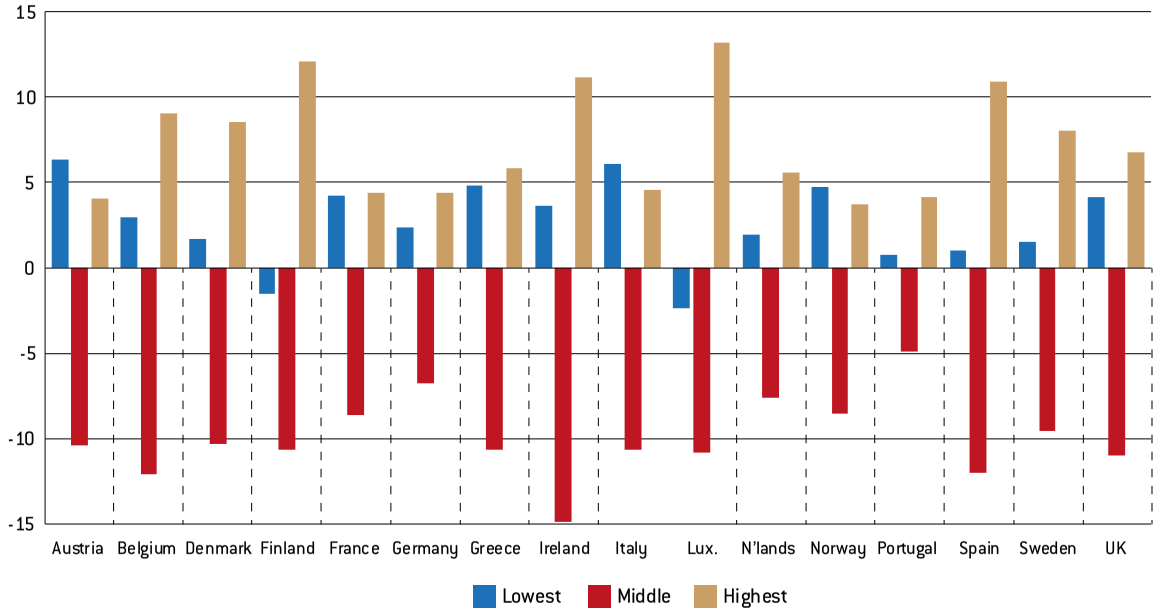
Figure 2.25: Employment impact of exposure to robots by education group



Source: Chiacchio *et al* (2018). Note: The figure indicates change in employment rate arising from 1 additional robot per 1000 workers in the economy, in percentage points. Bars refer to the confidence interval of 90 percent.

Goos *et al* (2014), using data from 16 EU countries, found that job polarisation is pervasive in EU labour markets (ie jobs requiring a moderate level of skills seem to decrease relative to those at the bottom, requiring few skills, and those at the top, requiring greater skill levels). Figure 2.26 shows that employment polarisation is apparent across the full range of countries. Declines in the share of middle-paying occupations are in the 5-15 percent range for countries including France, Austria and the UK. The fact that this polarisation pattern is so common across countries underlines the routine-biased technological change hypothesis (job polarisation).

Figure 2.26: Job polarisation in Europe. % change in hours worked per occupation group, 1993-2010



Source: Goos *et al* (2014). Note: Occupations are grouped according to how they pay: the four lowest paying, the nine middling and the eight highest paying.

Job polarisation is linked to technological change through the routine-biased technological change (RBTC) hypothesis, which has been supported by many studies: recent technological change is biased toward replacing labour in routine tasks. Moreover, there is also task offshoring (itself partially influenced by technological change). Both forces reduce the demand for middle-skilled workers relative to high-skilled and low-skilled workers (Autor *et al*, 2003; Autor *et al*, 2006, 2008; Goos and Manning, 2007; Autor and Dorn, 2013). Nevertheless, as Goos *et al* (2014) illustrated, for the EU, RBTC is much more important than offshoring. Their model explains not just overall job polarisation but also its within-industry and between-industry components. As they noted:

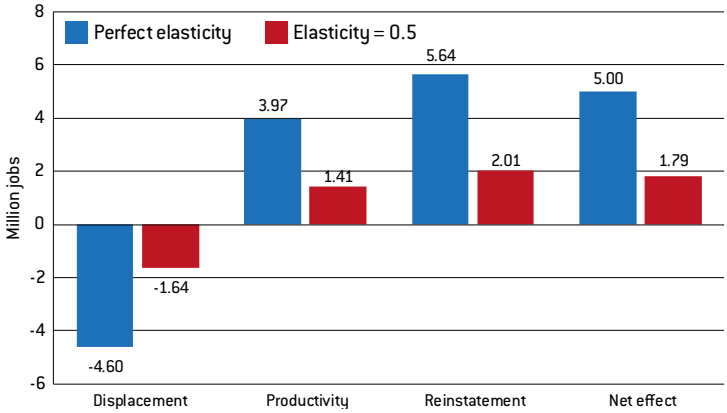
> *Within each industry there is a shift away from routine occupations, leading to within-industry job polarisation. But RBTC also leads to significant between-industry shifts in the structure of employment. On the one hand, an industry affected by RBTC will use less employment to produce a given level of output which will cause occupational employment shares to polarise even if output shares do not. On the other hand, industries intense in routine tasks will see a larger decrease in relative costs and output prices leading to a shift in product demand towards these industries* (Goos *et al*, 2014).

This effect reduces the impact of between-industry job polarisation but does not negate it. Such a between-industry shift is, for example, currently observed between the manufacturing and service sectors.

Last but not least, the positive relationship between employment rates and automation shown in Figures 2.21 and 2.23 refers to the overall impact of automation. By separating the different effects according to the theoretical predictions presented above, we arrive at Figure 2.27. We can decompose the overall impact of automation on employment into three different effects in line with the theory presented in section

4.The displacement effect as expected is negative, suggesting that labour demand has decreased by 1.64 million to 4.6 million jobs as technology has substituted for labour in routine tasks, and as production has restructured towards routine tasks. However, the associated productivity effects are greater in absolute value, implying an increase in labour demand of 1.41 million to 4 million (productivity effect) and 2 million to 5.6 million jobs (reinstatement effect) across Europe. So, the overall effect is small and positive as automation creates 1.79 million to 5 million jobs.

Figure 2.27: Predicted European labour demand and employment change, 1999-2010



Source: Bruegel based on Gregory *et al* (2018). Note: The blue bars show the number of jobs under the assumption that labour supply is perfectly elastic, which is inconsistent with an extensive literature finding finite supply elasticities. On the basis of this assumption, we derived an upper estimate of the impact of the effects of automation. If instead, a supply elasticity of 0.5 is considered, a more modest impact is estimated, as shown by the red bars.

Of particular interest from this decomposition of the overall effect of automation is that the net impact can only be positive if automation leads to the emergence of new categories of jobs (reinstatement effect). Clearly, this depends on our ability to transform technological change into new forms of work. This requires: i) helping people

develop their skills in ways that enable them to perform the newly-created tasks; ii) designing an appropriate framework that allows new forms of work to expand; and iii) distributing the resulted benefits in a fair way between social partners.

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3 Artificial intelligence, machine learning and their implications

3.1 Intelligent machines

The empirical results presented in chapter 2 refer to the impact of automation from the mid-1990s up to 2015. However, since about 2010, there have been new advancements based on machine-learning techniques that enable artificial intelligence (AI) systems to perform tasks in a very efficient way. AI systems are able to perform tasks that involve decision-making, changing the impact of automation on the workforce. There is a concern that the displacement of workers will be reinforced by these new technologies. Given that the introduction and implementation of these technologies has only just started, there is so far no available data that can allow us to assess the magnitude of the displacement effect, or the scale of the countervailing productivity effects (expansion of current job tasks or creation of new ones).

Software and AI-powered technologies can now retrieve information, coordinate logistics, handle inventories, prepare taxes, provide financial services, translate complex documents, write business reports, prepare legal briefs and diagnose diseases. They are set to become much better at these tasks in the next few years (Brynjolfsson and McAfee, 2012; Ford, 2015). Currently, to assess the impact of these technologies in the labour market, we can only underline the main characteristics of these technologies and apply speculative feasibility tests to the potential job tasks that will be created and displaced.

The idea of intelligent machines was developed in the early twentieth century, with the idea of 'human-like' intelligence a key concept. Vannevar Bush in 1945 proposed *"a system which amplifies people's own knowledge and understanding"*[11]. Alan Turing (1950) asked the question *"Can machines think?"* In his famous imitation game, Turing (1950) proposed a test of a machine's ability to exhibit intelligent behaviour equivalent to that of a human. A human evaluator judges an exchange of printed messages between a human and a machine that is designed to generate human-like responses. The evaluator would be aware that one of the two partners in the exchange is a machine, and all participants would be separated from one another. If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test.

The specific term *"artificial intelligence"* was first used by John McCarthy in his 1955 proposal for the first academic conference on the subject that took place in Dartmouth in the summer of 1956. However, the traditional approach to AI was not really about independent machine learning. Instead the aim was to specify rules of logical reasoning and real-world conditions which machines could be programmed to react to. This approach was time consuming for programmers and its effectiveness relied heavily on the clarity of rules and definitions.

Modern AI has deviated from this approach by adopting the notion of machine learning. This shift follows in principle Turing's recommendation to teach a machine to perform specific tasks as if it were a child. By building a machine with sufficient computational resources, offering training examples from real-world data and designing specific algorithms and tools that define a learning process, rather than specific data manipulations, machines can improve their own performance through learning-by-doing, inferring patterns and checking

11 Vannevar Bush (1945) 'As we may think', *The Atlantic*, July, available at https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/.

hypotheses.

Thus it is no longer necessary to programme in advance long and complicated rules for a machine's specific operations. Instead programmers can equip machines with flexible mechanisms that facilitate their adaptation to their task environment. At the core of this learning process are artificial neural networks (see section 2), inspired by the networks of neurons in the human brain. Nick Bostrom, a philosopher at Oxford University, even foresees the birth of a *superintelligence*, a form of machine intelligence that overtakes by far the capabilities of the human mind (Bostrom, 2017).

While the principles of machine learning were introduced several years ago, the great development of machine learning and AI systems has only started in the last decade, for the following reasons:

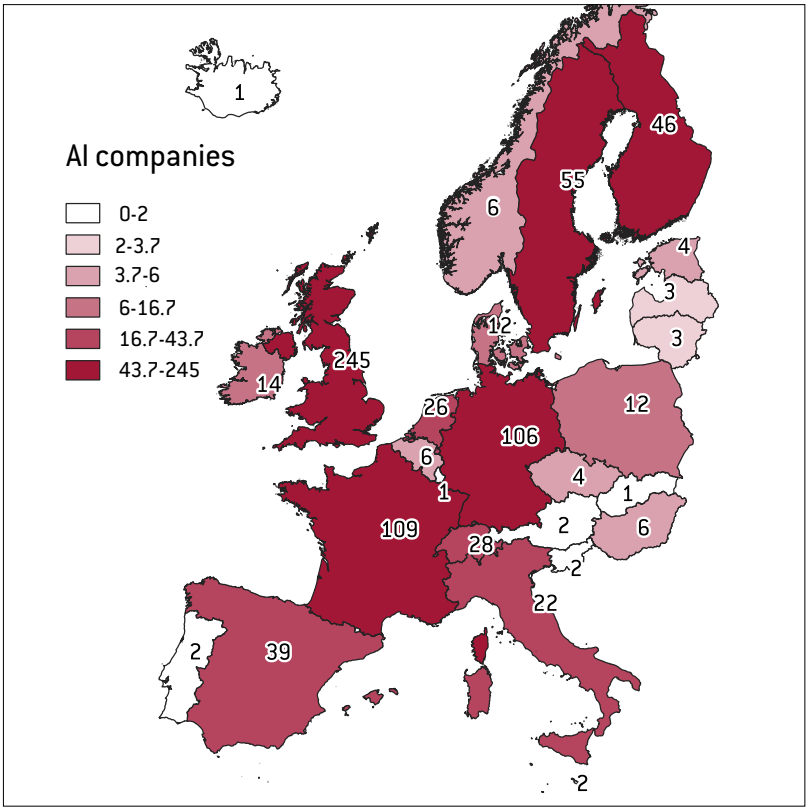
The volume of available data collected has increased significantly over the last decade and will continue to grow. AI systems have access to large datasets that help the training of machines so that they can improve the efficiency of their performance. The digitisation of nearly all media and the increasing migration of economic and social activities to the internet generate petabytes of data every second (OECD, 2014). The speed of data processing has also increased and in some applications approaches real time (White House, 2014). In addition, the variety of data collected has also vastly expanded. The value of data and how informative it is has also increased. The fusion of many different kinds of data processed has the power to deliver the targeted messages, products or services (White House, 2014).

There has been a significant increase in computing power and better connectivity through the internet. In particular, the supply and storage of digital information has increased, including in central locations (cloud computing), which allows significant amounts of data to be compared and analysed for the statistical purposes necessary to develop tools based on AI principles.

The drop in capital costs of digital technologies has significantly reduced barriers to entry for start-ups, making it less necessary than

in the past to mobilise huge amounts of capital before starting a new venture. At the same time, incentives to invest first in new markets have increased because of network effects, and the value of collected data often leads to competition for the market instead of competition within the market. In Europe, the United Kingdom has the strongest AI ecosystem. Asgard (2017) counted 121 AI firms in the UK, with London clearly the largest hub. In second place is Germany (51), with Berlin as the main AI hub supporting 30 AI companies. France (39) and Spain (31) follow in third and fourth places.

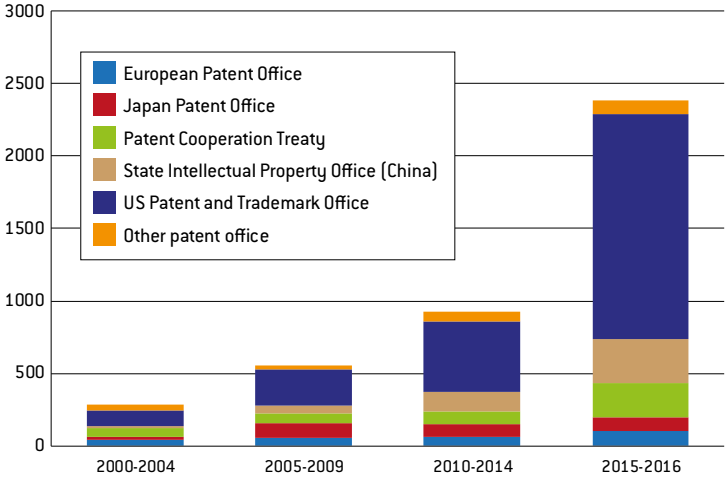
Figure 3.1: The distribution of AI companies in Europe



Source: Asgard (2017).

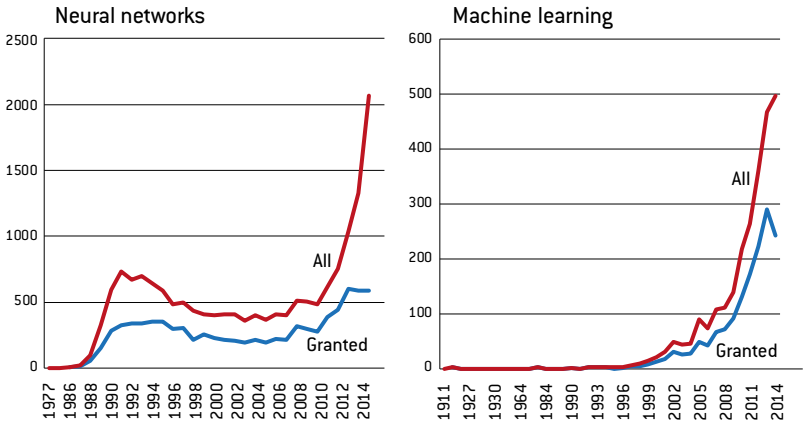
Analysis of patents can indicate which of the AI subfields are the most promising. There has been a rapid increase in AI patent applications to different patent offices worldwide (Figure 3.2). Within this, patent filing in the fields of machine learning and neural networks has boomed in recent years (Figure 3.3).

Figure 3.2: Number of AI patents granted by country



Source: Bruegel based on Fujii and Managi (2018), Ernst *et al* (2018).

Figure 3.3: Machine learning and neural networks patents (all vs granted)



Source: Bruegel based on PATSTAT. Note: Following the same methodology as Webb *et al* (2018).

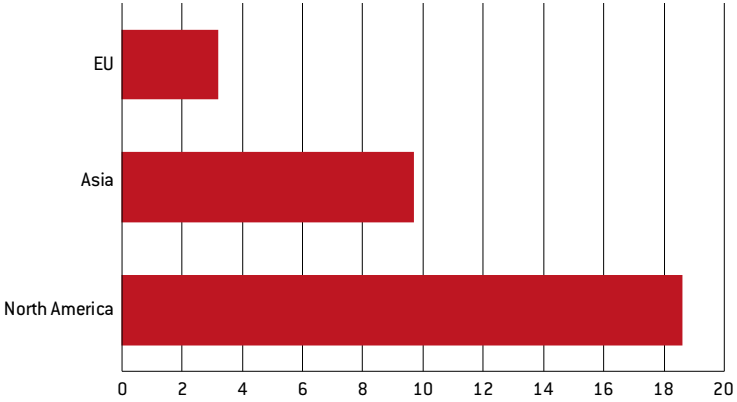
A 2019 study by the World Intellectual Property Organisation (WIPO) illustrates the growth in the application of AI techniques (WIPO, 2019). Deep learning is the fastest growing application, with a 175 percent increase in patents between 2013 and 2016.

In terms of functional applications of AI, WIPO (2019) shows that patent filings increased in particular in the field of computer vision (character recognition, biometrics, scene understanding, image and video segmentation, object tracking, augmented reality).

WIPO (2019) also shows that IBM is the leading AI patenter, with 8290 patents, followed by Microsoft with 5930, and by Toshiba, Samsung and NEC. Among universities, the largest numbers of patents are held by institutions in China and the Republic of Korea.

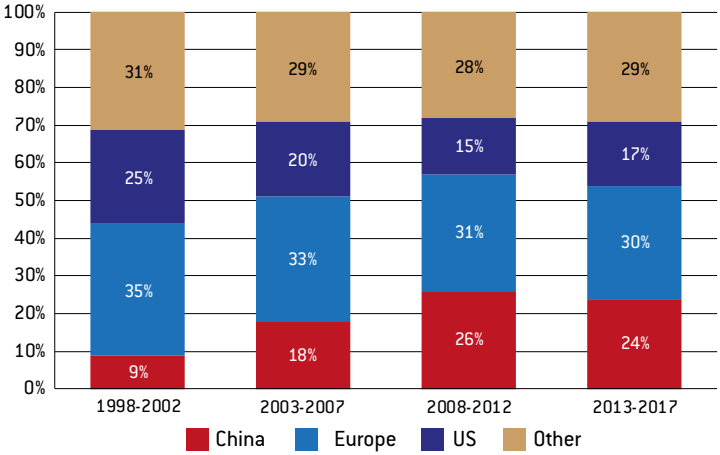
Europe still lags behind North America and Asia in terms of private investment in AI (Figure 3.4).

Figure 3.4: Private investment in AI, 2016 (€ billions)



Source: EU Digital Single Market Factsheet.

Figure 3.5: Percentage of AI publications by group and geographical origin



Source: Elsevier (2018).

