



Insights into skill shortages and skill mismatch

Learning from Cedefop's
European skills and jobs survey



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Foreword

This publication focuses on a topic of critical concern for policy-makers in recent years: skill mismatch. Cedefop has been active in skill mismatch research and analysis for almost a decade now, identifying significant areas of concern and contention surrounding the issue, including clarification of key concepts. It has also engaged in original data collection and analysis, resulting in several publications. Most prominently, in spring 2014 Cedefop undertook the first European skills and jobs survey (ESJS), a large-scale primary data collection of about 49 000 adult employees in 28 EU Member States. This report summarises many of the insights gained by closer empirical scrutiny of this new European data set.

We focus on skill mismatch because the economic crisis, with its mass destruction of jobs in some sectors, was associated with a significant decline in employment for individuals with lower qualifications and skills. The average duration of unemployment was extended and long-term unemployment, primarily comprising the lower-educated, expanded to a wide range of employees at all levels. In some EU countries traditional modes of production and business models have been disrupted greatly.

Research revealed that these growing labour market imbalances have seeped into higher structural unemployment rates, with the consequence of exacerbated concern that skill mismatch is worsening in the EU. Shifts in skill demand and supply have been reflected in the stated inability of employers to fill their vacancies with people that have the right skills. Data repeated by several sources indicated that four in 10 EU employers said in 2013 that they have difficulty finding the right skills when recruiting.

When looking to the future, further concern arises that Europe may be unprepared for the evolution of a new digitalised economic reality. For example, Cedefop's European skills forecasting model projects that by 2025 about 48% of all job opportunities in Europe will need to be filled by individuals with tertiary-level qualifications. The ESJS also shows that about 85% of all EU jobs need at least a basic digital skills level. It is visible, even to the untrained eye, that unripe technological advances, such as machine learning, big data analytics, the internet of things and advanced robotics, together with restructuring in global value chains, are reshaping the world of work as we know it today.

Existing research on skill mismatch has revealed that there are sizeable differences in the magnitude and economic costs of the many different types of skill mismatch. One-size-fits-all policies are unlikely to be effective as EU countries tend to suffer from different forms of the problem but it is clear that undertaking policies to reduce skill mismatch can result in sizeable efficiency gains. A Cedefop estimate, based on the ESJS, has shown that the existing skills of the EU's workforce fall about one fifth short of what is needed for workers to carry out their jobs at their highest productivity level. This calls for concerted action to stimulate further adult learning in Europe.

But how does all this square with the fact that a sizeable share of the EU workforce, typically four in 10 adult employees, feel that their skills are underutilised, or that close to a third of tertiary education graduates are overqualified for their jobs? And what should we make of the fact that most existing research shows that overskilling of the workforce is a more prevalent form of skill mismatch than skill gaps (McGuinness et al., 2017)?

Cedefop's ESJS provides some answers. It confirms that good understanding of the level and type of skills needed in people's jobs is paramount and that, ultimately, skill mismatch is a balancing act between the demands of workers' jobs and their own skills and attitudes. Our survey shows that almost one third of workers in the hospitality and catering sector and a quarter in the transport sector have not experienced any change in the need to learn in their jobs since they were hired; this compares with 15% in the finance sector and 17% in ICT. With stagnant skill demands in some industries and jobs, it

is no surprise that some graduates may feel that their skills exceed what is needed; for others, typically lower-skilled individuals, the challenge is to upskill and avoid skills obsolescence.

The survey has also highlighted that for many individuals, typically younger overqualified workers, skill mismatch can be an outcome of their own poor career choices: they are ill-informed about job prospects with the best returns on their human capital investment. Similarly, while 20% of older workers (55+) are found to have lower qualifications than needed by their jobs, only a minority do not have the necessary skills for their jobs; this is a reminder that qualifications are an imperfect signal of skills and that policy efforts to validate informal skills may go a long way towards mitigating skill mismatches.

In terms of additional policies for tackling skill mismatch, it is clear that further expansion of higher academic education attainment rates may not always be the right recipe for employment. By contrast, good-quality and labour-market-relevant vocational education and training, which argues for more work-based learning, has proved its worth. It is also widely accepted that strengthening key competences and soft skills within education curricula is desirable, given that a significant part of employer recruitment difficulties reflect such skill deficiencies. In this respect, the planned revision by the European Commission of the European key competences framework, espoused by the *New skills agenda for Europe*, is a valuable endeavour. Provision of better career guidance, building on the results of timely labour market and skills intelligence activities, is also paramount.

But education and training policies cannot, by themselves, lead to lower skill mismatch. Countries that enjoy lower levels of skill mismatch are those that enable efficient reallocation of skills and jobs across time and space. They have a lower tail of poorly managed firms, highlighting the significance of policies that raise managerial quality, in particular managers of smaller domestic firms. They also have a more flexible mix of labour market and business regulations and, crucially, better housing and child care policies (Polacheck et al., 2017). Cedefop's own research has further shown that countries with lower skills bottlenecks have unambiguously benefited from proactive enterprises, which prioritise talent management and also work in partnership with education and training institutions (Cedefop, 2015b).