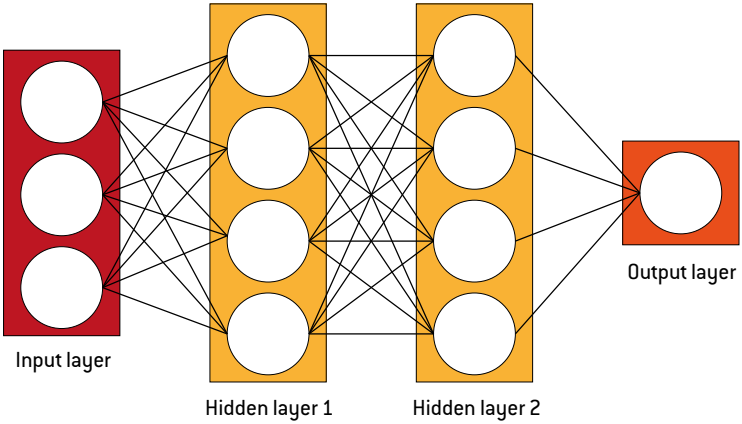
Between 1998 and 2017, the number of scientific publications on AI increased substantially from fewer than 10,000 in 1998 to more than 60,000 in 2017 (Elsevier, 2018, based on a sample of publications). There are strong regional differences in AI activity. Europe is still in

first place in AI research, despite rapid growth in China at the expense of the share of the US, which has regained some ground in recent years (Figure 3.5).

3.2 AI algorithms: how they operate

The most widely-applied structure of a machine-learning algorithm is a neural network. Artificial neural networks imitate the structure of the human brain rather than perform a standard statistical analysis. Usual statistical methods assume that different input variables have relatively simple and independent effects on the output variables that need to be explained. Artificial neural networks work differently. Rather than inputs directly and independently determining outputs, the inputs are combined in complex ways to create features of the phenomenon being studied, which in turn determine other features, which eventually determine the outcome. An artificial neural network is able to handle such sophisticated abstractions by learning the presence of more abstract features of data in its hidden layers (Figure 3.6).

Figure 3.6: A stylised neural network structure



Source: Posner and Weyl (2018).

A simple artificial neuron network is organised in different layers of neurons (with each neuron depicted by a node in Figure 3.6). Data is introduced into the network through the input layer. There are some hidden layers in which information is processed and finally an output layer from which results emerge. Each neuron within the network has a set of weights and an activation function. A network with many hidden layers combines signals by applying different weights to them and passing the result to the next layer. The number of hidden layers is indicative of the ability of the network to detect increasingly subtle features of the input data. The training of the network takes place through the adjustment of the weights given to neurons so that the network gives the desired response when presented with particular inputs.

The learning of the machine through such a structure has some critical ingredients:

- Data that consists of an extremely large collection of labelled examples: in the example of image recognition, data might refer to a large number of photographs tagged as containing or not containing a face.
- Computing power: artificial neural networks are connected via multiple servers to perform the algorithmic computation.
- In the most widely implemented type of machine learning, supervised learning[12], a third critical component is the programmers who supervise the process of learning and adjust the weighting function with which input variables are introduced into the algorithm to make the algorithm more efficient in order to achieve its objective more quickly and accurately.

12 In the supervised learning the main task is to learn some general function f(x)=y from a set of training examples of input-output (x,y). Supervised learning can be used when the objective is to train email servers to choose which emails should automatically go to the spam folder. Another task that can be learnt in this way is finding the most appropriate results for a query typed in a search engine.

Such an algorithm has a specific objective and a repetitive function. Each time, it tries to improve its performance by adjusting the weighting function with which each input variable is taken into account. Through repetition, the algorithm learns how to reach the desired output. This is why it is important to have access to abundant high-quality representative training data. Through numerous tests, the algorithm can improve its accuracy leading to better results.

3.3 The main applications of AI systems

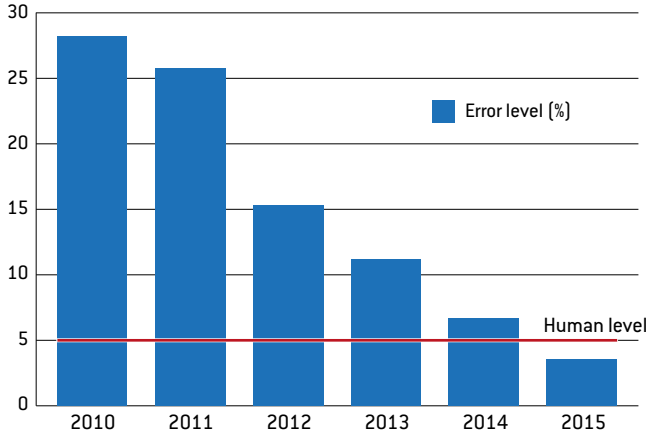
The combination of improved algorithms based on deep artificial neural networks and faster computer hardware has been critical for the development of machine learning. Machine learning has been quite effective in the following areas:

Object recognition

Probably the most striking demonstration of machine learning is the ImageNet Large Scale Visual Recognition Challenge[13], which evaluates algorithms for their capabilities in object detection and image classification at large scale. For any given word, ImageNet contains several hundred images. In the annual ImageNet contest, several research groups compete to get their computers to recognise and label images automatically. Humans on average label an image correctly 95 percent of the time. The respective number for the winning AI system in 2010 was 72 percent, but over the next couple of years the error rate fell sharply. In 2015, machines managed to achieve 96 percent accuracy, reducing the error rate below the human average level for the first time.

13 See http://www.image-net.org/challenges/LSVRC/.

Figure 3.7: Object detection accuracy in the ImageNet Visual Recognition Challenge



Source: Large Scale Visual Recognition Challenge (ILSVRC).

Visual question answering

While machines perform better than humans in identifying images as belonging to one of a thousand categories, humans can still recognise a larger number of categories and can also judge the context of an image in a more accurate way. The visual question answering (VQA) test is indicative of the current stage of progress of machines. The VQA dataset consists of images and open-ended questions about the content of those images. AI systems aim to produce answers to questions about images. Answering these questions requires an understanding of vision, language and common-sense knowledge. Despite the significant progress made by AI systems, they still have not managed to surpass the accuracy of human performance. The accuracy of the best AI system is below 70 percent compared to 80 percent accuracy for humans, given the same amount of time to respond to a question.

Speech recognition

Speech recognition is technology that can recognise spoken words,

which can then be converted to text. A subset of *speech recognition* is *voice recognition*, which is the technology for identifying a person based on their *voice*. AI systems have managed to perform similarly to humans in a task to recognise speech from voice recordings.

Meanwhile, AI systems are also approaching the human level in question answering. They have also significantly improved their performance in tasks such as natural language understanding, machine translation, theorem proving and playing cognitive games including Jeopardy![14], Go[15] and chess[16].

3.4 AI and its impact on jobs

While AI systems have already managed to perform better than humans in certain tasks, it should not be overlooked that workers perform a variety of different tasks[17]. As machines automate some of these tasks in particular jobs or processes, the remaining tasks that are non-automatable might become more valuable (Brynjolfsson and Mitchell, 2017). For example, in legal contexts, AI can perform well in classification tasks such as sorting large amounts of documents, but they cannot replace lawyers in formulating legal strategies (Levy and Remus, 2017). Machines are unable to represent clients in court. Lawyers can therefore allocate more time to preparation for the court and can become more efficient. We are still far from artificial general intelligence that would match humans in all cognitive areas.

Machines thus have the potential to replace workers and also to augment human capabilities by introducing new ways to make

14 See the very illustrative story in Brynjolfsson and McAfee (2014).

15 In March 2016, the AlphaGo computer program from the AI startup DeepMind (bought by Google in 2014) beat Lee Sedol in a five-game match of Go – the oldest board game, invented in China more than 2,500 years ago. This was the first time a computer Go program beat a 9-dan professional without handicaps.

16 In 1997, IBM's Deep Blue beat chess champion Garry Kasparov.

17 Occupations should be viewed as bundles of different tasks. The level of heterogeneity depends on the nature and type of each occupation.

work done by humans more efficient, which in turn increases labour demand. The question of whether the displacement or the productivity effect will dominate is certainly very relevant for the new generation of technologies. For tasks that can be done on the basis of machine-learning capabilities, labour demand is more likely to fall. For tasks that cannot easily be performed by machines, labour demand is more likely to increase. For example, AI systems might replace lawyers' assistants in the preparation of contracts and other paperwork and might help lawyers to have their files better-organised when they perform tasks that require their physical presence. Each time a machine-learning system crosses the threshold where for a particular task *"it becomes more cost-effective than humans, profit-maximising companies will increasingly seek to substitute machines for people. This can have effects throughout the economy, boosting productivity, lowering prices, shifting labour demand and restructuring industries"* (Brynjolfsson and Mitchell, 2017).

In assessing the implications of AI on the workforce, it is important to fully understand the transformative power of AI. Even labour demand within the ICT sector will not remain unaffected. While previously, creating a new computer program required a significant contribution from computer programmers, machine-learning algorithms trained by relevant data can now produce more accurate and higher-quality code and computer programs. At the same time, the costs of creating and maintaining new software can be drastically cut. Lower costs mean lower barriers to experimentation and exploration of the potential for computerisation of tasks, and will encourage the development of computer systems that will automate many types of routine workflows with little or no human intervention.

Brynjolfsson and Mitchell (2017) identified eight key criteria for job tasks that are suitable for automation:

1. A learning function can be constructed that maps well-defined inputs onto well-defined outputs;

2. Large relevant training datasets exist that enable the machine to learn and become more efficient in the provision of the task;
3. The task provides clear feedback with clearly definable goals and metrics;
4. The provision of the task does not require long chains of logic or reasoning that depend on diverse background knowledge;
5. It is not necessary to provide a detailed explanation of how the decision was made;
6. There is a margin for error;
7. The learning function should not change rapidly over time;
8. No specialised physical skills or mobility are required.

Based on these criteria, Brynjolfsson *et al* (2018) moved one step further and evaluated the suitability for automation by AI systems in the US economy of specific tasks and work activities[18]. They found that the five occupations least suitable for machine learning were: massage therapists, animal scientists, archaeologists, public address system announcers and plasterers. The occupations most suitable for machine learning were brokerage clerks, credit authorisers, morticians, undertakers and funeral directors, mechanical drafters and concierges (Brynjolfsson *et al*, 2018).

The exercise carried out by Brynjolfsson *et al* (2018) confirmed that many occupations include both tasks that are highly suitable for machine learning and tasks that are not. For approximately 400 occupations, fewer than 10 percent of tasks have very high SML scores (meaning a risk of automation above 90 percent), while for fewer than 200 occupations the percentage of tasks with equally high SML scores is around 20 percent.

18 Brynjolfsson *et al* (2018) used the O*NET database (https://www.onetcenter.org/database.html), covering 964 occupations and 18,156 specific tasks at the occupation level, which are further mapped onto 2,069 direct work activities. They computed suitability for machine learning (SML) scores, ie the higher the score, the more likely that automation of the task through machine learning is technically feasible.

This confirms that each occupation comprises a great variety of tasks, some of which are easier and some more difficult to automate. It is very rarely the case that the full range of tasks covered by an occupation can be easily automated. This observation should make us cautious when we make predictions about the risks of automation at the occupational level.

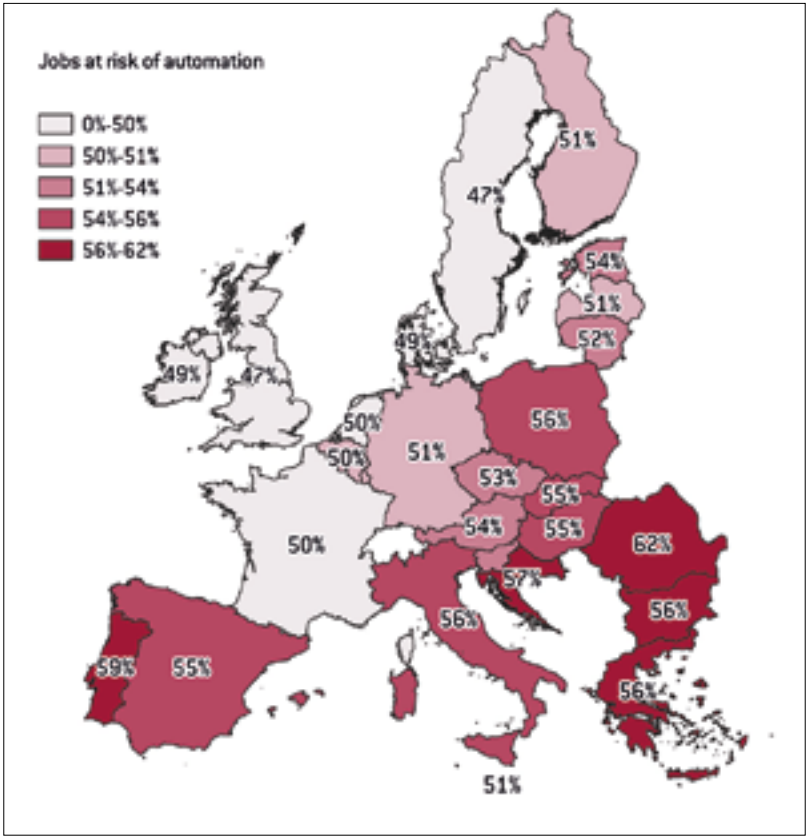
Frey and Osborne (2017) made occupational-level predictions for the US labour markets focusing on the displacement effect of new technologies and ignoring the associated positive productivity effects. In particular, they concluded that 47 percent of US occupations are at risk of automation in the next two decades. For the EU, Bowles (2014) found an even higher proportion – 54 percent – of EU occupations at risk. He concluded that the proportion of the EU work force that could be impacted significantly by advances in technology over the coming decades ranges from the mid-40 percent range (similar to the US) to well over 60 percent (Figure 3.8).

The importance of making predictions at the job-task level instead of occupational level was illustrated by Arntz *et al* (2017). They concluded that the Frey and Osborne (2017) result (47 percent of US occupations are at risk of automation in the next two decades) falls to 9 percent if predictions of the risk of automation are made with respect to tasks and not occupations. Aggregating the risk of automation at the level of occupations does not fully take into account the diversity of tasks each occupation comprises (with respect to the probability of automation).

Moreover, these studies focus on the feasibility automating different occupations/tasks. They ignore market developments, investment by firms and government interventions. They only provide a proxy for the displacement effect without estimating the associated productivity effects and the potential creation of new job tasks. A complete model would require taking a general equilibrium approach that takes into account other important factors that will affect the impact of automation on jobs. Unfortunately, such an equilibrium analysis has not been

done so far because AI and machine-learning technologies and their diffusion are quite recent and there is insufficient available data.

Figure 3.8: Risk of automation for occupations in EU countries
Source: Bruegel based on Frey and Osborne (2017).



Interestingly, Brynjolfsson *et al* (2018) concluded that the correlation of the suitability of tasks for machine learning with wages for each task is very low. That might suggest that machine learning is a very different technology from earlier types of automation and affects a different set of tasks. While the last waves of automation led to an increase

in job polarisation mostly explained by the routine-biased technological change hypothesis (see chapter 2), it is not at the moment clear that machine learning will have the same effect. If AI systems can provide expert advice that is more valuable to medium or low-skilled workers, it might benefit them relative to high-skilled workers and reduce the gap between them. However, it should not be overlooked that in contrast to earlier types of automation, such as industrial robots, AI targets more cognitive rather than physical tasks and can be viewed as a general purpose technology with a great variety of applications.

3.5 AI systems and creation of new jobs

As well as impacting current job tasks, AI systems have the potential to create new ones. A study by Accenture (2017) identified the categories of new jobs that will be created through the application of AI systems.

For example, human workers will be needed to teach AI systems how they should perform. AI trainers will help natural-language processors and translation systems make fewer errors, and they will teach AI algorithms to mimic human behaviour. For example, the conversational analysis tool Gong has created an algorithm that tries to teach AI systems when people are sarcastic and when they really mean what they say. In order to do that, it uses Twitter messages as the training data for its algorithm.

A second category of jobs involves unfolding the hidden or black box layers of AI systems (see section 3.2). While the input and output layers of a neural network structure can be readily observed, the same does not apply for the hidden layers via which the AI system processes the input variables to deliver the output. Sometimes, it is difficult even for the designers of the AI systems to know what exactly happens in the hidden layers of complex AI systems. Governments have already started to regulate in this area. For example, the EU's general data protection regulation has created a 'right to explanation', allowing individuals to question and fight any decision that affects them that was made purely on an algorithmic basis. This will require explainers

who will be able to say why and how algorithms reached particular decisions. As Wilson *et al* (2017) explained: *"Companies that deploy advanced AI systems will need employees who can explain the inner workings of complex algorithms to non-technical professionals.* [...] *For instance, if an expert recruiting system has identifi ed the best candidate for a research and development job, the employee could identify the variables that led to that conclusion and explain why someone was hired or passed over for promotion* [...] *and explain why someone was hired or passed over for promotion."*

A third category of new jobs will help ensure that AI systems operate as designed and that unintended consequences are addressed. Wilson *et al* (2017) found that less than one-third of companies had a high degree of confidence in the fairness and auditability of their AI systems, and less than half had similar levels of confidence in the safety of those systems. New employees thus need to be hired who will act as arbiters to upholding norm of human values and morals. If, for example, an AI credit approval system were to discriminate against people in certain professions or specific geographical areas, the employees should intervene and correct that behaviour.

A common characteristic of these categories is that they all require advanced knowledge of how algorithms are designed and function. Jobs related to ICT and computer science are therefore further expected to flourish. This, of course, does not mean that new jobs in other sectors and disciplines will not be created. It is too early to assess broad categories of new jobs in other disciplines.

3.6 Further implications of AI systems

The applications of AI can be classified into two broad categories of job tasks (Ernst *et al*, 2018), each of which generate some concerns from the point of view of workers:

1. Matching tasks: tasks that involve the matching of supply and demand. Machines are becoming significantly faster and more

efficient in identifying matches in these markets. They are also becoming cheaper in their matching tasks, so that companies find it attractive to rely on such systems. A popular application of AI systems that perform matching tasks is in collaborative platforms. While machines augment revenue possibilities through the sharing, renting or selling of individual's underutilised assets, this might come at the cost of worsening working conditions for the suppliers of services, whether or not they are classified as employees. In chapter 4, we discuss the risks involved in platform work, especially in relation to social protection.

Moreover, as De Stefano (2018) points out, privacy protection might be inefficient when AI systems make real-time monitoring of employees possible at low cost. More and more workers, for instance, use wearable work instruments that register their movements and location minute by minute, also measuring how fast they work and the breaks they take (Moore *et al*, 2018). These systems can also be used to check, for example, if these workers gather in specific locations, to prevent or react to collective action (De Stefano, 2016).

2. Classification tasks: such tasks include, for example, medical applications (diagnosis based on X-rays), legal services (reading and classification of legal documents), accounting and auditing (analysis of balance sheets, fraud detection) and recruitment (screening applicants). In the case of platform work, bad scores or performance below the algorithm's standard can lead to the exclusion of the worker from the platform. Workers live in constant anxiety about ratings and how platforms' algorithms take ratings into account when assigning the next job (FEPS, 2017). Such practices could also potentially lead to unfair discrimination. For example, companies might differentiate between categories of employees in terms of the working conditions, wages, benefits or responsibilities they offer. In such cases, discrimination raises the barriers to entry

to sensitive groups and minorities that find it necessary to accept lower wages or worse conditions in order to work and earn some revenue. Automated systems can replicate this bias (for example, consider access to loans, with African Americans reportedly facing higher barriers to access to the loan market). However, biases can occur when recruitment decisions are taken by humans. There is no empirical evidence that suggests AI systems are more biased than humans.

The application of AI systems could also have an impact on young people entering the work force. Let us consider again the example of the lawyer who uses an AI system to assist him/her in the preparation of contracts and documents. Such assistance can help the lawyer focus and perform more efficiently the tasks that require human presence and interaction, and therefore are not easily automated. However, AI might provide the lawyer with less incentive to hire a recent graduate from a law school for the secondary tasks of organising files and documents if such tasks can be performed by an AI system. Or at least, the young adult that enters the labour force needs to have an adequate knowledge of how to interact with the AI system in the provision of such secondary tasks. AI systems might therefore create some challenges in terms of the education and training of young graduates and their integration into the labour force.