By placing the aim of mitigating skill mismatch and raising VET attractiveness at its heart, the *New skills agenda for Europe* has provided us with a challenging set of policy proposals. But it is Member States themselves that will decide how best to tackle skill mismatch, given their own country-specific challenges and context. It is in this spirit that, since 2016, Cedefop has provided close support to countries that wish to improve the governance of their skills anticipation and matching systems. The empirical analysis in this report makes it clear that the challenge of mitigating skill mismatch is dependent on ensuring responsive feedback loops between VET and the labour market (Pouliakas and Ranieri, forthcoming). The best way to accomplish this is by striking closer stakeholder partnerships, building trust and engaging in coordinated actions between VET institutions and labour market actors.

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Introduction

1.1. The future of work breeds skill shortages and gaps

Unemployment, recruitment difficulties, skills becoming outdated and people doing jobs not using their potential are examples of skill mismatch: situations where skill supply and skill demand diverge. Policies addressing mismatch can mitigate the social and economic costs linked to the waste of skills and human potential it entails.

Analysis of skill mismatch is complex, given that it is multidimensional and manifests itself at different levels. Labour markets do not work perfectly, so some degree of skill mismatch is a given, but excessive mismatch has adverse economic and social consequences. Evidence suggests that there is substantial scope to improve skill matching in European labour markets but it is not an easy task to ascertain the most important policy implications (Cedefop, 2015c). The body of evidence on skill mismatch in Europe and beyond is vast. It covers many different types of mismatch and does not always reach firm conclusions, in many cases due to data being only partly suitable for analysis. National socioeconomic, labour market and institutional realities also make it difficult to come up with standard policy responses suitable to address mismatch problems.

Still, there is a need to identify general principles to help policy makers realise the ambitions of the *New skills agenda for Europe* launched by the European Commission in June 2016. Cedefop has worked extensively on skill mismatch research and analysis since 2008, setting up a research agenda, mapping existing research and clarifying definitions (Cedefop, 2010, 2012a), carrying out new research on the impact of skill mismatch for vulnerable groups (Cedefop, 2011) and mapping out policy responses for tackling

skill shortages and unemployment in EU economies (Cedefop 2015b, 2015c) ⁽¹⁾.

To address the significant gap in data and research evidence on skill mismatch across EU Member States, Cedefop also engaged in collection of new data via the European skills and jobs survey (ESJS) ⁽²⁾. This new rich source of information at EU level, examining drivers of skill development and dynamic evolution of skill mismatch in relation to changing complexity of tasks and skill needs in jobs, was carried out in spring 2014 in all Member States and surveyed about 49 000 adult employees. This report presents and summarises research and analysis carried out with this new data source, with a view to understanding better the skill mismatch phenomenon and providing policy-makers with insights that can help shape policies.

In-depth analysis of the ESJS data has revealed a number of interesting facts about the occurrence, cost and determinants of different forms of skill mismatch affecting EU workers. We live in times of heightened concern among policy-makers and the media regarding the tremendous changes in skill demands that will arise from the proliferation of digitalisation (including new forms of virtual work), artificial intelligence and robotics in our economies and societies (Brynjolfsson and McAfee, 2014; Ford, 2015; WEF, 2016; Cedefop, 2017a). The ESJS highlights that 43% of adult employees have recently experienced changes in the technologies they use at work and 47% saw changes in their working methods or practices. About one in five considers it very likely that several of their skills will become outdated in the next five years (Chapter 2).

Such accelerating change in technologies and skill demands spurs continuous debate about whether individuals will manage to adapt

⁽¹⁾ <http://www.cedefop.europa.eu/en/events-and-projects/projects/assisting-eu-countries-skills-matching>

⁽²⁾ <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

their skill sets sufficiently quickly to reduce the risk of being replaced completely by machines, ensuring that EU societies do not experience high rates of technological unemployment and job/wage polarisation. In the face of rapid advances in the digital era, some groups of the population (females, older, lower-educated, unemployed or inactive, employed in low-skill jobs) are at high risk of being left behind, succumbing to the so-called digital divide (Chapter 6). It is also clear that individuals who can survive and thrive in the digital economy, and those suited to the skill requirements of future jobs, are those who do not only possess good digital skills, but also a healthy mix of cognitive (problem-solving, creativity, learning to learn) and socioemotional (communication, collaboration) skills (Chapter 3).

For many in the business world the rapidly changing nature of production technologies has already resulted in widespread hiring difficulties for people with the required skills (Chapter 4). As the global economy continues to emerge from the pronounced economic downturn spurred by the 2008 global financial crisis, more than four in 10 employers continue to express difficulty in filling vacancies ⁽³⁾.

Taking only a snapshot of the labour market at the time that job applicants and employers first ‘meet’, in the recruitment market, raises some cause for concern. The ESJS data collected information about the match of individuals’ skills with those needed by their jobs at the time they were hired (Chapter 5). It reveals that individuals who come back to the job market after having spent an extended period of time in unemployment have greater skill gaps than those without career interruptions. This is likely to reflect atrophy of skills or lost skill development opportunities, in particular employer-provided training, during the time they were outside of the labour market (Cedefop, 2017b). Other population groups, including females, younger workers (graduates) and those with fewer qualifications, are also more likely to have lower skills than needed when commencing employment. Such find-

ings cause concern, since it is reasonable to expect that the average skill gap in the total job-seeker pool (including individuals who did not manage to return to work) is likely to be worse, underpinning employers’ inability to fill their vacancies.