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4 The rise of the collaborative economy and new forms of work

In this chapter, we discuss the growth of the collaborative economy, provide working definitions of the terms that frame the debate on the future of work in an era of increasing digitalisation, and discuss the particular challenges that platform work and other flexible forms of work have raised.

4.1 Definitions and characteristics of the collaborative economy

Over the past few years, new business models have emerged in the economy, empowered by digital technologies. These have disrupted a range of activities, from food delivery and transportation to accommodation and venture capital. Digital companies and their new business models collectively make up the platform economy. The diversity of lines of business and approaches makes it challenging, however, to study the platform economy as a general concept (see Petropoulos, 2017, for a more extensive description).

The main participants in the collaborative economy are:

- Service providers who share assets, resources, time and/or skills. They can be either private individuals offering services on an occasional basis ('peers') or professional service providers;
- Users who consume the assets provided;
- Intermediaries that connect providers with consumers via collabo-

rative platforms, and which might also facilitate other transactions such as payments from consumers to providers.

Transactions in the collaborative economy do not generally lead to a change of ownership. By using information technologies, intermediaries can capture the underlying preferences and characteristics of potential providers and users and can match supply of and demand for assets in an efficient way. Intermediaries typically charge fees in the form of a percentage of the value of each transaction.

Use of technology to provide valuable information about the quality of products and services can be very beneficial for the economy. Akerlof (1970) showed how the quality of goods traded in a market can degrade or even lead to market failures if buyers and sellers do not have equal access to information.

Our concern here and throughout, however, is not on the trading of goods, but rather on the trading of labour. Because we focus on platforms as labour markets, we exclude many well-known platforms such as eBay and AirBnB that deal primarily not with labour, but rather with the trading of goods and the renting of accommodation, respectively (Codagnone *et al*, 2016).

4.2 Definitions and characteristics of platform work and of social protection

Eurofound defines platform work as *"an employment form in which organisations or individuals use an online platform to access other organisations or individuals to solve specific problems or to provide specific services in exchange for payment"*[19]. The main features of platform work are:

19 European Foundation for the Improvement of Living and Working Conditions. See https://www.eurofound.europa.eu/observatories/eurwork/industrial-relations-dictionary/platform-work.

- Paid work is organised through online platforms;
- Three parties are involved: the online platform, the worker and the client;
- Work is contracted out;
- Jobs are broken down into tasks; and
- Services are provided on demand.

Platform work can be delivered either online or locally (in person). The most common tasks performed include:

- Professional tasks (for example, software development or graphic design);
- Transport (for example, personal transport or food delivery);
- Household tasks (for example, cleaning); and
- Micro tasks (for example, tagging images on web pages)[20].

The definition of non-traditional work is also important. The International Labour Organisation defines non-standard work as referring to *"jobs that fall outside of the realm of standard work arrangements, including temporary or fixed-term contracts, temporary agency or dispatched work, dependent self-employment, as well as part-time work, including marginal part-time work, which is characterised by short, variable, and often unpredictable hours"* (ILO, 2016).

Note that we refer throughout to platform workers. Given the variety of their relationships with platforms, we take no position on whether these workers are more appropriately viewed as non-traditional workers or self-employed contractors under current law, a topic that is being actively debated in many jurisdictions (see chapter 5), and the answer to which would tend to be heavily dependent on specifics of a particular case. Our focus instead is on identifying the characteristics that are relevant to determine the extent of social protection

20 Ibid.

platform workers should enjoy and the optimum policy goals, though noting that law might need to adapt to accommodate these emerging policy needs.

On social protection, the European Commission (2018b) describes social security (roughly synonymous with social protection) as follows: *"Social security serves to protect people against the financial implications of social risks, such as ill health, old age or job loss, and contributes to preventing and alleviating poverty and social exclusion."*

4.2.1 A classification of labour-intensive collaborative-economy platforms

Labour-intensive services are economic activities where most of the added value is generated by workers rather than by assets, machinery, buildings, knowledge, land or raw materials. For example, the internet ride-sharing service Uber and the internet labour-sharing service Amazon Mechanical Turk (AMT, https://www.mturk.com/) both rely heavily on the provision of labour by Uber drivers and AMT 'Turkers,' respectively. While the cars and computers used to provide these services are crucial, the labour of the worker is the essence of the service that is being sold.

Platforms change over time. It is possible that some platforms that function mainly as labour markets today might have little dependence on labour in the future. For example, if Uber rolls out an autonomous vehicle fleet as intended[21], it might become progressively less dependent on labour, and might evolve into a platform that primarily sells fully automated services. Likewise, the platforms facilitating outsourcing of routine and cognitive tasks (such as AMT) might ultimately turn to automation. Machine-learning professionals have long used these platforms for labelling datasets (Sorokin and Forsyth, 2008), which can then be used to train algorithms that can then label any new data,

21 Darrel Etherington (2018) 'Uber CEO hopes to have self-driving cars in service in 18 months,' *TechCrunch*, 23 January, available at https://techcrunch.com/2018/01/23/uber-ceo-hopes-to-have-self-driving-cars-in-service-in-18-months/.

effectively learning the exact task that was previously performed by platform workers and reducing or eliminating the labour intensity of the service provided.

Codagnone *et al* (2016) classified the wide spectrum of existing online platforms into two categories: online labour markets (OLMs) that provide the entire service electronically, and mobile labour markets (MLMs), where the delivery of the service is physical. Amazon Mechanical Turk services such as classification of photos or videos, or data cleansing, constitute an OLM inasmuch as no physical delivery is required. Uber services by contrast represent an MLM, since a car must physically appear at the requested location.

OLMs are potentially global, since the electronic services can potentially be delivered anywhere. MLMs are generally localised, because the services must be physically delivered.

Most MLMs are peer-to-peer, while most OLMs are peer-to-business.

Codagnone *et al* (2016) notes that there is a wide variation in the level of skill required between these two categories, and also within each category. Noteworthy examples include:

- OLMs for low-skill tasks, such as micro-tasking (eg object classification, tagging, transcribing, marketing spam, data entry, content reviews, website feedback), which are traded takes via markets such as Amazon Mechanical Turk. Micro-tasking here refers to highly standardised, repetitive tasks that are paid for per piece.
- OLMs for high-skill tasks, such as entirely self-contained creative projects (eg software development, engineering and data science, graphic design, clerical and secretarial work), in which are traded via platforms such as Upwork.
- MLMs for low-skill tasks, such as local routine physical services (eg TaskRabbit, Uber).
- MLMs for high-skill tasks, such as interactive services (eg TakeLessons).

Another aspect is the degree of control platforms exercise over the conduct of work, which is a key element in determining whether workers should be viewed as truly self-employed or as disguised employees. A four-quadrant classification would be based on the OLM/MLM split on the one hand, and on the degree of control on the other. This classification is similar to the one proposed by Forde *et al* (2017).

Box 1: The European Union Court of Justice ruling on the status of Uber

Launched in 2009, Uber Technologies Inc. (Uber) is a platform facilitating ridesharing and, more recently and to a lesser extent, food delivery. We focus on the ridesharing side of the business. Uber enables individuals ('users') to request a car with driver to drive them to an agreed location. This request is then forwarded by Uber to its network of drivers currently available in the vicinity. Different types of ride cater to different needs: economy (uberX, uberXL, UberSELECT), premium (UberBLACK, UberSUV, UberLUX), wheelchairs and baby-friendly cars, and Carpool (uberPOOL) (Uber, 2018). Because it involves physical routine work, Codagnone *et al* (2016) classified Uber as a mobile labour market for low-skill tasks.

Importantly, it is Uber that charges the passenger and that makes the payment to the driver – the passenger does not pay the driver, as in a typical taxi. Depending on the city, Uber decides the fare either upfront or after the trip. When the fare is determined upfront, it depends on a base rate, a rate for estimated time and distance of the ride, and the demand for drivers in that area. Uber collects the fares from users. Once a week, it transfers the money made by the driver to his/her bank account. Uber also takes a service fee on every ride (Uber, 2018). Although Uber has not been transparent about the amount of this fee and how it is computed, some industry analysts have estimated that it has increased over the years and is now much higher than 25 percent of the fares (Ridester, 2018).

The EU Court of Justice (CJEU) in 2017 ruled that Uber should be classified and regulated as a transport service rather than as an online information society service. The CJEU did not specifically rule on the status of Uber

drivers (see C-434/15, Asociación Profesional Elite Taxi v Uber Systems Spain, SL, CJEU, 20 December 2017).

- Independent supply of the services: By pooling drivers and users, Uber ensures a reliable supply and demand for the service, which makes it worthwhile for both sides of the market to remain in the market. An individual driver, outside the platform, could not generate an equivalently reliable market. There is therefore no independent supply of the services.
- Influence over the conditions under which the drivers provide their service: A key factor in the CJEU ruling was the control that Uber exercises over its drivers, as demonstrated by performance standards, monitoring of execution, controlling production and assets, implementing schedules and setting the price of the service. Uber does not directly establish strict performance standards for its drivers, but it forces them to comply with local applicable regulations. Additionally, Uber maintains a mechanism for rating of drivers by users and, more controversially, vice versa. Importantly, Uber forwards ridesharing requests to drivers depending on drivers' ratings, giving priority to the highest rated-drivers. This effectively enforces a user feedback-based competitive performance standard. Uber also has the right to monitor its drivers and users through its app, and evidence was provided to the CJEU that it leverages this power to detect pickier drivers (Codagnone *et al*, 2016). While Uber has no control over drivers' cars, it does require drivers to follow local regulations in terms of vehicle standards for chauffeur services. Uber has also notoriously leveraged its variable fares to effectively enforce schedules for drivers, favouring drivers working at unsocial hours. Finally, Uber sets the price of its service. The CJEU consequently concluded that Uber exerts a "decisive influence" over the service provided.

Sources: Owen Bowcott, 'Uber to face stricter EU regulation after ECJ rules it is transport firm', The Guardian, 20 December 2017, available at 17 May 2018 from https://www.theguardian.com/technology/2017/dec/20/uber-european-court-of-justice-ruling-barcelona-taxi-drivers-ecj-eu*; CJEU, C-434/15, Asociación Profesional Elite Taxi v Uber Systems Spain, SL, 20 December 2017.*

In any future rulings on the social protection rights of Uber drivers, other factors might be taken to account, such as:

- Financial dependence: To what extent are the drivers dependent on the Uber platform? There is likely to be substantial variability in how dependent on the platform Uber drivers are for their livelihoods.
- Profit motive: One might make the argument that drivers are not seeking profits.

4.2.2 The relationship between platform work and other forms of employment

We also need to consider how platform work relates to other forms of employment. Figure 4.1 shows the model used by the International Labour Organisation (ILO).

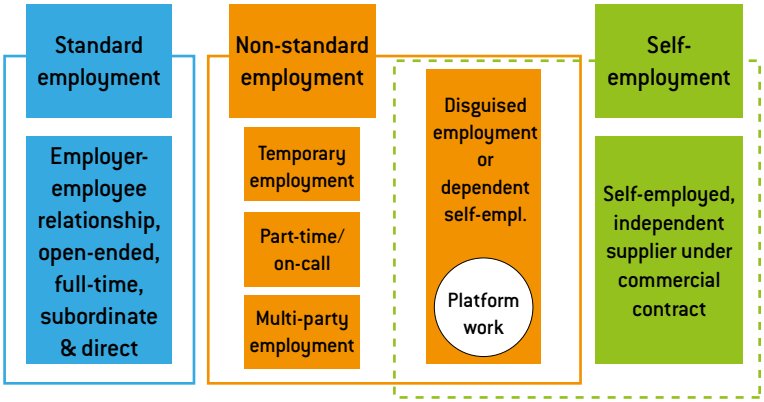
The ILO makes a distinction between standard employment and non-standard employment. Standard employment includes employment relationships satisfying four criteria: they are i) embodied by an employer-employee link, ii) open-ended and continuous (ie of indefinite duration), iii) full time, and iv) subordinate and direct.

Non-standard employment is defined as constituting forms of employment that do not satisfy at least one of these criteria (ILO, 2016). Non-standard employment therefore includes several forms of employment. Temporary employment is non-standard employment because it is not open-ended. Part-time and on-call work are likewise non-standard as they are not full-time. Multiparty employment, where a worker relies on a temporary agency or is a subcontractor to a party other than the end user of the labour, is also a non-standard form of employment because it is not direct with the end user and is not subordinate to the end user of the labour

Relationships in which the worker depends economically on a single client or a small number of clients, but where there is no employer-employee relationship, can be referred to as disguised

employment or dependent self-employment (ILO, 2016; Cherry and Aloisi, 2018).

Figure 4.1: Classification of employment relationships



Source: Bruegel, based on ILO (2016).

Platform work is not a standard form of employment. It is not embodied by an employer-employee relationship, is not open-ended or continuous, is not necessarily full-time and is not necessarily characterised by direct subordination to the employer. Some experts have argued that many platform workers should not be considered self-employed, but rather to be dependent self-employed (Cherry and Aloisi, 2018; ILO, 2018a; Forde *et al*, 2017; Codagnone *et al*, 2016). Dependent self-employment (Figure 4.1) is more likely to be found in cases of high platform control.

4.2.3 Sectors in which platform work is becoming prominent

The four sectors in which collaborative economy platforms have the most significant presence are:

- **Accommodation:** via platforms, people rent out properties or parts of properties. Examples of such companies include Airbnb,

HomeAway, HouseTrip, 9Flats, Wimdu, Onefinestay, Roomerama, Sleepout, Love Home Swap and Holiday Lettings. Airbnb provides a residential space rental platform that matches hosts and guests. Airbnb has achieved impressive scale in just a few years, offering more than five million lodging options across 191 countries. At its last financing, at time of writing, in 2017, Airbnb was valued at $31 billion[22].

- **Transportation:** Two different broad categories of platform can be distinguished in this sector. The first group of platforms facilitates the hiring of assets such as cars, motorbikes and bicycles. Examples are ZipCar, EasyCar, car2go, Autolib and Velib. The second group of platforms helps users rent assets together with labour and human capital. Examples include Uber, Lyft, BlaBlaCar, Car2go and Sidecar. Car2go offers transportation on demand using 'by-the-minute' rates. BlaBlaCar enables drivers with empty seats and paying passengers to share long-distance travel costs. Uber matches drivers with individuals who need a lift; in addition, it has branched out into food delivery, freight delivery, and more complex forms of ride hailing such as carpooling. It had 3.9 million drivers in the fourth quarter of 2018, and covered 63 countries and more than 700 cities worldwide. It generated $9.2 billion in revenue from its ride-hailing products in 2018. It is said to be hoping for a valuation in the $90 to 120 billion range in an expected initial public offering (IPO) later in 2019. Meanwhile, Uber's competitor Lyft is more narrowly focused on transportation in the US and Canada, and has set a price range for its impending IPO that would value the company at about $20

22 *Forbes* (2018) 'As A Rare Profitable Unicorn, Airbnb Appears To Be Worth At Least $38 Billion', 11 May, available at https://www.forbes.com/sites/greatspeculations/2018/05/11/as-a-rare-profitable-unicorn-airbnb-appears-to-be-worth-at-least-38-billion/#2998e01a2741.

billion[23].

- **Online labour markets:** Examples include Amazon Mechanical Turk (AMT), Adtriboo, TaskRabbit, Oltretata, Freelancer, Crowdsource, Crowdflower and Clickworker. These platforms specialise in micro-tasking. They match employers with on-demand workers.
- **Finance:** Crowdfunding platforms such as Kickstarter and IndieGogo match entrepreneurial projects with funders (venture capital financing). Peer-to-peer lending platforms such as Lending Club and Prosper connect individuals and SMEs with potential peer-lenders, without the involvement of any financial institution.

Eurofound (2018) identified 10 types of platform work that could be said to have reached critical mass in Europe in terms of the number of platforms and affiliated workers, differentiated primarily by the scale of tasks, the format of service provision (whether the tasks are delivered locally or online), the level of skills required, the process by which clients are matched to workers (offer of work versus competition) and the party that determines the work allocation. Eurofound identified:

- Local client-determined routine work (for example, when a client orders shipping services through Shiply);
- Local platform-determined routine work (for example, when a platform like Foodora determines which bike courier will deliver a meal);
- Local client-determined moderately-skilled work (for example, when a client contacts a worker through Stootie to assemble their furniture);
- Local worker-initiated moderately-skilled work (for example, when a worker contacts a potential client through Listminut to cut their lawn);

23 Lora Kolodny (2019) 'Uber is way more complicated than Lyft, and investors shouldn't value them the same way', *CNBC*, 13 April, available at https://www.cnbc.com/2019/04/13/uber-is-way-more-complicated-than-lyft-and-investors-shouldnt-value-them-the-same-way.html.

- Local client-determined expert (for example, when a client selects a worker through Appjobber to take pictures of a product in a local store);
- Local platform-determined expert (for example, when the platform BeMyEyes selects a worker to (remotely) assist a visually impaired person);
- Online moderately-skilled click-work (for example, when a worker tags images on Figure Eight);
- Online platform-determined expert (for example, when a platform like TestBirds sources software-testing tasks to a select group of workers);
- Online client-determined specialist (for example, when clients advertise and select a worker on Freelancer for business assistance); and
- Online contestant specialist (for example, when a large brand selects one or several winners in a design competition on 99Designs).

4.3 Platform work in the context of the evolution of EU labour markets

Platform work may be novel, but it is best understood as a continuation of the ongoing evolution of EU labour markets.

4.3.1 The evolution of European labour markets

Platform work is only one of the many new forms of work that have emerged in Europe in recent years. Eurofound has identified at least nine new forms of labour: (1) collaborative employment; (2) employee sharing; (3) portfolio work; (4) interim management; (5) platform work; (6) ICT based mobile work; (7) job sharing; (8) voucher-based work; and (9) casual work (2019).

4.3.2 Platform work as an aspect of labour flexibility

There is a temptation to think of the new forms of work as an altogether new phenomenon, but platform work is better understood as a further evolution of a move towards labour flexibility that was already clearly visible at least thirty years ago (as explained by Atkinson, 1984, and Atkinson and Meander, 1986, which we follow closely here).

Earlier generations might have hoped to have been employed by a single, large corporation for their entire working lives. By the 1980s, this dream had substantially eroded, especially in countries such as the United States and the United Kingdom. Many firms restructured their operations to make increasing use of part-time employees, temporary agency staff and contractors, gaining significant new flexibility by doing so. Atkinson and Meander (1986) identified three key reasons for firms to favour flexibility:

- **Productivity gains:** Firms looked to improve productivity, and to cut unit labour costs;
- **Market volatility and uncertainty:** firms sought to adapt their staffing practices to better adjust to larger and increasingly unpredictable market fluctuations;
- **Technological change:** firms felt the need for new staffing practices to accommodate new technology and to enable them to quickly introduce practices appropriate for future technology.

What kinds of flexibility do firms need to achieve these goals? The literature (see Atkinson, 1984) identified three distinct forms of flexibility:

- **Functional flexibility:** this enables employees to be quickly and smoothly redeployed between activities and tasks;
- **Numerical flexibility:** this is the ability to rapidly ratchet up and down the number of hours worked to match demand;
- **Financial flexibility:** this is the ability to rapidly adjust the cost of

pay and benefits to reflect the state of supply and demand in the external labour market.

This flexibility was (and continues to be) important for the EU, and represents a necessary complement in terms of labour to the single market for goods. Sapir (2006) argued that without *"… the liberalisation of labour markets … and greater labour mobility within and across companies, the liberalisation of product markets* [is] *unlikely to trigger the reallocation of resources necessary to produce higher growth."*

A distinction can be made between primary labour markets and secondary labour markets. The former are for employees with firm-specific skills that the firm seeks first to build (through training and development) and then to retain (through attractive terms and conditions, fringe benefits and promotion opportunities). These markets are largely internal to the firm.