Cedefop’s analysis based on ESJS and other European data highlights that skill shortages that genuinely arise due to an absence of job-ready candidates affect Europe’s most innovative, internationally competitive and dynamically growing enterprises, posing productivity and growth constraints. But not all recruitment difficulties arise due to job applicants lacking skills. Skill shortages are multifaceted and bottlenecks can reflect unattractive job offers, poor human resource practices in firms and limited labour market mobility (Chapters 3 and 4).

1.2. Wasted resources: invisible, underutilised skills

ESJS data reveal that a considerable share of the working population already possesses the skills needed by their jobs, even if these are not evident from their formal qualifications. This reflects that fact that people continue to build their human capital within workplaces, beyond initial formal education and training (Arrow, 1962). One in five older workers, for instance, has the necessary job skills despite being underqualified (Chapter 3). Underqualification is yet another form of mismatch, highlighting the need for EU policy-makers to make greater progress in setting up and rolling out systems of validation of non-formal and informal skills (Cedefop et al., 2017c).

Not only is there a large ‘invisible’ stock of skills available in the employed population, but many employees find themselves in jobs that do not fully utilise their potential. According to the ESJS, about one in four EU tertiary graduates is employed in jobs that require lower qualifications than their own (Chapter 7) and 27% of adult employees started their jobs with higher skills than needed (Chapter 8). As the survey was carried out at a time of low aggregate demand (2014),

⁽³⁾ Manpower Group: Talent shortage survey 2016/17: <http://manpowergroup.com/talent-shortage-2016>

such high mismatch rates partly reflect the stark decline in job availability, especially in some sectors (manufacturing, construction). This may have induced higher-educated individuals, particularly those faced with high cost of job search (financial or personal constraints), to take up lower-skilled jobs. Some would also argue that there is little need for broad policy action, given that such overeducated or overskilled workers usually move on to more suitable jobs over time.

But the ESJS data warn that the so-called career mobility hypothesis of skill mismatch may not be robust. There is great persistence in skill underutilisation. Workers who enter jobs genuinely mismatched, both overeducated and overskilled, have greater chances of remaining overskilled after several years of job tenure (Chapter 8). Overeducated workers are also more likely to be employed in jobs without promotion prospects; their motive for accepting their mismatched job in the first place is the desire to attain some job security. For some the choice of a mismatched job is consciously made, as they trade finding a job matched to their skills in favour of striking a better work-life balance or remaining closer to their home (Chapter 7). The availability of good career guidance and counselling and of future-oriented labour market intelligence are beneficial policies for steering younger labour market entrants away from making wrong career choices and raising awareness about their consequences (Chapter 3).

Part of the reason that overeducated workers endure a wage penalty relative to their former classmates is because of lower levels of work experience and non-formal/informal skills; these are traits that may be mitigated with the promotion of suitable work-based learning policies and practices (Chapter 3). However, little evidence is found to suggest that this wage gap reduces as the skills of overeducated workers are gradually aligned to their job-skill requirements.

These aspects reflect the fact that the skill needs of overeducated workers' jobs more closely mirror those of 'fellow workers' (comparable lower-educated individuals who are well-matched in similar types of jobs) as opposed to

their 'classmates' (similarly educated workers who have found matched jobs) (Chapter 7).

1.3. Acknowledging skill mismatch dynamics

A key insight of the ESJS is that relying on a snapshot of the labour market may lead to erroneous policy conclusions for tackling skill mismatch. Despite its persistence, skill mismatch is not immutable: it is an inherently dynamic phenomenon that can change with seniority, especially for a sizeable part of the employee population that sees its initial skill gaps diminish over time (Chapter 8).

The type and evolution of skill mismatch during an individual's job tenure comes from the balance between the rate of skills growth and the degree of change in the complexity of job tasks. The two forces are interlinked and although it is difficult to establish causality, the ESJS shows that there is significant negative correlation between the incidence of skill underutilisation at the start of work and a worker's subsequent skill formation (Chapter 9). This suggests that individuals who enter into less complex jobs, characterised by non-autonomous, routine tasks with little scope for continuing learning (both non-formal and informal) and limited contract duration (temporary contracts), have greater odds of seeing their skills remain stagnant over time. Jobs that entail informal learning (interaction with peers, learning from supervisors, trial-and-error), have more impact on the degree of skill development of adult workers than provision of structured training courses by employers.

Individuals who commence their employment with some degree of skill gap are usually employed in such complex jobs and benefit most from the multiplying effect of non-formal and informal learning on skills growth. By contrast, overskilled employees are usually found in jobs with limited task complexity (given their higher overall skill level) and this inhibits their further skill development on the job. From a learning perspective, high rates of underskilling in a country's working population could be a sign of pos-

itive momentum in the growth of its skills stock. By contrast, policy-makers should be greatly concerned by high overskilling rates in labour markets, as they are a sign of stagnant growth in skills and skill needs.

Despite significant increase in skill needs in EU job markets, it is also important that some new technologies may be associated with deskilling and some firms rely on low-skill market strategies, increasing inequalities in pay and continuing training opportunities. The ESJS data point out that 4% of the employee workforce experienced declining variety of job tasks since the start of employment; for 17% it stayed the same. Differences across industries are stark. Close to a third of adult workers in the accommodation, catering and food services, transportation and storage, and social and personal services sectors saw stable or decelerating task complexity since they began their jobs. At the other end of the spectrum, less than a fifth of employees in professional, scientific and technical services, financial, insurance or real estate services, and ICT are subject to stagnant skill demand. Far too many EU workers, especially in middle- and lower-skilled occupations, are also required to use low basic and digital skills as part of their daily work routines. Low levels of task complexity in such jobs inhibit the continued skill formation of individuals, perpetuating a bad jobs-low skills vicious cycle.

1.4. Reducing skill mismatch: a different mindset

The new insights on skill mismatch obtained from analysis of ESJS data and wider research suggest that policy-makers would benefit from adopting a different mindset in relation to mitigating discrepancies in skill supply and demand in their economies (Table 1). However, striking the right policy mix is a challenging task.

Instead of focusing solely on employer difficulties in finding the right skills, it is important first to take stock of the potentially large volume of existing unrecognised and underutilised skills in the labour market. Further, a substan-

tial share of employers' hiring difficulties arises due to poor jobs offers, inefficient human resource management and other job market rigidities. Policy-makers must carefully distinguish the part of skill shortages that may be mediated by adapting/reforming publicly funded VET systems from that which can be best tackled by a wider set of labour market and other policy reforms.

Helping specific vulnerable population groups reintegrate into the labour market with minimal skill gaps, via well-designed activation policies, is also important (Cedefop, 2017b). Equally important is the need for placement in good and stable jobs, to ensure sustainable and continued growth in the skills of those who spent extended periods outside of work. The provision of good career guidance and counselling to graduates and job-seekers is also key, as this may prevent overskilling at early career stages from which it is difficult to escape.

Policy-makers should also be aware that the goal of perfect skills matching is a chimaera and that one-shot policy measures are likely to be short-lived. The reason is that a specific type of skill mismatch affecting an individual may change with seniority. Individuals whose skills are matched to their job skill requirements at one point are likely to become mismatched, in one form or another, at a subsequent time.

Some degree of skill mismatch may also be a sign of healthy dynamics in jobs markets, as would be the case when high observed underskilling rates in the adult workforce go hand-in-hand with a high share of dynamically changing jobs. This situation can be a marker of continued learning taking place among workers, with subsequent beneficial productivity outcomes and higher worker adaptability to economic change.

While too much literature and policy debate has tended to view skill mismatch as a cost, effective skills matching policies in Europe may provide an opportunity for healthier job markets. Policies that focus on disrupting the persistence of overskilling among demotivated workers, by promoting investment in higher-end product market technologies and better management practices, are likely to have

Table 1. **A different approach to skills matching**

Mainstream view	Additional insights
<p>Skill shortages EU employers cannot find the right skills Graduates are ill-prepared for the skill needs of modern workplaces.</p>	<p>Skill surpluses The skills of a significant share of the EU adult population are unrecognised or underutilised. Low incidence of workplace learning in some sectors/occupations. Low reliance on skills of females and older workers; high dependence on temporary workforce. Stagnant task variety and inequities in skill needs in some sectors.</p>
<p>Skill mismatch: static Policy-makers should aim to match skill supply to skill demand.</p>	<p>Skill mismatch: dynamic One-shot policy solutions to matching skills and jobs are short-lived. Some skill mismatch can be healthy if associated with changing skill needs and continued skill formation.</p>
<p>Skill mismatch: a cost Skill gaps are associated with lower productivity.</p>	<p>Skill mismatch: an opportunity Some skill gaps reflect greater opportunities for continuing learning. Transitions from overskilling to matched skills/skill gaps bring productivity gains.</p>
<p>Activation: the low road Policy-makers should aim for quick reintegration of unemployed/inactive.</p>	<p>Activation: the high road Skill mismatches at job entry can reinforce the scarring effect of unemployment; train-first activation and sustainable employment needed.</p>
<p>Lifelong learning: an individual responsibility Individuals should invest in adult training to shield against career interruptions and changing skill needs due to rapid digitalisation.</p>	<p>Lifelong learning: a joint worker-firm responsibility Most continuing learning takes place informally in workplaces. Employer-provided training has a greater marginal effect on workers' continuing skill development.</p>

positive long-term productivity outcomes and encourage continued learning and adaptability among staff.

1.5. Reading the report

This report is a compilation of several online analytical research pieces – so called ESJ Survey Insights ⁽⁴⁾ – that have been authored by Cedefop experts using own in-house empirical analysis and research studies that have used ESJS micro-data (Polacheck et al., 2017). The individual chapters of the report are self-standing pieces and can be read independently; they deal with analyses concerning different forms of skill mismatch.

Part 1 of the report sets the scene by discussing important drivers and policy challenges for tackling skill mismatch in the EU. Chapter 2 focuses on literature and findings that consider the implications of digitalisation and automation for skills obsolescence (Chapter 1), given that technological changes are the major driver of changing skill needs in the future world of work. Chapter 3 draws on key policy challenges, as highlighted by the ESJS data, facing skills policies in EU countries, including the EU's *New skills agenda for Europe*.