Secondary labour markets are for those with general, transferable skills or no skills at all. Since these workers are fungible, the firm has little incentive to train or retain them. In contrast to primary employees, secondary labour market conditions are broadly tied to the external labour market (Atkinson, 1984).

The evolution of the 1980s (see again Atkinson, 1984) led to the emergence of four main categories of worker:

- A *core group* of full-time employees, such as managers, designers, technical sales staff, quality control staff, technicians and skilled craftsmen;
- A *first peripheral group* of full-time employees, but with more limited job security and career opportunities;
- A *second peripheral group* under more flexible contractual arrangements, such as part-time workers (twilight shifts, overlaid shifts, peak manning), job sharers, temporary contractors or public subsidy trainees.
- An *external group*, where jobs are not firm-specific at all, either

because they are highly specialised or because they are routine and low skill. These functions might be contracted out or handled by temporary help agencies.

For the core group, with firm-specific skills that are not readily available in the outside labour market, training and retention are important. This is less the case for the peripheral groups, and is not important for the external group (see Table 4.1).

Table 4.1: Evolution of firms to achieve labour flexibility

Group	Basis for pay	Skills	Training and retention	Job security
Core group	Performance	High, firm-specific	Important	High
First peripheral	Hours worked	Moderate	Less important	Moderate
Second peripheral	Hours worked?	Low	Unimportant	Low
External	Tasks done?	High or low, but not firm-specific	Unimportant	Nil

Source: Bruegel based on Atkinson (1984).

How does this relate to collaborative economy work? It is fairly clear that a driver for Uber or Lyft performs a rather low-skill job that requires only limited firm-specific skills and minimal training. In fact, the skills are so general and limited that we can reasonably expect their jobs to fall victim to automation once self-driving cars are sufficiently reliable. Whether their work is more akin to that of the second peripheral group (ie employees under flexible contracts) or the external group (independent contractors) is precisely the question that has occupied courts and regulators in various countries and municipalities in recent years (see chapter 5).

Platform work is, however, very diverse. The micro-tasking undertaken via Amazon Mechanical Turk (see section 4.2.3) does not require any firm-specific skills, and thus fits more easily into the external

group of the Atkinson (1984) model. Those highly-skilled workers who provide work through profession-specific platforms that rely on freelancers, project managers and other professionals[24] could be better likened to the first peripheral group.

It is important to note that the literature on labour flexibility places its focus on benefits to the firm. The impact on employees is considered to only a limited extent, but it was generally expected for secondary employees (in peripheral and external groups) that *"conditions of employment seem likely to deteriorate substantially – payments for non-worked time (holidays, sickness and pension) are likely to be most badly affected"* (Atkinson, 1984).

It is also worth noting that the technology embodied in these new collaborative-economy firms could potentially offer flexibility not only to firms but also to workers. Where labour flexibility historically pushed many workers outside of prime shifts, platform workers might have the option (within limits) to work the hours they choose to work. This is clearly the case for many of the most prominent platforms, including Amazon Mechanical Turk and, to some extent, Uber (section 4.2.3).

4.4 Empirical evidence on the extent of the collaborative economy and platform work in the EU

Describing the platform economy and platform work in the EU has proved challenging for researchers (Pesole *et al*, 2018; Forde *et al*, 2017; Codagnone *et al*, 2016). Even figuring out the size of such a novel and decentralised industry has been difficult, and estimates for the EU vary widely. Beyond broad aggregate figures, there are also significant differences in estimates of many aspects of platform work, ranging from the age of participants to the type of work carried out via platforms.

24 Consider for example the Upwork platform. See https://www.upwork.com/i/how-it-works/client/.

Box 2: Challenges in measuring the collaborative economy

The collaborative economy is a new phenomenon. Many of the tools and techniques experts use to measure economic activity do a poor job when applied to the collaborative economy.

To begin with, the definitions of different forms of economic activity embodied in the *Statistical Classification of Economic Activities in the European Community* (or *NACE* based on its acronym in French) do not cleanly map onto the many emerging collaborative economy activities. National statistical agencies in Europe are consequently not currently set up to track collaborative economy activities.

Second, who are the providers of services? It is difficult and potentially burdensome to capture small scale, non-professional providers of services.

Third, even though platforms generally have information about their service suppliers, EU data protection rules might limit the ability of service providers to provide information about their suppliers to independent researchers. Or perhaps platforms use privacy obligations to justify refusals to provide data that they do not wish to provide – it is hard to judge.

Fourth, administrative data (such as income declarations) will often be known to public authorities, but there is no systematic reporting of the collaborative economy as such and public authorities are typically not permitted to make this data available to independent researchers.

Web scraping can be used to capture some of this data, but the choice of data to be scraped tends to differ from one collaborative economy platform to the next. Obtaining an integrated and coherent picture of the collaborative economy can be labour-intensive, if it can be done at all.

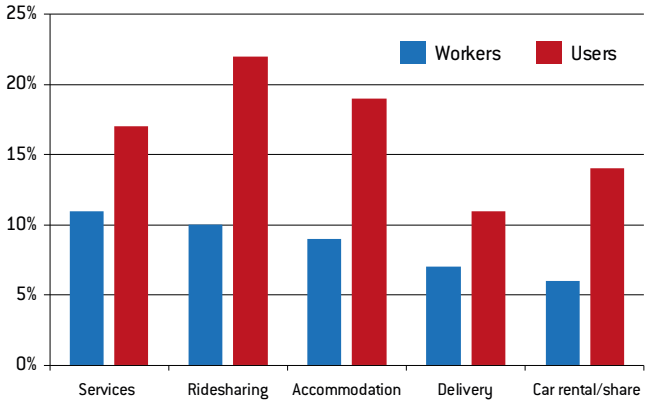
In the longer term, it seems clear that it will be necessary to identify the data that policymakers truly need, and to have national statistical agencies collect it systematically. Unfortunately, we are a long way from that point. Since data obtained via web-scraping techniques will tend to focus only on specific aspects of the operation of these platforms, and in light of the limitations likely to be found in the data obtained, it is challenging to derive broad policy lessons from web-scraped data.

4.4.1 Size and scope of the collaborative economy in the EU and the United States

Despite the limitations noted in Box 2 some useful survey data is available for the United States, and somewhat less for the EU.

According to a 2015 survey of 3,000 Americans (Burson-Marsteller *et al*, 2015), 44 percent of the population have used collaborative platforms. Corrected for internet usage and demographics, the data shows that almost all of the people involved in the collaborative economy have used the services (42 percent) of a collaborative platform and about half have worked (22 percent) through a collaborative platform.

Figure 4.2: Share of the US population share that participates in collaborative economy (2015)



Source: Burson-Marsteller *et al* (2015).

Figure 4.2 shows the share of the US population that participates in the collaborative economy. Providers primarily offer services such as home repair and moving (11 percent), ride sharing (10 percent), accommodation (9 percent) and, to a lesser extent, food delivery (7 percent) and car rental/sharing (6 percent). The services provided are quite evenly spread across the different types of service identified in Burson-Marsteller *et al* (2015). Demand meanwhile is more biased

towards ride sharing, accommodation (19 percent) and services (17 percent). Providers and users have, on average, offered or used services from two types of platform.

Recognising the need for better data on the size and scope of the collaborative economy in Europe, the Commission's Joint Research Centre (JRC) initiated the *COLLaborative Economy and Employment* (*COLLEEM*) survey in 2017. Based on the data developed by the COLLEEM survey, Pesole *et al* (2018) found that 11.9 percent of internet users between 16 and 74 years old in 14 EU countries[25] have earned income at least once by providing services via online platforms. When adjusting for internet usage, this figure corresponds to 9.7 percent of the total population between 16 and 74, or around 37 million people. In terms of frequency, they found that 7.7 percent of the population between 16 and 74 worked via platforms at least once a month, and 5.6 percent regularly worked via platforms for ten or more hours per week. However, Forde *et al* (2017) concluded based on surveys and literature that between 1 percent and 5 percent of the adult population of the EU has provided paid services through the platform economy at least once, far lower than the Pesole *et al* (2018) figure of 9.7 percent.

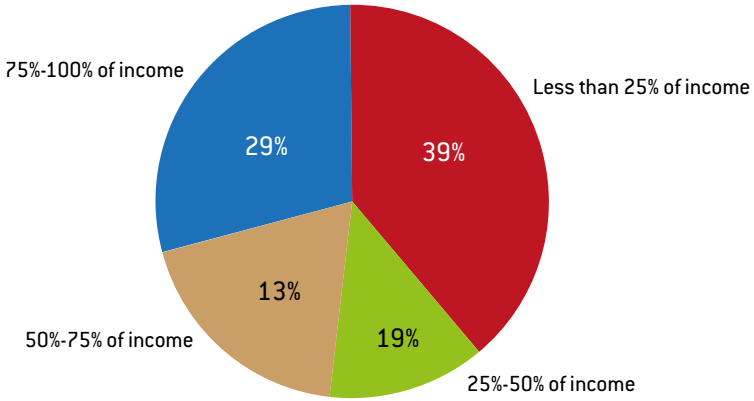
Platform work is more prevalent in some EU countries than others, but the reasons are not immediately evident. In the UK, 11 percent of the working age population has worked at least once via platforms, while in Sweden, 12 percent of the working age population has worked at least once via platforms (Codagnone *et al*, 2016). In a survey of 2,000 working-age adults carried out between January 2016 and April 2017, Huws *et al* (2018) found that the proportion of respondents reporting doing some platform work was 9 percent in the UK and the Netherlands, 10 percent in Sweden, 12 percent in Germany, 18 percent in Switzerland, 19 percent in Austria and 22 percent in Italy.

25 Croatia, Finland, France, Germany, Hungary, Italy, Lithuania, Netherlands, Portugal, Romania, Slovakia, Spain, Sweden and the United Kingdom.

4.4.2 To what extent do workers depend on platform work?

Figure 4.3 shows the share of household income derived from the collaborative economy for US families that are active in the collaborative economy: 39 percent of these households earn less than 25 percent of their income from the collaborative economy, while 29 percent rely heavily on income earned via collaborative economy platforms.

Figure 4.3: Percentage of household income derived from the collaborative economy, US families, 2015



Source: RFS 1099 Report, Bloomberg.

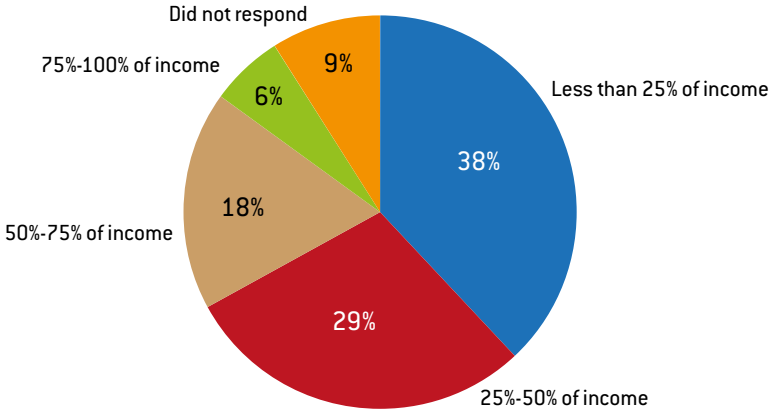
Pesole *et al* (2018) provided a similar detailed breakdown of how much of the income of platform workers in the EU comes from platform work based on data from the previously mentioned COLLEEM survey. The survey did not distinguish between personal income and family income.

From their own survey, Forde *et al* (2017) found that a quarter of platform workers depended on platform work for at least 70 percent of their income[26]. While this estimate is much higher than that in Pesole

26 Their survey covered 1200 platform workers using Amazon Mechanical Turks, Clickworker, Crowdflower and Microworkers (Forde *et al*, 2017).

et al (2018), the magnitude suggests that there is a significant minority of platform workers who are dependent on platform work for most of their income.

Figure 4.4: Percentage of income derived from platform work, EU families, 2017



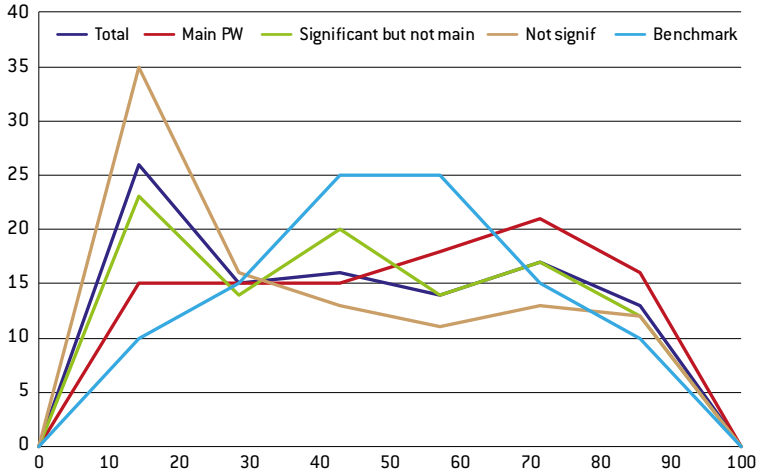
Source: Bruegel based on Pesole *et al* (2018).

On the other hand, Huws *et al* (2018) reported that platform work contributed a much smaller proportion of total income for most respondents to their survey. It contributed more than half of all personal income for only 2.3 percent of the total sample in Austria, 3.5 percent in Switzerland, 2.5 percent in Germany, 5.1 percent in Italy, 1.6 percent in the Netherlands and 2.7 percent in Sweden and the UK – forming the main source of income for an average of 2.9 percent of respondents in the seven countries of their sample.

In assessing reliance on platform income, Pesole *et al* (2018) considered income earned by platform workers from platform work and from wages, and also income from other sources such as rent and capital gains. Their analysis offers two insights. First, they found that individuals in the lowest income decile are overrepresented among platform workers, representing 26 percent of platform workers

(compared to the 10 percent benchmark that would be expected if all deciles were equally likely to participate in platform work). Second, there appears to be a slight polarisation in the income distribution of platform workers, particularly for those workers who rely most on platforms. As well as the overrepresentation of individuals from the lowest income decile among platform workers, individuals from the highest income decile are also overrepresented among platform workers. This is associated with a systematic underrepresentation among platform workers of individuals with an income between the 25th and 75th percentile (Pesole *et al*, 2018), as shown in Figure 4.5.

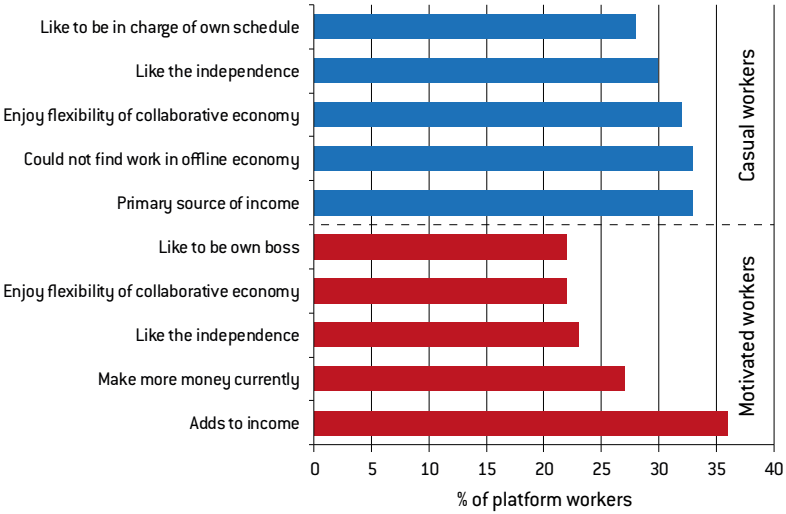
Figure 4.5: Distribution of platform workers per income decile



Source: Bruegel, based on Pesole *et al* (2018). Note: 'Total' refers to the entire sample of platform workers. 'Main PW' refers to platform workers who earn >50 percent of income from and/or spend 20 hours per week on platform work. 'Significant but not main' refers to platform workers who earn between 25 percent and 50 percent of their income from and/or spend 10 to 20 hours per week on platform work. 'Not signif' refers to platform workers who earn less than 25 percent of their income from and spend less than 10 hours per week on platform work, but have worked at least once on platforms. Finally, 'Benchmark' is the theoretical distribution representative of society as a whole.

In order to understand whether platform workers should be thought of as employees versus self-employed, it is interesting to consideration the perceptions of platform workers themselves. In the EU, 38.1 percent of platform workers who rely on platforms for most of their income, or who regularly work 20 hours or more per week via platforms, regard themselves as employees and do not consider themselves to be self-employed (Pesole *et al*, 2018). In other words, many dependent platform workers consider themselves to be *de-facto* employees even though they have a self-employment contract.

Figure 4.6: Reasons for joining collaborative economy platforms (US, 2015)



Source: Burson-Marsteller *et al* (2015).

Figure 4.6 shows that the 36 percent of those platform workers who earn less than 40 percent of their monthly income in the collaborative economy (ie those who are least dependent on the collaborative economy, referred to by Burson-Marsteller *et al* (2015) as 'casual workers') participate in the collaborative economy in order to add to their income. Smaller percentages of these workers are attracted primarily because of the flexibility of work in collaborative economy business models.

The same data also indicates that the 33 percent of workers who earn more than 40 percent of their monthly income in the collaborative economy (ie those who have greater dependency on the collaborative economy, referred to by Burson-Marsteller *et al* (2015) as 'motivated workers') consider the collaborative economy to be the primary source of their income, the same percentage as those who work in the collaborative economy because they could not find work in the offline economy. A nearly equal share work in the collaborative economy because they value the independence or flexibility that it provides.

4.4.3 Who are the platform workers?

The demographic composition of the collaborative economy workforce is also important to understand because it is a factor in determining social protection needs. The typical platform worker is younger than other workers, with median age of 34 compared to 44 for other workers. Nevertheless, there is also a significant minority of older individuals and retired people employed in the platform economy (Pesole *et al*, 2018; Forde *et al*, 2017; Codagnone *et al*, 2016). Among platform workers, the younger the worker, the more likely the worker is to rely on platform work as a source of income (Pesole *et al*, 2018).

Gender also plays a role, reinforcing the conclusions of Forde *et al* (2017). Males are more likely than females to perform platform work. Women constitute 47.5 percent of non-platform workers in the EU, 40.2 percent of workers using platforms only occasionally, 31.2 percent of workers who use platforms frequently but not as their main job, and 26.3 percent of workers who rely on platforms as their main job[27].

In terms of education, of the population between 25 and 75 years

27 Pesole *et al* (2018) defined these categories of platform workers more rigorously: i) not significant platform work (<25 percent of income derived from platform work and <10 hours of platform work per week, but have worked at least once on platforms); ii) significant but not mainly platform work (>25 percent and <50 percent of income and/or 10 to 20 hours of platform work per week); iii) mainly platform work (>50 percent of income and/or 20 hours of platform work per week).

old, Pesole *et al* (2018) found that the share of platform workers with tertiary education was consistently above 50 percent, regardless of the intensity of their usage or their reliance on platforms. This is in striking contrast to the share of non-platform workers with tertiary education, which is 36.2 percent. These results are similar to the results of the survey done by Forde *et al* (2017), and to the review of the available evidence in Codagnone *et al* (2016).

Platform jobs span a wide range of human capital needed, although once again there are significant difficulties in assessing the relative importance of each type of service (Pesole *et al*, 2018; Codagnone *et al*, 2016). Pesole *et al* (2018) found that the most prevalent type of task was online clerical and data entry, involved in 43 percent of platform jobs. These tasks are typically considered as routine and requiring less skill. This finding is in line with Forde *et al* (2017). However, the second and third most prevalent types were professionals and creative tasks, which 30 percent of platform jobs involved (note that the categories are not mutually exclusive – an individual might have performed more than one kind of platform work). These tasks are typically considered less routine and requiring of greater skills (Pesole *et al*, 2018).

4.4.4 Working conditions and the sense of well-being of platform workers

The working conditions of platform workers are diverse. Most workers who rely on platforms as their main source of income, or who depend on platforms as a significant complement to their income, report that their platform work is often stressful and routine (Pesole *et al*, 2018). Platform workers work very few hours compared to traditional workers; 28.5 percent work fewer than 10 hours a week via the platform or on other jobs. More than half work fewer than 30 hours per week, on the platform or on another job. Only 14.7 percent of platform workers work a full 40-hour week either on platform work or non-platform jobs. At the other end of the spectrum, 7 percent of platform workers work more than 60 hours per week, on platform work or other jobs (Pesole *et al*, 2018).

The survey of platform workers in Forde *et al* (2017) also sheds

some light on their wellbeing, highlighting the prevalence of unscrupulous platform users (paying less than promised, delaying pay, communicating aggressively or systematically underestimating the time required for tasks). While platform workers valued flexibility, they viewed negatively the pay levels, job security, career prospects and routineness of tasks. This resulted in mixed overall satisfaction levels among platform workers. Note however that there is substantial variability of results depending on the platform and type of task.

4.5 Challenges for platform work

The key concern with platform work is that it offers forms of employment without standard contracts and leaves workers *"without sufficient access to social protection due to their labour market status or the type of employment relationship"* (European Commission, 2018a).

The emergence of platform workers can be viewed as a growing aspect of a broader challenge. Platform work can be viewed as an aspect of labour flexibility (section 4.3.2). Non-traditional, flexible forms of labour have been expanding at least since the 1980s, largely as a means of enabling firms to cope with uncertain demand and with technological change.

Surveys and studies show that platform workers face many challenges, not only in terms of social protection, but also in terms of their overall earnings:

- Low wages: Wages earned via platforms are very low, with just a few segments of workers able to earn above middle level income (Codagnone *et al*, 2016). The average pay levels for the four platforms surveyed by Forde *et al* (2017) were significantly below minimum wage in European countries, with a gap of up to 54.1 percent between platform wages and the national minimum wage in the case of France.
- Limited ability to save or to invest in pensions: the low earnings, together with statutory limitations, mean platform workers save

very little for pensions (Forde *et al*, 2017).

- Limited access to social protection schemes: platform workers are partly or fully excluded from many forms of social protection (see chapter 5.2). The majority of platform workers surveyed had no access to social protection schemes in relation to disability, old age, pregnancy, care or unemployment (Codagnone *et al*, 2016; Forde *et al*, 2017).
- Limitations on collective bargaining rights: to the extent that they are considered to be self-employed, platform workers typically lack the right to bargain collectively (Forde *et al*, 2017; Riley, 2017).
- Intrusions on other rights: platform workers are also more vulnerable to violation of privacy and to discrimination (Codagnone *et al*, 2016).

At the same time, the flexibility that these new forms of work embody can provide benefits to the firms that organise them and to those who perform the work. In many cases, workers who might otherwise be unemployed or underemployed have a new source of income. Workers might benefit from greater choice over the hours that they work. Any policies on platform work should therefore be carefully targeted so they do not needlessly undermine these potential and actual benefits.

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5 Social protection in the EU today

In this chapter, we provide a broad overview of social protection policies in the European Union and discuss why non-traditional workers (including the self-employed) are often excluded from effective social protection, taking into account the lack of statutory coverage and practical impediments. The classification of platform workers plays an enormous role in their entitlement to social protection under current law and is an illustration of the broader problems that can be expected as non-traditional forms of work continue to proliferate. We discuss efforts to broaden the approach to social protection in light of the growing diversity and complexity of forms of work, and reflect on the development of skills and the need for lifelong learning, which must surely represent a key element in any coherent policy response to the changes in the world or work.

5.1 Social protection in the EU

5.1.1 The economic rationale for social protection

Social protection is largely about the redistribution of resources, and secondarily about facilitating intertemporal transfers of resources, such as through pensions. The proper role for public policy is debated, but it is generally accepted that government has a role to play. The French economist Thomas Piketty argues that the state should seek to counter inequality that arises from factors beyond the control of individuals (Piketty, 2015). This is often expressed in terms of the Rawlsian

philosophical *maximin* principle, *"according to which a just society should seek to maximise the minimum opportunities within the social system"* (Rawls, 1985).

Within this broader framework, the numerous individual instruments that comprise the core of the modern welfare state have emerged for a range of interrelated reasons (Piketty, 2015). Unemployment insurance for instance has never been provided by private insurers, despite the obvious benefits to those who would have been insured, largely because of the challenges inherent in *information asymmetries* between potential insurance firms and insured individuals. The individual knows how much he or she earns, but would not be motivated to report it correctly to a private firm. The individual will also tend to know much more about the risk of losing his or her job than would a private insurer. Governments are better positioned than private firms to address the information asymmetries and to carry the risks.

Information asymmetries likewise exist for health insurance. In the absence of some form of regulation, healthy individuals might effectively choose to self-insure, thus leaving private insurers with a pool of high-cost individuals. Conversely, since the insured individual has limited influence or ability to judge the underlying costs, private insurance can lead to high prices and unnecessary procedures.

On pensions, there are several arguments for a government role (Piketty, 2015). Markets might be inefficient in achieving the intertemporal transfers needed; low-income individuals might not have access to efficient investment instruments for achieving the necessary intertemporal transfers; and individuals might under-invest, prioritising short-term over long-term needs.

5.1.2 Who pays and who benefits?

The question of who pays for benefits, and how, is clearly important in this discussion. Notably, should the cost be borne by the government, the firm or the individual?

The shift from traditional full-time employment to various non-traditional forms of work, and to self-employment, exacerbates funding challenges. Governments are well equipped to collect payments when an employee is paid. Collecting from the self-employed is more difficult, verification of income is challenging and the risk of systematic underpayment is far greater. Furthermore these challenges to funding come at a time when the work force is expected to decline because of demographic changes and the share of gross value added achieved by labour is likewise in decline.

How, then, can funding best be secured? One might reasonably expect that fiscal redistribution, with funding coming from neutral taxation on profits for instance, should generally be preferred over direct redistribution. If firms are required to contribute to social protection based, for instance, on the number of workers they employ, this will tend to increase their perceived cost of labour and will lead them to employ fewer workers (Piketty, 2015). The cost of employee benefits is effectively a part of the payments that the firm makes to the worker. The argument is thus that the increased cost to the firm will tend to be reflected in the price of the goods or services, which will tend to reduce consumption because of the price elasticity of demand, or else will shift usage in the direction of less-expensive substitutes or alternatives.

In practice, however, many additional factors come into play. The increase in benefits could be expected to stimulate an increase in the number of people willing to do the work. The risk of price increases might be contained by the risk or reality of competitive entry, or by the price of imported goods or services. The degree to which the increased cost to firms leads to less employment in practice is thus debatable.

This question is closely linked to the elasticity of substitution between capital and labour. If the effective price of labour goes up, to what extent will firms substitute capital (eg investment in more or better equipment) for labour?

In speaking of social welfare systems, a distinction is sometimes made between insurance-like models similar to those introduced in

Germany in the late nineteenth century, and those like the United Kingdom's National Health Service (NHS), which is available to all. The former is referred to as Bismarck's model (named after the Germany's Iron Chancellor), the latter as Beveridge's model (after the designer of the UK's NHS). By the time that Bismarck left office in 1890, the programme he had launched already included not only health insurance, but also accident insurance, disability insurance and an old-age retirement pension.

These models differ in terms of who pays for the benefits and who is qualified to receive the benefits. In Bismarck's model, benefits are available only to the families of those who work, and are paid for by employees. In Beveridge's model, they are typically available to all, and are funded out of general taxation revenues.

Table 5.1: Different approaches to health care: Bismarck versus Beveridge

	Bismarck	Beveridge
Payments	Employers and employees	General government revenue
Beneficiaries	Employees and their families	All citizens

Source: Bruegel based on Kutzin (2011).

For many benefits, there is an argument to be made that they are important for all, not just for the families of those who work. It might also be the case that those who are not covered would have to be cared for in any case, possibly through public-assistance mechanisms that are less well tailored to the specific needs in question. For this reason, there has been a global move away from pure Bismarckian systems (Kutzin, 2011).

Health systems with Bismarckian characteristics in the EU have been under pressure in recent years because of (1) demographic change that shrinks the number of contributing workers as the population ages; and (2) reduction in consumption of health-care services during the years of economic crisis, again potentially undermining the

base of economic support (Kutzin, 2011).

As already noted, funding mechanisms should generally be preferred that do not impose increased costs per worker on firms (ie fiscal rather than direct mechanisms). This is not a question of the level of funding, but rather reflects the need to avoid depressing the number of workers.

Bismarckian systems may oblige the participation of all employees. If participation was purely voluntary, the system might attract only individuals who know that they are unhealthy. This would tend to necessitate unacceptably high premiums.

Bismarck-type solutions are arguably easier to 'sell' to the electorate. They do not involve transfer payments, and thus tend not to be perceived as disadvantaging anyone.

A challenge in crafting a Bismarckian solution for non-traditional workers is that it would need to accommodate a wide range of circumstances in a coherent way. Some independent workers might be reliant on income from independent work, making them scarcely different from employees. Others might work only a few hours per week. Some, particularly in the latter group, might be supplementing income they already earn from a part-time or full-time job. Some might switch from traditional forms of employment in one year to independent work in another year, while others might do both at the same time.

For those who perform only a minimal amount of independent work (eg in the collaborative economy), and who are not otherwise productively engaged, it might be inappropriate to expect the firm to provide the full range of social-protection benefits. Conversely, for those who work a substantial number of hours per week or month, it seems clear that they should not reach the ends of their careers and have no pension.

An ideal solution could involve a totalisation of benefits accrued from multiple sources and from multiple modes of work. Consider for instance systems such as Social Security in the United States, where contributions are made for all income, irrespective of whether it is

from wages or from self-employment income. Benefits are based on total contributions.

Especially with Bismarckian schemes, actual implementation responsibility need not rest solely with the government. Private insurance firms, unions or other organisations often have roles to play. This is particularly common for pension plans, health insurance and invalidity (disability) insurance. The development of the gig economy has contributed to the modernisation of insurance arrangements so that plans are becoming available that are better suited to new forms of work, including those in the collaborative economy.

Beveridge-type solutions make particular sense for forms of social protection from which all of society benefits (Kutzin, 2011). They protect all citizens, or all residents, not merely the families of all employees. A Beveridge-type approach might make the entire discussion of social protection for platform workers and for other non-traditional workers partly or fully irrelevant, since all would be protected by comprehensive mechanisms. However, universal protection can be expensive.

5.1.3 Comparative assessment of EU member states in terms of efficiency and equity

Sapir (2006) developed a typology that remains relevant today in which EU countries are classified relative to the EU average on two key measures that reflect labour policy: efficiency and equity. A member state's social model was considered to be efficient if it provided sufficient incentives to work and, therefore, if it generated relatively high employment rates. It was deemed to be equitable if it kept the level of poverty reasonably low.

Sapir (2006) used the national employment rate as an estimate of efficiency, and 1 minus the national poverty rate after social transfers as an estimate of equity. The reasoning was that a social system is equitable if it prevents people from falling too far behind in terms of income, and it is efficient if it still provides productive labour with

incentives to participate in the economy.

Relative to the overall EU values, member states were grouped into four quadrants:

- *Front-runners* that are both equitable and efficient;
- Those that are *inequitable but efficient*;
- Those that are *equitable but inefficient*; and
- *Laggards* that are neither equitable nor efficient.

In Sapir (2006), these quadrants were described as the Nordic, Anglo-Saxon, Continental, and Mediterranean quadrants, with each corresponding closely to the geographical placement of the member states found in each quadrant. The member states in each cluster tended to be somewhat similar in terms of key characteristics, such as their social protection expenditure levels, the strength of their unions and the degree of wage compression.

The situation has evolved considerably since Sapir's work more than a decade ago. The quadrants are still relevant, but they correspond less well today to the geographic categorisation of Sapir (2006). Two major changes are visible:

- The accession of 13 countries since 2004 brings additional variation to the EU landscape of social security systems and represents a shift in the average EU poverty rate from roughly 15 percent in 2004 to 17 percent in 2016; and
- The performance of some member states has changed markedly.

We have built on Sapir (2006) by continuing to use the employment rate, but diverging slightly by using 1 minus the 'at risk of poverty' indicator. One might imagine that 1 minus the indicator measures the likelihood of not being at risk of poverty; however, Darvas (2017) demonstrated that the 'at risk of poverty' indicator *"essentially measures income inequality, not poverty"*. The 'at risk of poverty' indicator is

available for 2005, the first full year after ten mainly former-communist countries acceded to the European Union, and only one year later than the data used in Sapir (2006). It is also available for 2016.

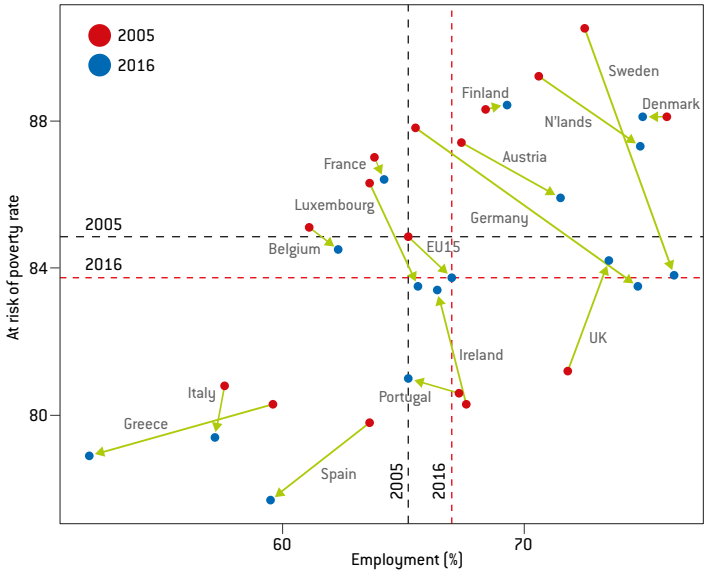
The level of labour participation in the EU15 versus the EU28 differed relatively little in 2016 (67.0 percent versus 66.6 percent, respectively), and the same is true for 1 minus the 'at risk of poverty' indicator (83.7 percent and 82.7 percent, respectively)[28]. In 2005, however, the then-new member states were not at the same level as the EU15 (with a 65.2 percent employment rate for the EU15 versus 63.3 percent for the EU28). In order to be able to compare between the years, and also to compare to Sapir (2006), we used EU15 averages to distinguish between the four quadrants in both years.

Figure 5.1 shows our results for the years 2005 and 2016, using four quadrants based on Sapir (2006). Data for 2005 appear in red, while data for 2016 appear in blue. In order to have a stable definition, however, we base our identification of quadrants on the 2005 data, which corresponds to the solid red lines in Figure 5.1.

EU15 efficiency was better in 2016 than in 2005 (with labour participation increasing from 65.2 percent to 67.0 percent). Equity, however, had worsened (declining from 84.8 percent to 83.7 percent). Graphically, the intersection of the blue lines has shifted lower and to the right compared to the intersection of the dashed red lines. Nine of the countries likewise show a trend toward greater efficiency at the cost of lower equity.

28 In this section, wherever we quote statistics for a group of member states, we are referring to the simple arithmetic mean of the individual member-state values.

Figure 5.1: Shifts in efficiency and equity among EU member states, 2005 and 2016



Source: Bruegel based on Eurostat data and the conceptual model of Sapir (2006).

Compared to the 2005 data, the 2016 data shows some noteworthy changes. At the same time, it is clear that the geographic classification of the quadrants as used in Sapir (2006) has blurred compared to the past.

Among the mainly Nordic countries that comprised the front-runner quadrant in Sapir (2006), namely Austria, Denmark, Finland, the Netherlands and Sweden, all continue to do well, but four of the five show large gains in efficiency at the expense of large declines in equity. Only Denmark shows a different trend, with a small decline in efficiency and negligible movement in equity.

Germany increased its labour participation rate by an impressive 9.2 points, but at significant cost in terms of increasing inequity as expressed by a decline of 4.3 points in the 'at risk of poverty' indicator.

The labour reforms set in motion under the Hartz Plan probably played a large role in the increase in labour participation; moreover, the increased participation of women in the German labour market (from 61.5 percent in 2006 to 70.8 percent in 2016) might have played a role.

Among the Mediterranean countries that comprised the laggard group, Spain, Greece and Italy all show substantial declines both in efficiency and in equity. In Italy and Spain, efficiency declined by 0.4 and 4.1 points, while equity declined by 1.4 and 2.1 points, respectively.

Little movement is visible among the equitable but inefficient continental countries. Efficiency in France increased by 0.4 points, while equity declined by 0.6 points. Belgium likewise shows little movement.

Among the efficient but inequitable countries that comprised the Anglo-Saxon group in Sapir (2006), Portugal and Ireland both show gains in equity coupled with a decline in efficiency. In the UK, however, efficiency increased by 1.7 points, while equity improved by 3.0 points.

Our focus here is on the EU15 in order to facilitate comparison of 2005 to 2016, but it is worth noting that some of the newer member states have also made substantial gains or losses. In Poland, for instance, efficiency increased by 11.7 points, while equity improved by 3.6 points.

This analysis has clear implications for public policy. The cluster of laggards (including the Mediterranean countries Spain, Italy, and Greece) continues to slide, and seems to be ripe for labour market reform. Within the inefficient but equitable quadrant, Belgium and France have scarcely changed their respective positions. These countries would likewise appear to be ripe for labour market reform.

Sapir (2006) argued persuasively that equity is to a significant degree a valid national political choice, but that efficiency is crucial in order to maintain competitiveness. This implies that enhancing efficiency should be a higher priority than enhancing equity. Reform

of labour policy in order to enable labour flexibility would thus appear to be in order for the equitable but inefficient quadrant, and especially for those in the laggard quadrant.

5.2 Gaps in the social protection of platform workers

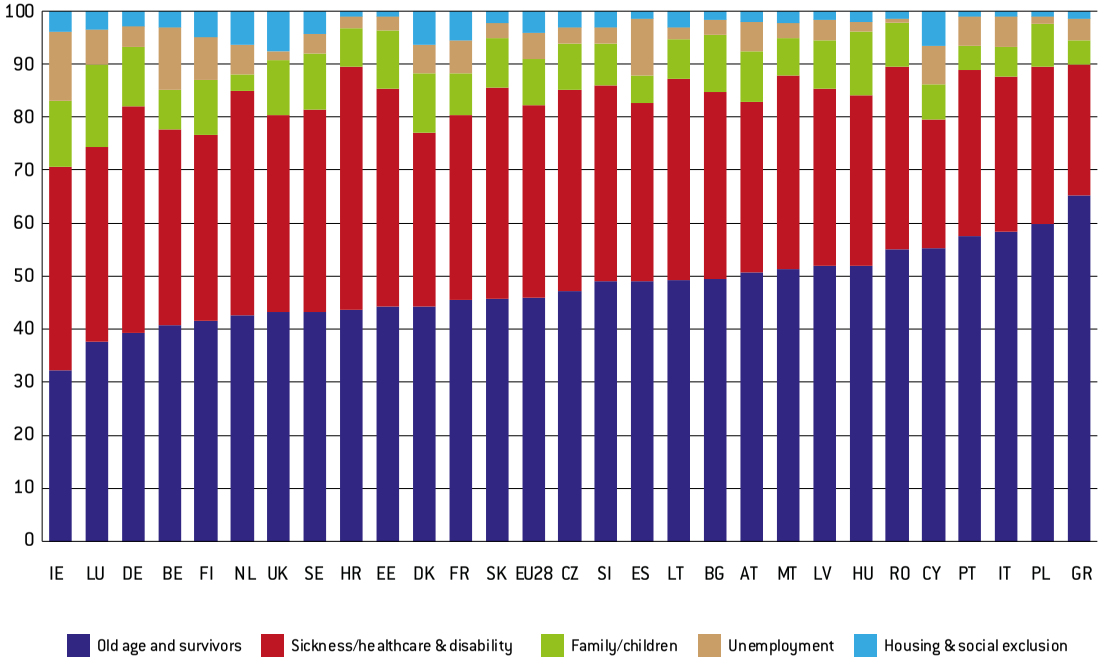
The treatment of most platform workers as self-employed, despite dependency in some cases on the platforms for which they work, raises concerns about their social protection (ILO, 2018a; Codagnone *et al*, 2016). There is a growing recognition of the need to provide for these platform workers' needs, ideally in a manner that meshes with other initiatives to achieve social protection for traditional workers, non-traditional workers and the self-employed in a comprehensive and holistic way.