Part 2 of the report comprises of Chapters 4 to 6, which focus on skill mismatches that occur when the skills of individuals are not sufficient to meet the needs of their jobs. A much discussed form of skill mismatch that arises when employers have difficulty sourcing the

⁽⁴⁾ <http://www.cedefop.europa.eu/en/publications-and-resources/statistics-and-indicators/statistics-and-graphs/esj-survey-insights>

right talent for their organisation is skill shortages. Chapter 4 discusses the incidence of skill shortages across EU businesses and worldwide and pays attention to understanding their underlying causes. Chapters 5 and 6 consider skill gaps among workers. These can arise as a result of inefficiencies in recruitment, industrial restructuring or a tightening labour market combined with non-responsive vocational education and training systems (Chapter 5). Digital skill gaps, in particular, may be common due to accelerating technological demands but also individuals' lack of a complementary skill set to digital proficiency (advanced numeracy, planning and organisation skills, problem-solving) (Chapter 6).

Part 3 moves away from the notion that workers' skills lag behind their job demands and considers various instances of skill underutilisation, a prominent occurrence in many EU job markets. Chapter 7 tests alternative the-

ories that may explain why some younger, higher educated individuals accept jobs below their education level (overeducation), usually at early stages of their working lives. Chapter 8 looks at the dynamics underpinning the transitions of adult employees between different states of skill mismatch, both when they change jobs and also during their on-the-job tenure. It also considers whether overeducation is genuinely associated with workers with fewer skills and abilities and if such educational mismatch is a temporary or persistent state. Chapter 9 concludes by highlighting the implications of skill underutilisation for workers' continuing vocational training and skill formation.

PART 1

MATCHING SKILLS
AND FUTURE JOBS:
DRIVERS AND
CHALLENGES

Rise of the machines: digitalisation, automation and skills obsolescence in the EU

Cedefop's European skills and jobs survey (ESJS) reveals that 43% of EU employees experienced a recent change in the technologies they use at work. Changing technologies and structural change across and within sectors and occupations are expected to raise the share of the EU adult workforce faced with a high risk of technological skills obsolescence. Yet, concerns about widespread automation and robotisation may not materialise into a jobless world. Ultimately the future of work should depend on human acumen that will complement, and not be replaced by, artificial intelligence.

2.1. The fear of technological unemployment

Recent years have seen a surge in new research studies on the future world of work. Much of this new literature was prompted by claims that close to a half of jobs in advanced economies may be replaced or automated by new technologies and robots (Frey and Osborne, 2013), or that we are at a critical turning point where various disparate pieces of the innovation puzzle are now coming together in a manner that will cause exponential transformation in the near future (Brynjolfsson and McAfee, 2014). At the heart of this is fear that current slow rates of economic growth and productivity in advanced economies will continue well into the future and that people will either lose their jobs or not be able to find adequate work in the new digital age. Welcome to the new age of robots.

With so much innovation and change taking place as part of what some call the 'fourth industrial revolution' (WEF, 2016) – autonomous cars, 3D printing, smart homes, financial market 'algos', machine learning and big data, artificial intelligence, internet of things, robotics – it is easy to blame new technology for the high rates of unemployment affecting European and other advanced Western societies. However, history tends to highlight the potential fallacy of doing

so. One of the world's most celebrated economists – John Maynard Keynes – predicted almost 85 years ago, in 1930, that a 'new disease' would afflict societies due to the gains in productivity outpacing or replacing the need for human labour. Keynes foresaw the generation of 'technological unemployment' as part of his manuscript *Economic possibilities for our grandchildren*: 'Today we are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come – namely technological unemployment. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour' (Keynes, 1910, pp. 321-332).

Since that time, however, Keynes', and many other people's grandchildren, have enjoyed sustained growth in employment and prosperity over the long term.

Box 1. 18th century machines that 'will ruin the country'

'One day in the 1760s James Hargreaves, a hand-loom weaver from the village of Oswaldtwistle, was struck by the way an overturned wheel kept on spinning. What would happen, the weaver wondered, if several spindles were to be placed upright, side by side? Might it not be possible to spin several threads at once?

Working with a knife, Hargreaves shaped a primitive engine, a 'jimmy' – and the initial reaction from some was disgust. Angry neighbours raided Hargreaves's barn, on the grounds that the machines would 'ruin the country'. If one jenny could do the work of eight spinners, reasoned the neighbours, that would put seven out of work.

In fact, the spectacular new spinning capacity provided the basis for a cotton boom. In the 1770s, as earnings rose, spinners and weavers took to parading the streets on paydays with £5 notes in their hatbands. Their wives drank tea out of the finest china' (Lacey, 2007).

2.2. The job creation and transformation potential of digitalisation

There is little doubt that a new digital era has dawned. Digital technologies are not only changing the way we learn and work but are also modifying social habits and the way we live our lives. And despite fears that digitalisation and robotisation will be a substitute for labour inputs, technological innovation has been historically associated with a positive net employment premium (Vivarelli, 2015; Abadie et al., 2016). In most cases any initial labour-saving effects tend to be substituted by compensatory price or income effects associated with greater product innovation, such as lower prices of high-tech consumer goods and new product markets that stimulate higher aggregate demand.

James Bessen's (2015) fascinating journey back to the 19th century cotton mills illustrates, along with numerous other examples from economic history, that technological progress brings short-term disruptive effects that are nevertheless offset in the long-term by rising incomes, higher consumer demand and the creation of more productive and rewarding jobs ⁽⁵⁾. Such is the case also with more recent technological advances, such as the introduction of automat-

ed teller machines (ATMs) in the 1970s in the US banking industry. Bessen (2015, p. 108) has shown that, by the mid-1990s, there was no sign of such machines replacing human tellers, the reason being that overall demand for more customer-oriented financial transactions rose during this period, operating costs fell and tellers could afford to devote their working time to other, more specialised, tasks.

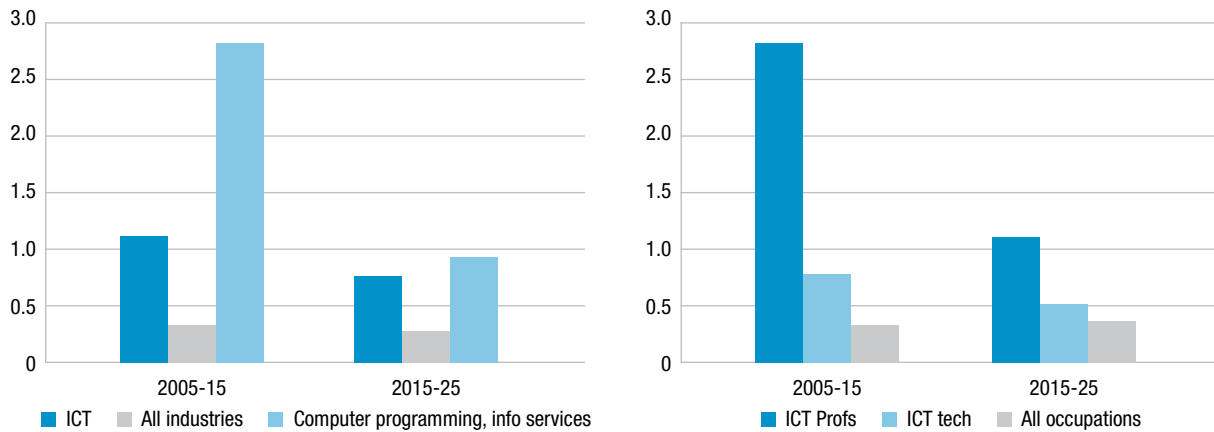
The spread of information and communications technologies (ICT), and especially of computing services, has by itself proved a major jobs driver in European economies in recent years, although not at levels that would by itself alleviate job destruction due to automation (Berger and Frey, 2016). Yet, the ICT sector enjoyed an almost three times higher annual employment growth rate than the rest of the economy during the previous decade and was persistently strong during the global economic downturn. About a million jobs were created in occupations tightly knit to ICT services, such as ICT professionals and ICT technicians and associate professionals, while, according to Cedefop's skills forecasts ⁽⁶⁾, a further half a million more jobs are anticipated to be created in the next decade in Europe (Figure 1).

A notable consequence of widespread digitalisation is also the rising incidence of new online forms of platform employment or crowd work in the so-called gig economy (Meil and Kirov, 2016).

⁽⁵⁾ For an interview with Professor James Bessen (Boston University School of Law) and Professor Richard Freeman's (Harvard University) speech on robots given as part of the Cedefop conference *Maximising skills for jobs and jobs for skills* see: <http://www.cedefop.europa.eu/en/events-and-projects/projects/assisting-eu-countries-skills-matching/videos>

⁽⁶⁾ <http://www.cedefop.europa.eu/en/events-and-projects/projects/forecasting-skill-demand-and-supply>

Figure 1. **Past and anticipated employment growth rates in ICT and all industries, 2005-25, EU-28**



Source: Cedefop European skills forecasts: <http://www.cedefop.europa.eu/en/events-and-projects/projects/forecasting-skill-demand-and-supply>

Digital platforms connect service providers and users in the exchange of goods, services and labour in an open marketplace. Platform owners facilitate the organisation of such work and production by linking together different digital technologies, operations and networks that transcend spatial boundaries for the execution of disassembled (sometimes standardised) tasks and projects. According to a recent study, such platforms could add more than EUR 370 billion to the EU economy and bring more than 5.2 million workers into employment (McKinsey, 2015). Although conventional labour market statistics cannot yet provide a representative measure of the incidence of crowdwork in the EU, recent evidence points to its growing prevalence (Kässi and Lehdonvirta, 2016). A 2016 representative survey of online paid crowdwork in several EU countries has highlighted that its incidence (individuals engaging at least once in an economic transaction in labour platforms) can range from about 9% to 12% in the UK, Netherlands, Sweden and Germany to as much as 19% in Austria (Huws et al., 2016). The ever-growing importance of the platform economy is likely to have an impact not only on workers directly offering their online labour services in platforms, but also the entire workforce in sectors of the econo-