There are six branches of social protection that have been prominent in the discussion of the social protection of non-traditional workers and the self-employed. These branches of social protection have been centre stage in the analysis and the policy measures put forward by the European Commission (see section 5.4.2), based on the analysis conducted in ESPN (2017). They are:

- Unemployment benefits;
- Sickness benefits;
- Maternity and equivalent paternity benefits;
- Invalidity benefits;
- Old age benefits; and
- Benefits in respect of accidents at work and occupational diseases.

To provide perspective, it is useful to consider the relative magnitudes of expenditure for these different branches of social protection. Old-age and survivors' pensions tend to be the largest spending item, followed by sickness, health care and disability, but differences between member states are substantial.

Figure 5.2: Expenditure on social protection benefits by function (2014)



Source: European Commission (2018c).

5.2.1 Gaps in statutory coverage

Existing social protection measures often provide little or no coverage of non-traditional workers in general and of platform workers in particular. These social protection arrangements were primarily designed with full-time employees in mind. Many were designed before the rise of the newer forms of non-standard employment, including temporary, multi-party or on-call, or more recently platform-based workers.

There are two main causes of limitations on the participation of platform workers in social protection schemes:

- The contracts of platform workers typically classify them as self-employed contractors. This often implies they are *de facto* excluded from social protection mechanisms provided to employees (Forde *et al*, 2017);
- Access to many benefits is conditional on a minimum number of hours worked per employer, on the duration of employment or on the earnings from a single employer (ILO, 2017). If a worker splits his or her efforts between two or more activities, or between traditional and non-traditional work, this compounds the risk that critical thresholds might not be reached.

Table 5.2 shows the statutory limitations on the main branches of social protection to which various forms of non-traditional workers are subject.

For the self-employed, the exclusions can be even more significant. Table 5.3 shows the statutory limitations to selected branches of social protection to which the self-employed are subject.

Table 5.2: Lack of formal social security coverage for non-standard workers

Benefit type	Casual workers	Seasonal workers	National specificities	Freelance	Apprentices	Trainees	Vocational trainees
Unemployment	RO, HU, MT, LT	BG, RO, LV, HU, MT, LT	AT[a], CZ[b], DE[c], PL[d], SK[e]		BE, EL, HR, MT, NL, PL	EL, FR, IT, LT, MT, NL, PL, RO	
Sickness	HU, LT, LV, RO	HU, LT, LV, RO	CZ[b], SI[d]		BE, HU, NL, PL	DK, FR, HU, LT, NL, PL	DK, EL, FR, HU, PL
Maternity	LT, RO	BG, LT, LV, RO	CZ[b], PL[d], UK[h]	BG, FR	BE, MT	FR, HU, IT, LT	EL, FR, HU, IT
Accident/ occupational injuries	RO, HR, LT	BG, LT, LV, RO	CZ[b], ES[f]				
Old age/ survivors' pensions	MT, LT	BG, HU, RO, LT	CZ[b], HU[g], LU[g], MT[h], PL[d]		BE, HR, MT	EL, FR, HU, IT, LT, MT	
Invalidity	HU, LT	HU, LT	AT[a], PL[d]				

Source: European Commission (2018c, page 137). Notes: The table reports in which branches and in which member states non-standard workers are excluded from formal coverage in the sense that they have no mandatory coverage and cannot opt–in to voluntary schemes. National specificities: a) marginal part-timers; b) agreement to perform a job; c) mini-jobbers; d) civil law contracts; e) employees on 'work agreement' with irregular income; f) domestic workers; g) on-call jobs; h) temporary agency work.

Table 5.3: Lack of formal social security coverage for the self-employed

Unemployment benefits	BE[a], BG, CY, DE, FR, IE, IT, LV, MT[b], NL, UK[b]
Sickness benefits	EL[a], IE[b], IT[a]
Accident & occupational injuries	BE, BG, CY, CZ, IE, LT, LV, NL, SK, UK

Source: European Commission (2018c, page 137). Notes: The table reports in which branches and in which member states at least one sub-group of the self-employed is excluded from formal coverage in the sense that they have no mandatory coverage and cannot opt -into voluntary schemes. a) Only one or more sub-groups of the self-employed are not formally covered. b) In these member states only means-tested benefits are available to the self-employed while they are excluded from contributory schemes.

In terms of the percentage of all workers who are entitled to key benefits such as maternity leave, sickness and unemployment cover, all member states have exclusions: however, the impacts vary substantially in different member states (Table 5.4). These restrictions impact many non-traditional workers, not just platform workers.

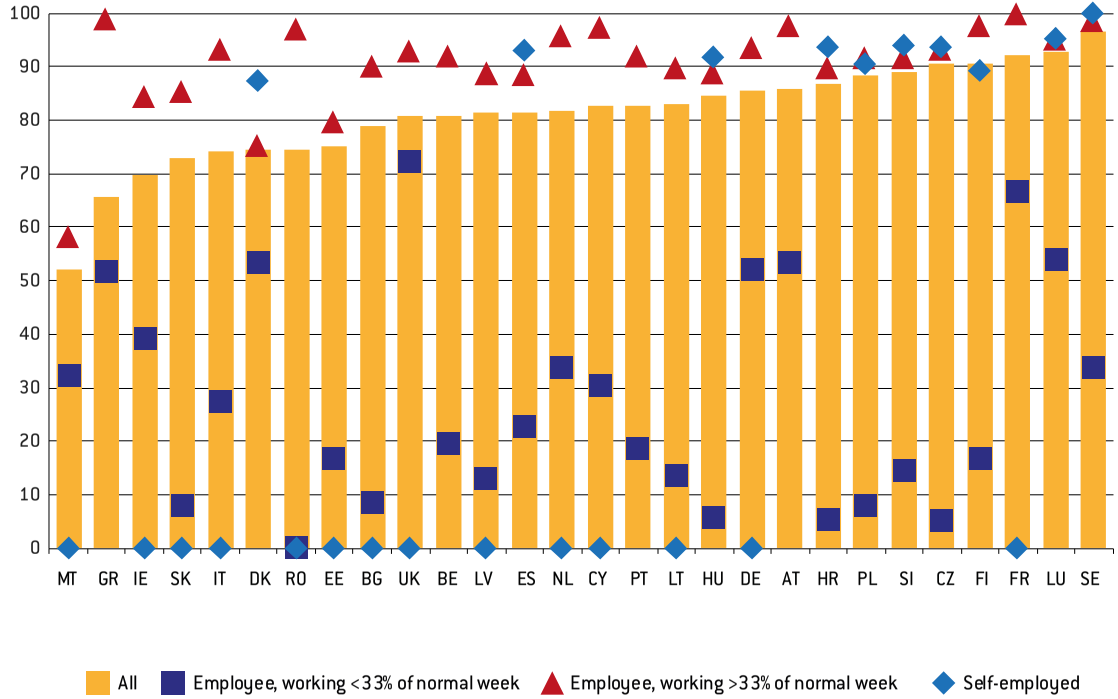
Unemployment benefits are a particularly complex case, especially inasmuch as it can be challenging to identify what constitutes unemployment for a self-employed individual. For less-than-full-time employees, the statutory right to access benefits is often conditional on the fraction of a normal number of hours worked. Figure 5.3 shows the total potential entitlement to unemployment benefits by country, as well as entitlement of individuals who worked less than 33 percent of a normal work week, those who work more than 33 percent of a work week and the self-employed (who often have no access at all to unemployment insurance).

Table 5.4: Percent of workers not entitled to social protection benefits, by type of benefit and member state (2014)

	Maternity	Sickness	Unemployment
Luxembourg	6.9	1.5	2.5
Estonia	0.2	0.5	3.2
Ireland	6.9	5.5	4.1
Czechia	11.9	14.2	4.9
United Kingdom	8.3	0.2	5.0
Lithuania	15.5	9.8	5.0
Croatia	11.4	6.4	6.4
Hungary	11.2	0.3	7.1
Slovakia	3.9	0.1	7.4
Sweden	7.4	0.1	8.1
Germany	2.6	3.5	9.5
Austria	0.9	3.7	9.8
Finland	1.3	0.3	9.9
Slovenia	12.6	4.5	10.1
Portugal	3.0	13.2	11.0
Spain	7.4	6.4	12.4
Poland	13.2	17.1	12.7
EU	7.6	7.7	12.9
Latvia	0.5	0.7	13.2
France	4.1	3.3	13.8
Bulgaria	9.3	9.4	15.1
Malta	3.8	2.6	15.4
Denmark	11.5	6.9	15.4
Cyprus	2.9	3.0	17.2
Netherlands	0.7	12.7	17.9
Belgium	9.3	2.8	18.4
Italy	15.0	23.7	24.6
Romania	15.1	11.2	28.7
Greece	9.2	19.7	35.8

Source: European Commission (2018c, page 139).

Figure 5.3: Potential coverage of unemployment insurance schemes in EU countries (2016)



Source: European Commission (2018c, page 139).

5.2.2 Gaps in access to social protection for those who have statutory coverage

Even for workers who are *formally* covered for a specific branch of social protection, there are often gaps in *effective* coverage (see also European Commission, 2018a). Many benefits are conditional on eligibility periods, or on a level of contributions over a period of years. As workers move between different forms of non-traditional work, they might not be able to meet the eligibility periods, or might not accrue enough combined time because the benefits from different forms of labour are not properly aggregated.

Rules are already in place[29] to protect social protection rights when moving within the European Economic Area (EEA), which is comprised of the EU member states plus Norway, Iceland and Liechtenstein. The rules cover sickness benefits; maternity and equivalent paternity benefits; old-age pensions; pre-retirement and invalidity benefits; survivors' benefits and death grants; unemployment benefits; family benefits; and benefits related to work accidents and occupational diseases. These ensure totalisation of benefits as an individual moves from one EEA member state to another, in accordance with the following principles (European Commission, 2018c):

- **One country only:** A person is covered by the social security system of one member state at a time so that he/she only pays contributions in one country. The person is entitled to benefits, if any, in the country where he/she pays contributions.
- **Equal treatment or non-discrimination:** A person moving to another EU member state has the same rights and obligations as the nationals of the country where he/she is insured.
- **Aggregation:** When claiming a benefit, previous periods of insurance, work or residence in other countries are taken into account if necessary (for example to demonstrate that the person satisfies a minimum period of insurance required under national law in order

29 Regulations (EC) 883/2004 and 987/2009.

to be entitled to benefits).
- **Exportability:** If a person is entitled to receive a benefit in cash from one member state, he/she may generally receive it even if he/she is living in a different member state.

Relative to platform work (and many other forms of non-traditional employment and self-employment), these measures fall short of the social protection that would appear to be needed. The European legislation that is already in place seeks to address the problem of aggregation of benefits in terms of movement between the member states, but not domestically within a member state. It applies to various forms of non-traditional work, but does not cover the self-employed, and probably does not adequately cover most forms of platform work.

5.3 Labour market policies: platform work and worker classification

Our focus in this section is on the classification of non-traditional workers in general, and platform workers in particular. This classification is crucial for today's social protection systems.

A number of countries have established a third category of employment that represents an intermediate status between the widely used categories of employee and self-employed. The rationale is that this intermediate category offers more flexibility to platform workers than the status of employee, but might also provide social protection rights that are more proportionate and fit for purpose than the limited rights provided to the self-employed (Codagnone *et al*, 2016). Third categories of employment have already been implemented in Canada, Italy, Germany, Spain, South Korea and the United Kingdom. Box 1 discusses several of these, based largely on the case study evidence in Cherry and Aloisi (2018).

Box 1: Countries that have established a third category of work

Canada: In Canada, the concept of a third category of work was legally established in the 1970s for 'dependent contractors'. The criteria for inclusion in this category are: i) the economic dependence of the contractor on the purchaser of services (determined by the level of exclusivity); and ii) the contractor providing services essentially individually ie without employees of his/her own (Cherry and Aloisi, 2018).

The rights associated with this intermediary status are effectively the same as those of employees when it comes to collective bargaining (Labour Relations Act, 1995; see https://www.ontario.ca/laws/statute/95l01). Dependent contractors are also entitled to notice of termination according to the Ontario Court of Appeal (McKee v. Reid's Heritage Homes Ltd, 2009).

Germany: In Germany, a category of 'employee-like person' was legally established in 1974. The criteria for a worker to be included in this category are that the worker should be: i) working for the benefit of a client; ii) under a contract for a specific project; iii) providing the service personally and essentially without employees of his own; iv) mainly working for one client; and v) relying on one client for at least 50 percent of his/her income.

The rights associated with this intermediary status include many of the same rights enjoyed by employees: unionisation and collective bargaining, parental leave, paid holidays and protection from harassment (Cherry and Aloisi, 2018).

Italy: In Italy, a category of 'quasi-subordinate workers' was legally established in 1973. The criteria for a worker to be included in this category relied on the worker: i) collaborating with the buyer of services; ii) being in a continuous and long-standing relationship the buyer of services; iii) coordinating functionally with the buyer of services; and iv) providing the service essentially individually ie without employees of his/her own.

The additional rights associated with this status in comparison to those of self-employed contractors are very limited. These workers gained access to dispute resolution mechanisms, but they were not protected by substantive labour law, and they were not entitled to labour rights, sick or parental

leave, overtime pay or protection against unfair dismissal, among others (Cherry and Aloisi, 2018).

Spain: In Spain, a category of 'economically dependent self-employed workers' was legally established in 2007. The criteria used to assess whether a worker is included in this category are: i) being a natural person providing services in a personal capacity; ii) dependence for at least 75 percent of income on a single client; iii) registration of the position with the social administration agency; iv) confirmation by the buyer of services to the social administration agency; and v) notification of changes to the position, if any, to the social administration agency (Cherry and Aloisi, 2018; Cabeza Pereiro, 2008).

The rights extended to these dependent self-employed workers are largely the same as those of employees (Cherry and Aloisi, 2018). These include the presumption of the existence of an indefinite duration contract, the same working time provisions as for employees, protection against unfair dismissal, a new form of collective bargaining mechanism ('professional interest agreements') and access to labour tribunals (Cabeza Pereiro, 2008).

South Korea: In South Korea, a statutory category of 'special type workers' was created by an amendment to the Korean Industrial Accident Compensation Insurance Act in 2010 (see http://www.moleg.go.kr/english/korLawEng?pstSeq=58002). The criteria used to assess whether a worker is included in this category are: i) the routine provision of labour necessary for the operation of the purchaser of services; ii) presence of payments for these services; iii) living on these payments; iv) that the worker does not rely on other persons to provide the labour service; and v) that the worker is involved in one of the specific activities listed in a presidential decree associated with the act[30] (Cherry and Aloisi, 2018).

The rights in terms of compensation and insurance for industrial accidents that are extended to workers in this category are identical to those of

30 This list includes, for example, insurance salespersons, visiting teachers, quick service drivers and exclusive chauffeur service workers.

regular employees.

United Kingdom: In the United Kingdom, an intermediate category for casual workers was legally created in 1996 (Employment Rights Act, 1996; see https://www.legislation.gov.uk/ukpga/1996/18/contents). The criteria for a worker to be included in this category are: i) personal provision of services to the counterparty; and ii) the counterparty not having the contractual status of client or customer of any profession or business undertaking carried on by the worker. The interpretation of these general criteria in the courts has resulted in four additional effective criteria: iii) a significant extent of supervision of the worker by the counterparty; iv) integration of the worker's service into the core business of the counterparty; v) the economic realities of the relationship justify this status, based on a range of factors[31]; and vi) whether there are ongoing contractual obligations to provide the services (Garben, 2017).

The rights associated with this category are more limited than those of employees, but include coverage by the national minimum wage, working time rights, data protection, the right to time off for family emergencies and rights to a safe and healthy work environment (Garben, 2017).

These different approaches to the establishment of third or intermediate categories of work have helped to extend protection to genuinely dependent self-employed workers, but some have been more successful than others. While Canada's is generally considered a success, Italy's third category of employment resulted in arbitrage opportunities for employers leading to many employees being reclassified as dependent self-employed.

Some experts argue that adding a third category of work, no matter

31 These include, among others: a) whether the worker is in business on his/her own account; b) payment methods; c) supply of equipment; d) schedule and holiday arrangements; e) financial risk; and f) the worker's ability to provide substitutes to carry out the tasks instead of personally providing the services (European Agency for Safety and Health at Work, 2017).

how well designed, would be of limited value to platform workers because the contractual presumption of self-employed status pre-empts the ability of platform workers to access the benefits of the intermediary category without first achieving reclassification through the courts (Cherry and Aloisi, 2018; Codagnone *et al*, 2016).

5.4 Labour market policies and automation

5.4.1 Measures taken or tried at member-state level

The measures taken or tried to date have sought to achieve one of more of three goals:

- Ensuring that platform workers fall within a category of employment (possibly a new category) that provides for adequate social protection (see section 5.3);
- Ensuring portability of benefits; and
- Ensuring the right to organise and to bargain collectively.

Benefits portability refers to the ability of individuals on the labour market to transfer certain benefits that they have accrued from one job to the next, across economic sectors and across employment categories. Benefits portability could potentially apply in the future not only to traditional and non-traditional workers, but also to the self-employed.

There are good reasons to attach relevant benefits to an individual rather than a position, an employer or even a status of work, regardless of the professional path taken by that individual (Auguste *et al*, 2015). The ILO also recommends portability of benefits as a way to ensure both flexibility and protection in the modern economy (ILO, 2016). In France, for example, portability is established through a Personal Activity Account that preserves accumulated rights to training, hardship compensation, work time recuperation and more. This portability provides better coverage in the event of professional transitions.

Portability has its place, but is not a panacea for the needs of platform workers. Portability does not address minimum wage rights, for instance, or the right to collective action (Codagnone *et al*, 2016).

A second strand of literature has instead emphasised the crucial importance of ensuring effective access to a mechanism for collective bargaining as a means of ensuring protection of platform workers. Freedom of association and collective bargaining are fundamental labour rights helping workers to avoid exploitation, and are established in the ILO Constitution and reaffirmed by the 1998 ILO Declaration on Fundamental Principles and Rights at Work (ILO, 2011). Principle 8 of the European Pillar of Social Rights likewise calls on social partners to respect the right to collective action and to conclude collective agreements (European Union, 2017).

In most cases, platform workers are treated contractually as being self-employed. As long as this is the case, they generally have no legal right to collective bargaining (Forde *et al*, 2017; Riley, 2017). In a few cases, courts have over-ridden platform worker contracts and recognised that they fulfil many of the conditions of employment and should therefore be accorded the right to bargain collectively.

Several other factors make it difficult for platform workers to exercise freedom of association (De Stefano and Aloisi, 2018). First, as platforms leverage digital technologies, workers are often dispersed geographically and do not routinely interact with each other. Second, many platforms are designed to put service providers into competition with one another. Several platforms have rating systems that make workers reluctant to attempt to exercise their rights because of the potential reputational costs. Finally, the ability of platforms to monitor and exclude uncooperative service providers might strengthen platforms' bargaining power, and might thus make workers reluctant to act collectively (De Stefano and Aloisi, 2018).