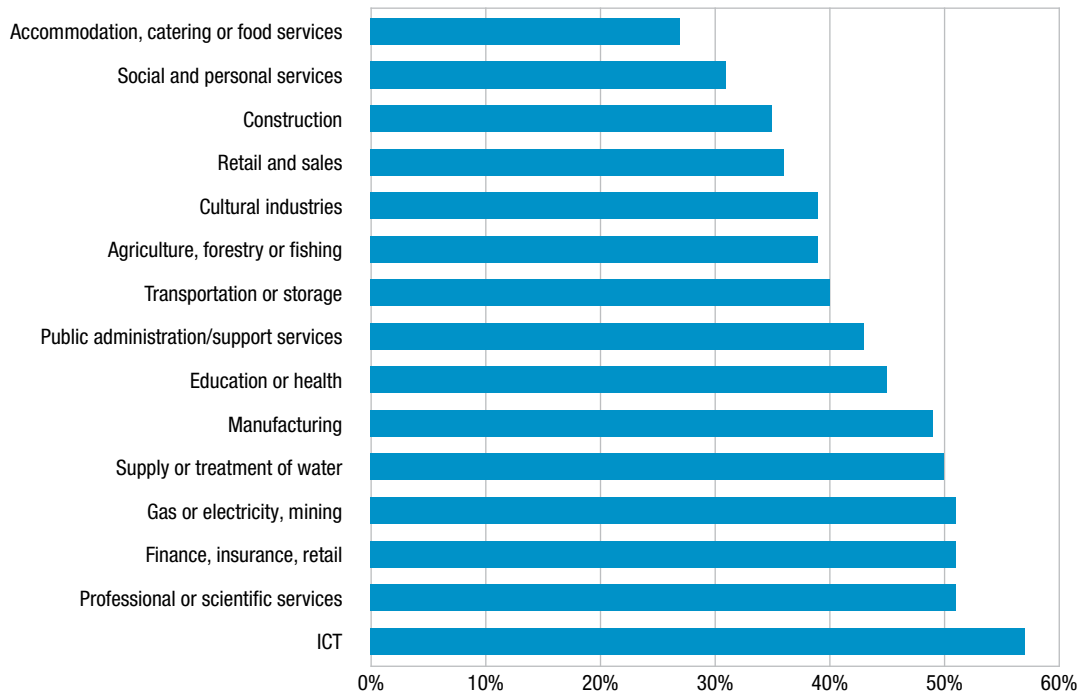
my where online gig work is an economically feasible alternative to traditional organisation.

Even though the ICT sector as a whole accounts for a small share (3% to 4%) of total EU employment, digitalisation permeates most economic activities and occupations. Cedefop's recent European skills and jobs survey (ESJS) has revealed a remarkable degree of innovation across the board. A significant share (43%) of EU workers have seen the technologies they use (machines, ICT systems) change in the past five years or since the time they started their current employment, while 47% experienced changes in their working methods or practices (7). More than half of employees in Ireland, Malta, Slovenia, Finland, Sweden and UK felt the impact of changing technologies used for their work.

New technologies are more prevalent in the rapidly changing ICT sector, where 57% of all jobs have experienced change, but close to a half of workers were also affected in several other high-innovation economic activities, including gas, electricity and mining (51%), financial, insurance and real estate services (51%), professional, scientific and technical services (51%) and manufacturing/engineering (49%) (Figure 2). Technological change is more likely to affect in-

(7) An additional 29% experienced some product innovation (changes in the products or services produced within their workplace) while 26% experienced changes in the intensity of contact they have with clients or customers (Cedefop, 2015a). <http://www.cedefop.europa.eu/en/publications-and-resources/publications/3072>

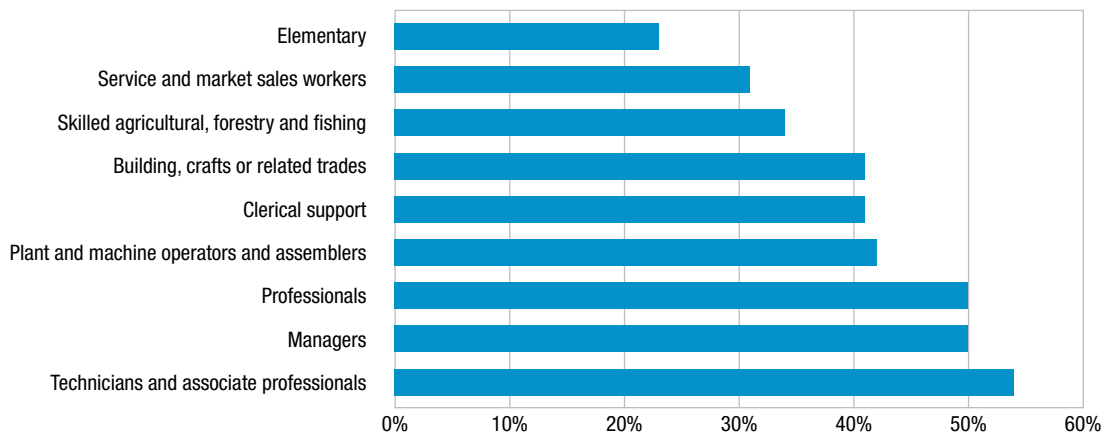
Figure 2. **Share of adult employees who experienced changes in technologies used in the workplace in past five years by economic sector, 2014, EU-28**