A number of experts argue more broadly in favour of strengthening platform workers' collective bargaining rights. Unionisation helps to prevent abuses of human rights and of fundamental labour rights,

which are allegedly common in some segments of the platform economy (De Stefano and Aloisi, 2018). Drawing a parallel with pre-first world war dock workers' own gig economy, Riley (2017) highlighted the historical role of collective action in ensuring the development of fairer working conditions over time. Forde *et al* (2017, p. 107) argued that collective representation *"would offer numerous potential advantages in terms of redressing the very considerable power imbalances"* common in the platform economy. Forde *et al* (2017) recommended reforming existing collective bargaining institutions and competition rules to ensure greater representation of platform workers in the social dialogue.

Box 2: Legal measures in France

France: The French law of August 2016 (LOI n° 2016-1088 *du 8 août 2016 relative au travail, à la modernisation du dialogue social et à la sécurisation des parcours professionnels*, also called *loi Travail*), represents a recent attempt to deal in a consistent way with multiple aspects of social protection. The law's primary objective is to reinforce the collective bargaining process within companies, while providing companies with greater flexibility. It also addresses benefits portability and the right to collective action.

The law established new mechanisms for the portability of benefits via its Personal Activity Account *(Compte personnel d'activité*), which enables the time worked in different jobs to be aggregated for purposes of determining eligibility and for establishing the level of funding for training and for hardship benefits. The law also strengthened rights to lifelong training, unionisation and insurance against work accidents. Importantly, the law also extended these rights to platform workers (see also Garben, 2017).

While the law has been very unpopular among unions, French and IMF economists have been overall very positive. They have highlighted the impact of the law in making the labour market more dynamic while preserving the right to social dialogue (Golla, 2016; IMF, 2016).

5.4.2 The European Commission's Council Recommendation (European Commission, 2018a)

The ability for the EU/EEA to act on social protection is constrained by the principle of subsidiarity. The normal tendency is to think of responsibility for social protection as resting primarily with the member states, not with the EU; however, the EU has a complementary role to play. According to the TFEU, *"social policy, for the aspects defined in this Treaty"* is identified as a *"*[s]*hared competence between the Union and the Member States … The Union may take initiatives to ensure coordination of Member States' social policies"* (Art. 4(2) and Art. 5 TFEU).

The EU has for instance explicit authority to safeguard if needed the effective free movement of individuals, particularly in relation to the portability of benefits. The rules at EU level to protect social protection rights when moving from one member state to another[32] are important, and were discussed in section 5.2.2.

Additional powers complementary to those of the member states are identified in Articles 151-156 TFEU, with the EU given some authority over workplace health and safety issues, working conditions, social protection and the rights of employees made redundant.

At European level, limited coordinating measures have been in place for some many years[33].

32 Regulations (EC) 883/2004 and 987/2009.

33 Among them are Council Recommendation of 27 July 1992 on the convergence of social protection objectives and policies (92/442/EEC), OJ L 245, 26.8.1992, p. 49–52; Commission Recommendation of 3 October 2008 on the active inclusion of people excluded from the labour market (C(2008) 5737), OJ L 307, 18.11.2008, p. 11–14; Commission Communication Towards Social Investment for Growth and Cohesion – including implementing the European Social Fund 2014-2020, COM (2013)83; A renewed commitment to social Europe: Reinforcing the Open Method of Coordination for Social Protection and Social Inclusion', COM(2008) 418 final; Council Decision (EU) 2015/1848 of 5 October 2015 on guidelines for the employment policies of the Member States for 2015, OJ L 268, 15.10.2015, Country-specific recommendations; Modernising and improving social protection in the European Union, Communication from the Commission, COM (97) 102 final, 12 March 1997; Fixed-Term Work Directive 1999/70/EC; Part-time Work Directive 97/81/EC; and more.

The EU and in particular the European Commission have sought to strengthen and modernise social protection in the EU. At the strategic level, this is visible in the European Pillar of Social Rights (European Union, 2017). At the legislative level, it is mainly visible in a Council Recommendation on access to social protection for workers and the self-employed (European Commission, 2018a and European Commission, 2018b)[34].

The Commission formulated the legislation as a Council Recommendation. This is a flexible format that does not create binding outcomes, and that leaves great flexibility to the member states. It should be viewed as a pragmatic compromise. As the Commission put it, *"The Recommendation responds to the need to act at EU level, while taking into account the lack of political consensus, at this point in time, on the direction of the reforms"* (European Commission, 2018a).

The Commission's stated goals include:

- **Enhanced social protection for non-traditional workers and the self-employed:** *"Overall, if the measures proposed in the Recommendation are fully implemented by Member States, non-standard workers and the self-employed, who represent all together 39% of the employed population, will benefit from better protection. … Currently, non-standard workers face a much higher risk of poverty (16% compared to 6% for standard workers in 2016) as a result of low income and gaps in coverage. Similarly, social protection systems play a much weaker role in reducing the poverty risk for the self-employed compared to salaried workers on average in the EU."* (European Commission, 2018a)
- **Mobility for workers:** *"Well-designed social protection systems may also facilitate participation in the labour market by supporting labour market transition for individuals who switch jobs, move in or*

34 This Council Recommendation was unanimously approved the by the ministers for employment and social affairs of the EU member states in December 2018.

out of work, start a company or close it down. … Reducing differences in access to social protection is also expected to encourage transitions between contract types and labour market statuses, promoting labour market dynamism." (European Commission, 2018a)

- **Levelling the playing between traditional and non-traditional firms**: Businesses could benefit from reduced unfair competition, a possible increase in productivity of individuals in the newly-protected forms of employment and self-employment and from positive effects on labour market dynamism.

The Council Recommendation would apply not only to traditional and non-traditional workers, but also, significantly, to the self-employed. It would apply to six major branches of social protection:

- Unemployment benefits (but not necessarily for the self-employed);
- Sickness and health care benefits;
- Maternity and equivalent paternity benefits;
- Invalidity benefits;
- Old-age benefits; and
- Benefits in respect of accidents at work and occupational diseases.

The Council Recommendation would oblige member states to ensure that all workers, including non-traditional workers and the self-employed, enjoy a basic level of social protection. The detailed mechanisms are, however, left to the member states, as are judgments about benefit levels and programme financing. The Council Recommendation also seeks to promote portability among different forms of work, and transparency on behalf of workers. (European Commission, 2018a, page 8).

The Council Recommendation also encourages member states to ensure (1) that all periods of work are taken into account, and that they are accumulated and transferrable across all types of work and

self-employment; (2) that the level of social protection is adequate, taking into account conditions in the member state; and (3) that full information about all social protection arrangements are widely and freely available.

The Council Recommendation does not oblige member states to take particular actions but it does require each country to develop a plan showing how it will implement the Council Recommendation. The Commission would then monitor and benchmark implementation through the European Semester and the Open Method of Coordination for Social Inclusion and Social Protection.

5.4.3 Other solutions that have been discussed

Additional recommendations to address the social protection needs of platform workers are discussed in the literature.

Felstiner (2011) was one of the first to study crowdsourcing and the platform economy, and identified some of the key problems that legal scholars, judges and policymakers would face with the rise of this new form of labour market. As a potential solution, he highlighted the possibility of defaulting to an employee status for work taking place over the internet, so long as the work relationship fulfils some clearly defined conditions (Felstiner, 2011). In the same vein, Cherry and Aloisi (2018) also suggested a default presumption of employee status as the way forward, largely in light of mixed experience in countries that attempted instead to define a third category of work (see section 5.3). This presumption would be subject to the worker satisfying specific standards, such as a threshold number of hours worked per month, to ensure that the presumed employee status does not discourage the truly collaborative or irregular use of platforms (Cherry and Aloisi, 2018).

While a default presumption of employment status would have the benefit of simplicity that benefit unfortunately comes at the cost of a loss of flexibility and the risk of distortions. Given the great variety of platforms and of workers' motives for working via these platforms,

it is unlikely that a single threshold (eg based on number of hours worked) would suffice for the majority of workers. The presumption of employment would avoid the risk of some forms of misclassification, but might introduce other misclassification risks, and does not prevent arbitrage across categories. Such an approach might incentivise platforms and other companies to impose a limit on the number of hours worked by their workers (either explicitly or implicitly) in order to avoid classification as employees. Conversely, platform workers and other self-employed workers might be incentivised to perform their duties more slowly or to undertake less value-added work in order to rack up more hours.

Empirically, the presumption of employment has not worked well to resolve classification difficulties (Garben, 2017). In the Netherlands, the presumption of employment has led to contradictory judicial conclusions, even for workers within the same industry. In Belgium, while the presumption has not yet been tested in the courts, courts have precedents in refusing to reclassify self-employed workers as employed (Garben, 2017).

Based on an extensive review of the literature, Codagnone *et al* (2016) suggested broadening minimum wage regulations, enforcing maximum daily hours and minimal forms of social protection, providing some form of health and liability insurance, ensuring health and safety standards are respected and (as previously noted) ensuring portability of benefits. They also emphasised the need to regulate the type and intensity of monitoring and control allowed over platform workers (Codagnone *et al*, 2016).

Riley (2017) provided a case study of measures put in place to protect truck-owning drivers dependent on forestry companies in Australia. As well as the right to associate, the reforms included accessible and affordable dispute resolution mechanisms, protection from unfair termination, legally scrutinised decent remuneration and, interestingly, reducing information asymmetry through the publication of the costs of forestry companies (Riley, 2017). The case study shows that

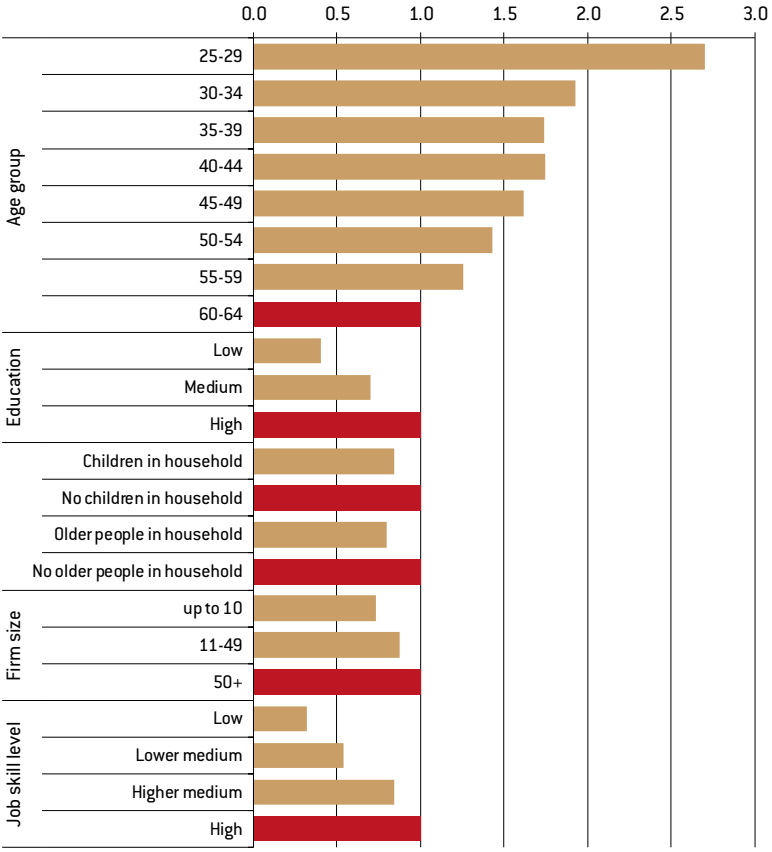
solutions to the social protection needs of platform workers could take many different forms. Government intervention might not always be necessary. For example, the insurance industry is currently responding to the rise of the platform economy: innovation in that field has led to the development of insurance products suitable for dependent self-employed workers[35]. Such innovative products might also make social insurance more efficient for both employers and employees.

5.5 Digital skills, education and training

The rapid transformation of the workplace implies the growing need to regard education not as a one-time activity but as a lifelong process. This need is widely recognised, but Europe lags behind its global competitors in many important respects. Notably, those who take part in lifelong-learning activities appear in many cases to be those who already have high levels of skills, while those with lesser skills also appear to have less opportunity to benefit from lifelong-learning opportunities. Those who are young and just out of school make more use than those who are older; those who work for large firms have greater opportunities than those who work for small and medium enterprises (SMEs), which desperately need to upgrade their skills bases and their take-up of digital technology (Figure 5.4). That the young participate more can also be interpreted more positively, however, in that it might imply that the importance of lifelong learning is growing over time.

35 *The Economist* (2018) 'Your policy is arriving in three minutes – Insurance and the gig economy', 5 April, available at https://www.economist.com/news/finance-and-economics/21739984-how-insurance-policies-are-being-adapted-fit-freelance-working-insurance-and.

Figure 5.4: Probability[36] of having attended a lifelong learning course or activity within the previous four weeks, 2016



Source: European Commission (2018c, page 99).

36 The values are the result of a regression analysis. Each value is the quotient of the probability of an individual in that group having undertaken a lifelong learning course or activity during the previous four weeks, divided by the probability of an individual in the corresponding reference group having undertaken a lifelong learning course or activity during the previous four weeks. The probability for individuals in each reference group is represented by the black bar in the group, which explains why each black bar has a value of 1.0 (ie it is divided by itself).

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6 Recommendations

Key findings

- Automation, artificial intelligence and robotisation are sure to have a huge impact on the workplace in the coming years; however, they will not necessarily lead to massive unemployment.
  - To date, the use of robots and ICTs does not appear to be associated with a marked increase in unemployment.
  - Artificial intelligence and related technologies will potentially have a far broader impact than robotisation, touching not only manufacturing (a relatively small sector) but also all service sectors.
  - In the medium to long term, the combined impact of AI, big data and machine learning is difficult to predict. These technologies will eliminate some existing jobs but will also create new jobs. Predictions that were popular a few years ago that half the population might be unemployed now seem unlikely.
- There is a related and growing tendency in developed economies towards job polarisation, with routine jobs requiring moderate levels of skill declining relative to both those at the bottom (that require fewer skills) and those at the top (that require greater skill levels).
- Labour flexibility that increases over time has been with us for decades, but automation is accelerating this trend and is giving rise to new forms of work.
- Current social protection arrangements are geared toward traditional employees. Non-traditional employees and the self-em-

ployed tend to be exposed to gaps in statutory coverage.
- Even if statutory coverage is available, non-traditional employees and the self-employed might have difficulty exercising their social protection rights because the time worked as they change from one status to another is not properly accumulated.
- The social protection arrangements of EU countries vary greatly in terms of efficiency, equity and the degree to which social protection is universal and funded out of general revenues (Beveridgean) versus being oriented mainly to workers and their families, and paid for by workers (Bismarckian).

No EU country is purely worker-funded or purely universal, but there are major differences between them, and these have implications in terms of performance. Denmark, Finland, Sweden and the Netherlands have long been characterised by a heavy tilt toward universal (Beveridgean) arrangements (Schoukens, 2000). These four countries have also consistently been among the very best performers in the EU in terms of both efficiency and equity.

6.1 Adequate social protection for all workers

The growth of labour flexibility together with the increasing richness and complexity of work relationships poses new challenges for the social protection of workers (as explained in chapter 5). There are three key aspects to this problem.

First, many workers whose circumstances are not very different from those of traditional employees are not classified as employees. To the extent that national social protection systems treat them as self-employed, they tend to be excluded from statutory protection in many EU countries (see section 6.1.1).

Second, even when workers are correctly classified as non-traditional employees or as self-employed, it does not mean they have no need of social protection. The need for protection against illness, old age, invalidity and occupational hazards is just as real for these

workers as for any other[37] (see section 6.1.2).

Third, workers are far more likely to switch between traditional employment, non-traditional employment (eg part-time) and self-employment than in the past, and with far greater frequency. These workers might not be able to aggregate time worked and contributions made in order to qualify for benefits at an appropriate level (see section 6.1.3).

The EU has little direct power in these areas, but a Council Recommendation on access to social protection for workers and the self-employed (European Commission, 2018) was unanimously agreed by EU countries in December 2018. The principles embodied by the Council Recommendation potentially address most of the challenges outlined above; however, the problems are still far from solved. While the Council Recommendation has moral force, it lacks legal force. Social protection systems in EU countries are very diverse – implementation is likely to vary greatly from one member state to the next, and some might choose to implement the Recommendation in ways that fall short of fully addressing the problems that are visible. Whether the Council Recommendation can truly deliver the changes in social protection that are needed remains to be seen.

With that in mind, the recommendations in this section take the principles in the Council Recommendation as a given, but explore the likely practicality and effectiveness of the different ways in which EU countries might implement them.

6.1.1 Avoiding misclassification of workers

There would be obvious benefits in achieving a harmonised, EU-level definition of what constitutes an employee versus a self-employed individual. The emergence of platform workers has increased the immediacy of the issue, but concerns stemming from the lack of

37 For the self-employed who have their own employees, this is somewhat less the case. They often have the means to self-insure.

clarity in these definitions have been visible for decades (see for instance Schoukens, 2000). The criteria that would need to be taken into account in order for an individual to be treated partly or fully as an employee are already somewhat clear in the rules established in some member states that have established a third category of work (including Italy, Spain, Germany and the UK; see section 5.3) – the performance of personal services for someone else, where the worker is dependent on the purchaser of the services for a substantial portion of his or her income, and the worker does not have employees of his or her own.

It is very difficult to see how to put common EU definitions in place. Under the TFEU, these definitional aspects of social protection clearly fall to member states, not to the EU. As with most aspects of social protection, the definitions of 'employee' and 'self-employment' vary greatly in different EU countries (Schoukens, 2000). Most member-state definitions of self-employment already incorporate the notion that a self-employed individual is practicing a professional activity for the purpose of gain without being an employee or a civil servant. Most definitions reflect to some degree the notion that a self-employed individual is not subordinate to the party for whom the work is performed; details of interpretation, however, vary considerably. Even within a single member state, determination of self-employment status might differ in relation to different forms of social protection, or in relation to social protection, labour law and tax law. More to the point, the impact of classification of a worker's status on the social protection benefits he or she receives is highly specific to the member states. EU Regulation (EC) 883/2004 on the coordination of social security systems *explicitly defers to the member state's definition* of *"activity as an employed person"* and *"activity as a self-employed person"*. Finally, any definition at EU level might easily collide with the various definitions of a 'third category of work' that already exist in several EU countries.

None of this means, however, that the EU does not have a role to

play. Most member states recognise that these classification issues have become increasingly problematic, and that sham self-employment should be prevented. The Commission should promote consensus and convergence among the member states on the classification of self-employment, and identify and promote best practices that have been implemented by individual countries.

In the medium to longer term, the more promising solution might be to ensure the adequacy of benefits provided to dependent self-employed individuals. In member states where this is already the case, the determination of employee versus self-employed status becomes an uncontentious technical determination[38].

6.1.2 Statutory coverage of non-traditional workers and the self-employed

Under Articles 8 and 9 of the Council Recommendation, *"Member States should ensure that workers have access to social protection by extending formal coverage on a mandatory basis to all workers, regardless of the type of their employment relationship."* This would cover on a mandatory basis sickness and healthcare benefits, maternity/paternity benefits, old age and invalidity benefits and benefits in respect of accidents at work and occupational diseases. Unemployment benefits for the self-employed would be on a voluntary basis.

This might seem to be clear enough: member states should ensure adequate social protection for non-traditional workers and the self-employed. But the member states enjoy great latitude in terms of how to implement this in practice. We would expect that low-cost member states will determine adequacy to be reached at substantially lower payment levels than in high-cost member states.

Under the Council Recommendation, differences in arrangements between traditional employees, non-traditional employees and the

38 Schoukens (2000) argued that in member states that implement universal coverage for all, *"the distinction between workers and self-employed people is of little importance because the social security benefits are not linked to the practise of labour in the first place."*

self-employed *"should be proportionate and reflect the specific situation of beneficiaries."* Again, it will be important to see how member states implement these guidelines.

Who pays for benefits and who is entitled to receive benefits are of profound importance. Under a universal (Beveridgean) system, all citizens (or all residents) are covered, so the question of self-employment is irrelevant in terms of eligibility for coverage.

Conversely, a system based on worker contributions faces challenges in covering employees who work less than a full schedule. For a worker who is active for, say, ten hours a week, where should the funding come from to ensure proper health care? Health-care costs are presumably independent, more or less, of the number of hours worked. Irrespective of whether the payment is made by the employer, the employee or both, funding of social protection for occasional workers would appear to be challenging.

Perhaps the most important questions revolve around how to finance these arrangements (see section 6.2). These manifest differently in universal versus worker-funded systems, but both face significant challenges.

6.1.3 Aggregation and transferability of benefits across different modes of work

For employees, portability of benefits between EU member states already exists under Regulations (EC) 883/2004 and 987/2009. There is no assurance of portability of benefits within a single member state, nor is there assurance of portability across different types of work (for instance, between traditional employment and self-employment).

The Council Recommendation seeks to put sweeping reforms in place, stating that *"Member States should ensure that entitlements … are accumulated, preserved and transferable across all types of employment and self-employment statuses and across economic sectors"*.

This would appear to be the right principle. In particular, under a worker-funded system, it would mean for example that a worker who spends part of his or her day as a self-employed platform worker (eg

driving for Uber) and part of the day as a part-time employee of a taxi firm could derive the full social protection benefits from his or her combined volume of work.

Portability of benefits from one member state to another is already covered *for traditional employees*. With an increasing fraction of the EU labour force comprised of non-traditional employees and the self-employed, the guarantees provided in current regulations cover less and less of the workforce.

This issue tends to manifest itself somewhat differently in a universal (Beveridgean) system. It might however become an issue for a worker who moves from a worker-funded to a universal-coverage member state.

6.1.4 A shift in the direction of universal benefits

Many of these issues are simpler in a so-called Beveridgean system where benefits are available to all. Eligibility is not tied to the status of the worker and totalisation of benefits is of little relevance as long as the worker remains in the member state. Once coverage is extended to all citizens or all residents, instead of to all employees, these problems should in principle largely be solved.

The distinction between worker-paid benefits and universal benefits is not black and white, not absolute. No EU country is purely Bismarckian, nor is any member state Beveridgean in every respect. Even the countries that are viewed as being closes to universal in their coverage (such as the Netherlands, Sweden, Denmark, Finland and the UK) are in reality hybrids where worker funding applies to some aspects of social protection (Schoukens, 2000).

With this in mind, we doubt that an overall shift of EU social protection systems to a universal, Beveridgean basis is likely. A mix of social protection arrangements is likely to persist for many decades at least. A shift to worker funding playing a smaller role, and universal coverage with funding from general revenues playing a greater role, is possible and perhaps inevitable.

Such a shift would tend not only to change who bears the cost of social protection, but might also represent a significant increase in the cost of social protection because more people would need to be covered. How should any increase in cost be paid for? We return to this issue in section 6.2.

6.1.5 Private enterprise to the rescue

As noted in section 5.4.3, some insurance companies are adapting their plans in order to meet the needs of self-employed workers. This is unlikely to satisfy *all* social protection needs of all non-traditional workers – first because their needs are too diverse, and second because the information asymmetries between insurers and the insured in respect of some of the risks in question are too great. Enhancements to private insurance plans might nonetheless have a useful role to play in some member states.

6.1.6 Participation in social dialogue

As noted in section 5.4.1, the self-employed are prohibited in many member states from participating in social dialogue (which includes joining unions and participating in strikes).

It seems fairly clear that this prohibition is inappropriate today for various forms of the dependent self-employed. The participation in social dialogue of drivers who work for ride-hailing services cannot be said to be anticompetitive, nor is it much different from the participation of drivers who work as employees for conventional taxi services.

It seems equally clear, however, that organisations that participate in social dialogue will need to modernise and adapt in order to remain relevant in the workplace of the future. The kind of workplace social interactions that facilitated solidarity with trade unions are lacking today for many platform workers, and also for many workers who primarily telecommute.

6.1.7 Preserving the dignity of workers

A topic that has not been very prominent in the debate, but that is likely to become more visible, has to do with the introduction of intensive surveillance into the workplace.

The concern here is that firms monitor the efficiency of their workers in carrying out their tasks. In and of itself, this is nothing new or nefarious – firms have always sought to know how their workers perform. Time and motion studies have been with us for than a hundred years.

However, for many of the new forms of work that are mediated by digital platforms, the ability of firms to perform surveillance on the worker is enormous. At what point does this become an improper intrusion against the dignity of the worker?

There is no easy answer. It would appear that a balance must be struck. Firms have a right, in the interest of efficiency, to monitor the performance of their employees, but this cannot be at the expense of turning the workplace into a surveillance state.

6.2 Funding the welfare state

The measures outlined in section 6.1 entail increased social protection expenditure, implying challenges for the funding of the EU social model. Once again, the challenges are different in worker-funded Bismarckian systems compared to universal-coverage Beveridgean systems. All EU member states are hybrids reflecting some mix of the two, but nonetheless, it is useful to distinguish between the two for purposes of analysis.

6.2.1 Challenges to funding

The EU funding model for social protection is under threat, even in the absence of any need to expand social protection, for a variety of reasons:

- **Declining labour share:** The share of gross value added attribut-

able to labour, as distinct from capital, has been declining for the past two decades (see section 1.4);

- **Demographic challenges:** With an aging population, fewer workers must support more retirees, and the retirees who live longer tend to run up greater health costs;
- **Base erosion/profit shifting challenges:** At the same time that the contribution of labour to the funding of social protection is declining for the reasons just noted, the ability to tax highly-profitable digital firms is also under threat because of the ease with which profits can be shifted to low-tax jurisdictions.

6.2.2 Solutions in a worker-funded Bismarckian system

The challenges to funding in a worker-funded system follow directly from the challenges identified in section 6.2.1. Contributions to social protection would generally come from workers, but the contribution of workers to the economy is declining, and moreover a declining relative fraction of workers is burdened with supporting an increasing relative fraction of retirees.

The impact of expanding coverage to non-traditional workers and to the self-employed is complex. Many EU countries already provide some benefits to the self-employed, and many make some collections from the self-employed. Similarly, if large numbers of the self-employed were to be re-classified in line with the discussion in section 6.1.1, there would be impact on both expenditures and tax revenues associated with the re-classified workers.

Furthermore, there are limits to the extent to which it is prudent to increase social protection contributions from employers. To the extent that employers perceive the higher contributions as a cost of production, it might lead them to employ fewer workers, or (depending on price elasticity of labour versus capital) to substitute equipment for workers at a faster pace. This potentially might make the problem worse, not better.

Under these conditions, it is difficult to expand coverage and thus to incur increased social protection costs. It is difficult to reconcile rising costs with a shrinking funding base.

It seems clear that, in the medium term if not the near term, other funding sources need to be found. No EU member state is purely worker-funded today. A further shift away from worker funding seems inevitable in the medium term.

6.2.3 Solutions in a universal coverage Beveridgean system

A shift in the direction of more universal, Beveridgean systems seems to be inevitable in the medium term. The universal system is potentially simpler and more manageable in that the level of funding is somewhat de-coupled from the number of workers and the earnings per worker. The *structure* of payments for the funding of social protection is superior to that of a purely worker-funded system.

Society as a whole must, however, continue to be productive for this to be sustainable.

Costs might be higher in a universal system compared to a worker-funded system because more workers are covered. Or perhaps not – in a progressive European economy, the most basic social protection is likely to be provided to all anyway, even in a member state where social protection is primarily based on worker funding.

Universal coverage systems will also need to guard carefully against so-called welfare tourism. If it is too easy to move to a member state in order to collect generous benefits, the system risks becoming both economically and politically unsustainable.

In a universal coverage Beveridgean system, payments come from general revenues rather than from funds earmarked for social protection. This might help to avoid distortions, but funding must be adequate.

It is likely that tax revenues to fund social protection will need to come increasingly from capital rather than from labour. This begs the question of how an increase in general revenue might be achieved

without creating unacceptable economic distortions, or unacceptable burdens on societal efficiency. Needless to say, there is no easy answer – if there were, it would likely already be in use.

6.2.4 An unconventional solution: the 'robot tax'

The idea of a 'robot tax' originated with the founder of Microsoft, Bill Gates. Gates argued that if human workers' income is taxed today, and then a robot is deployed to do the same work, it seems logical to think that we should tax the robot at a similar level to the human. Some have gone on to suggest that a robot tax could be used to pay for the re-training of human workers who have lost their jobs to robots (Merler, 2017).

Most economists are sceptical of this proposal. A European robot tax would tend to hinder innovation, thus reducing European competitiveness, and possibly leading to distortions in relative investments in capital versus human labour (Merler, 2017).

A more obvious and fundamental objection has not been prominent in the literature to date, namely that there is no evidence that robotisation has led to significant unemployment to date, and that the level of unemployment that artificial intelligence and related technologies are likely to cause in the future is uncertain but probably not as great as some fear. Most experts (see for instance Arntz *et al*, 2017) have now concluded that the actual level of unemployment to be expected as a consequence of digitalisation is nowhere near the 47 percent Frey and Osborne (2017) predicted (see section 3.4). Some empirical analysis, including our own (see sections 2.4 and 3.4), finds that unemployment is actually *lower* today in the regions that have seen the greatest deployment of robots and ICT. In other words, the robot tax might be a response to a problem that is not real.

6.3 Addressing possibly high unemployment

A much-discussed reform is that of an *unconditional basic income* (*UBI*) that might partly or fully replace current social protection

schemes. While proponents argue that this reform would help to redistribute the benefits from automation and digitalisation, critics stress that financing a basic income would require higher taxes and might lead to unintended consequences such as the reduction of people's willingness to work (Midoes, 2019).

Much of the recent interest in UBI has been prompted by forecasts of widespread unemployment arising from automation, such as those made by Frey and Osborne (2017). If the degree to which automation and artificial intelligence cause net unemployment is more modest, as more recent studies suggest (see sections 2.4 and 3.4), there might be little need for UBI.

In January 2017, Finland started an experiment, paying randomly-selected long-term unemployment-benefit recipients a guaranteed basic income that was not reduced if they found work. The results of this trial are not published at the time of writing; however, the Finnish government rejected a proposal to expand the experiment to a sample of employees (OECD, 2019). Press reports suggest that recipients were happier, but that few behavioural changes have been visible[39]. Our understanding, based on informal discussions with highly knowledgeable local stakeholders, is that the funds provided (just €560 per month) substituted guaranteed funds for non-guaranteed funds that the same recipients would have received anyway with high likelihood. Given the rather small funding, and the fact that the funding was not incremental for the great majority of recipients, it is not surprising that large scale behavioural changes were not in evidence.

6.4 Managing rapid change: Education, training and more

The degree to which digitalisation will cause unemployment might be debated, but there is no question that it will lead to disruption in the workplace. It will be necessary to manage the rapid and accelerating

39 Ashitha Nagesh (2019) 'Finland basic income trial left people "happier but jobless"', *BBC News*, 8 February.

changes associated with widespread digitalisation. Some professions will disappear, others will emerge, but nearly all are likely to be transformed profoundly. The impact might well be greatest on medium-skill workers whose routine jobs are most likely to be eliminated by artificial intelligence and automation.

A theme throughout this Blueprint has been that the traditional model of lifetime full-time employment in a stable and profitable firm has been on the decline for many decades. Automation, digitalisation and robotisation are hastening a decline that was already underway.

It is already the case that many of us perform work that is quite different from that for which our academic training prepared us. We strive today to train people for the jobs of today and tomorrow, but it is a safe bet that many who are in school today will ultimately do jobs very different from those for which they were trained.

The implications are clear, if challenging to respond to. For schools and training programmes, it will be necessary to maintain a focus not only on the specific narrow skills needed for today's jobs, but also on broader skills such as quantitative skills and foreign language skills, which contribute to flexibility in the future, and that can be applied in many different ways.

For individuals, expectations must change. Most of us grew up expecting to complete our formal education, and then to spend our working years contributing to some profession. Those days are gone. For those in school today, the more likely sequence will comprise alternating periods of training and of work, as they adapt to changing needs of the job market. This is the new normal.

A number of EU countries have sought to respond to these new realities by creating accounts for training, to be used by those who already have established jobs.

With an accelerating pace of change, a key challenge will be to take those who are thrown out of gainful employment through no fault of their own, and to get them back to work without falling into poverty while they make the transition. This is partly a job for social protection

funding, and partly a matter of retraining to enable redundant workers to rejoin the workforce with no more loss of time, and no more loss of self-esteem, than are strictly necessary. Some EU countries do a notably better job of this today than others.

All of this implies a need for our institutions to evolve in ways that encourage career change and flexibility. Europe today is subject to many forms of institutional rigidity. In order to adapt, it is this rigidity that we will need to overcome.

Education and training are primarily the responsibility of the member states rather than of the EU, but here as elsewhere the EU can promote good policy and can play a supporting and constructive role.

6.5 European Union measures and member-state measures

Social protection is first and foremost the responsibility of EU member states. The explicit authority of the EU in the sphere of social protection is circumscribed but still substantial. First, the EU has explicit authority under the TFEU to promote the single market, notably by facilitating the free movement of workers, which is essential to an integrated labour market. Second, the EU has somewhat broader authority to *"take initiatives to ensure coordination of Member States' social policies"*. Third, the EU has authority, albeit limited, to establish minimum standards for social protection in the member states (Art. 153 TFEU). The Council Recommendation (European Commission, 2018) is largely a manifestation of this third source of authority.

The Council Recommendation does not establish a legally binding framework, but it has moral force. The Council Recommendation does not create obligations in terms of the actions to be taken by member states: however, it calls on each of them to develop and submit an action plan on how the Council Recommendation will be implemented in the member state. It calls on the Commission (together with the Social Protection Committee) to establish a benchmarking framework and to develop agreed common quantitative and qualitative indicators to monitor implementation. With that in place, the

Recommendation says progress is to be monitored *"in the context of the multilateral surveillance tools in line with the European Semester and the Open Method of Coordination for Social Inclusion and Social Protection"*.

Member-state social protection systems are extremely diverse, and will continue to be diverse under the Council Recommendation. A one size fits all approach would not work, and would not be accepted by the member states or by their citizens. This is not necessarily a defect – it is not clear that perfect harmonisation of social protection systems within the EU is necessary or even desirable. Current arrangements have evolved over many decades in response to the perceived needs of each member state.

At the same time, the Council Recommendation is an attempt to promote minimum standards of social protection across the member states, irrespective of how these standards are achieved.

The Council Recommendation is designed to have effect through moral suasion and to some extent through name-and-shame mechanisms. These mechanisms have limited force. If the Council Recommendation is truly to have impact, it falls to the European Commission and EU agencies to monitor implementation and to encourage any laggard member states to provide adequate social protection.

The tools available to the Commission to monitor and benchmark implementation are, as noted, the European Semester and the Open Method of Coordination for Social Inclusion and Social Protection. The Commission should employ these tools judiciously. The Commission can also identify and promote best-practice implementation mechanisms as they emerge.

Will the Council Recommendation be effective? It is hard to say – it faces high hurdles, and comes at a time of ebbing solidarity among the member states. That the member states were able to achieve consensus at all on basic principles can be viewed as a significant achievement, but whether that achievement can be translated into concrete

change at member-state level remains to be seen.

6.6 Summary of recommendations

A number of recommendations flow from the discussion in this chapter:

- The Commission should promote consensus and convergence among EU countries on the classification of self-employment, and should identify and promote best practices that have been implemented by individual member states.
- Member states should strive to ensure that nominally self-employed workers whose circumstances are not very different from those of employees (ie the dependent self-employed) are not inappropriately barred from statutory access to social protection.
- Member states should ensure that there is mandatory statutory coverage in the key branches of social protection[40], not only for traditional employees, but also for non-traditional employees, providing benefits (and also incurring costs) proportionate to their respective circumstances.
- Where eligibility or benefit levels depend on the number of hours worked, member states should ensure that they are properly accumulated across different modes of work, both within the member state and also for individuals who move from one member state to another.
- Member states might want to consider whether an eventual shift in the direction of a universal Beveridgean system (where benefits are available to all citizens and long-term residents, and are funded out of general revenues) is warranted.
- Member states need to re-think social dialogue to enable certain

40 Sickness and healthcare benefits, maternity/paternity benefits, old age and invalidity benefits, benefits related to accidents at work and occupational diseases, and (except for the self-employed) unemployment benefits.

of the self-employed to participate in ways appropriate to their circumstances. Social dialogue partners such as unions might also wish to consider changes to enable them to better accommodate the needs of non-traditional workers and the dependent self-employed.

- Many member states see a complementary role for unions, insurance companies or other organisations in the provision of social protection. These arrangements are already showing signs of being able to adapt to the changing world of work. This is a positive trend that should be encouraged.
- Monitoring the efficiency of workers is normal and appropriate, but new norms might be needed to ensure that workplace surveillance does not become needlessly or inappropriately intrusive.
- Systems in which workers cover the full costs of their benefits are unlikely to be sustainable in the medium term. It will be increasingly difficult to reconcile rising costs with a shrinking funding base. It is already the case that no EU member state implements purely worker-funded social protection.
- In a Beveridgean system, coverage is universal, and payments come from general revenues rather than from funds earmarked for social protection. This might help to avoid mismatches and distortions, but funding must be adequate. A shift in this direction seems to be in order, but no EU country implements a purely universal model today, and we do not expect purely universal-coverage social protection models to emerge in the foreseeable future.
- It seems clear that, in the medium term if not the near term, new revenue sources need to be found if the EU social protection model is be maintained and expanded.
- Universal basic income (UBI) and the negative income tax might prove to be of interest if automation and artificial intelligence result in a massive net reduction in employment; for now, however, widespread unemployment does not seem likely.
- Even in the absence of a massive net reduction in employment,

changes to the nature and volume of work will be hugely disruptive. Rapid and accelerating change because of digitalisation will need to be managed in the near to intermediate term. Social protection will need to step in to help people get back to work without falling into poverty while they make the transition from obsolete jobs to newly-created jobs. This is likely to be especially true for medium-skill workers whose jobs are most likely to be eliminated by artificial intelligence and automation. A shift from traditional forms of education and training to a focus on lifelong learning is urgently needed. It will be necessary to overcome the institutional rigidity that gets in the way of career change and flexibility.

- The Council Recommendation strikes the right balance and establishes the right principles, but is a recommendation that does not create binding obligations. Whether it can be effective remains to be seen. The Commission must monitor and benchmark implementation by member states to ensure that reasonable standards are met. In doing so, the goal of protecting workers should take precedence over harmonisation across the member states.

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DIGITALISATION AND EUROPEAN WELFARE STATES

Rapid technological progress and innovation can destroy jobs and disrupt welfare systems. This is not a new concern. Historically, automation of production processes has led to extraordinary efficiency gains and to the displacement of labour. But history has also shown that, in the longer run, the gains in efficiency pay off and new jobs are created.

But the past is not necessarily a guide to the future. Currently, an unprecedented digitalisation of our economy is underway. Artificial intelligence has become a reality and machines are able learn how to outperform humans in some cognitive tasks. The way work is performed is also changing, with jobs allocated via online platforms and people matched to tasks in a way that means they are neither full-time employees, nor self-employed workers in the traditional sense.

For welfare systems, which are largely funded by taxes on employment, these changes have significant implications. One of the big challenges of the twenty-first century will be to redefine the nature and functioning of welfare states in the context of the fundamental changes brought about by digitalisation, artificial intelligence and the changing status of workers. If technology has a negative impact on labour income, how will the welfare state be funded? How can workers' welfare rights be secured? This volumes tackles these questions and provides recommendations to inform the discussion in the European Union.

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