NB: Share of EU adult employees who experienced changes to the technologies (machinery, ICT systems) they used in the past five years/since they started their main job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Figure 3. **Share of adult employees who experienced changes in technologies used in the workplace in past five years by occupation, 2014, EU-28**



NB: Share of EU adult employees who experienced changes in the technologies (machinery, ICT systems) they used in the past five years/since they started their main job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Table 2. Share of adult employees who experienced changes in the technologies used in the workplace in last five years by occupation, 2014, EU-28

Occupation	% of group	Occupation	% of group
ICT technician/Associate professional	67%	Legal, social and cultural professional	40%
ICT professional	60%	Skilled agricultural worker	40%
Science and engineering associate professional	57%	Assembler	40%
Production or specialised services manager	55%	Agricultural, forestry and fishery labourer	40%
Health professional	55%	General or keyboard clerk	38%
Electrical and electronic trades worker	55%	Street and other sales or services worker	38%
Science and engineering professional	51%	Street or related sales/services labourer	37%
Business and admin associate professional	50%	Teaching associate professional	36%
Stationary plant or machine operator	50%	Protective service worker	36%
Administrative or commercial manager	48%	Driver or mobile plant operator	36%
Hospitality, retail or other services	48%	Skilled forestry, fishery and hunting	35%
Teaching professional	48%	Other skilled trade (building, crafts or related trade)	35%
Health associate professional	48%	Sales worker	33%
Legal, social and cultural associate professional	48%	Labourer in mining, construction, manufacturing (building, crafts or related trade)	32%
Handicraft and printing worker	48%	Another building and related trades worker	31%
Metal, machinery and related trades worker	46%	Labourer in mining, construction, manufacturing (elementary occupations)	31%
Business and admin professional	44%	Personal services worker	27%
Other associate professional	44%	Personal care worker	27%
Chief executive, senior official or legislator	43%	Food preparation assistant	27%
Other clerical support worker	43%	Other elementary worker	22%
Customer services clerk	41%	Agricultural, forestry and fishery labour	18%
Numerical and material recording clerk	41%	Cleaner or helper	12%

NB: Share of EU adult employees who experienced changes in the technologies (machinery, ICT systems) they used in the past five years/since they started their main job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

dividuals employed in high-skilled occupations, most notably technicians and associate professionals (54%), managers (50%) and professionals (50%) (Figure 3). ICT technicians (67%) and ICT professionals (60%), science and engineering technicians (57%) and professionals (51%) as well as production and specialist services

managers (55%), health professionals (55%) and electrical and electronic trades workers (55%) are most likely to have experienced changing technologies in their workplaces (Table 2).

2.3. The risk of automation and job destruction

With such a level of technological change taking place across and within EU workplaces, concerns about the disruptive effects of technological progress and digitalisation and implications for widening inequality remain strong. These are supported by the fact that digitalisation is believed to have contributed to the polarisation of jobs in the labour market (Autor et al., 2003, 2006, 2015), in that many advanced economies have experienced a 'hollowing out' of jobs in the middle-skill segment (such as crafts and related trades, plant and machine operators). It is said that the greater automation allowed for by new technologies and advanced robotics has facilitated the substitution by machines of jobs that were reliant on the execution of codifiable (usually routine/non-cognitive) tasks. Alongside this, recent decades have seen greater employment growth in high-skilled occupations, which are intrinsically dependent on job tasks that require high-level interpersonal and cognitive skills. However, some increase has also been evident among low-skilled, non-routine, jobs, in activities which involve close human interaction and tasks that are not (yet) easily substitutable by machines (such as personal services and social care).

By focusing on evidence of shifts in employment trends across different types of occupational groups, Frey and Osborne (2013) have argued that as consequence of the 'second machine age', close to a half of all jobs in the US could be at risk of being substituted by computers and algorithms in the next decade or two.

Such claims have been recently dismissed on the grounds that they potentially exaggerate the extent to which occupations as whole can be automated. In contrast, it is now being reported that there is a marked degree of variation in task complexity within broad occupational groups (Autor and Handel, 2013; Cedefop, 2015a; Eurofound, 2016). For this reason, when estimating the risk of automation it is necessary to take into account the fact that workers who may be classified within the same occupational group may perform a different portfolio of tasks (routine versus non-routine, cognitive, manual, communica-

tion-based) due to the fact that their employers may design their work or workplaces differently (Pouliakas and Russo, 2015).

A recent study on these lines by Arntz and colleagues (2016) calculated that the share of OECD jobs potentially at risk of automation is much smaller than originally thought. The study found that just 9% of jobs in the countries that participated in the OECD's survey of adult skills (PIAAC) are at a high risk of being automated, with at least 70% of the tasks in these jobs being automatable. The risk ranges from a high of 12% of jobs in Germany, Spain and Austria to around 6% or less in Estonia and Finland, reflecting differences in past ICT investments and structural economic characteristics between countries. A larger share of jobs have also been found to be at low risk of complete automation; between 50% and 70% of their tasks may be automated. Although not entirely at risk of potential destruction, these jobs have a high probability of seeing their tasks being markedly transformed.

Adopting a similar logic, a large-scale study by McKinsey (2017) has revealed that less than 5% of existing occupations are wholly automatable, though for 60% of occupations at least one third of their task profile is susceptible to automation. The study of Acemoglu and Restrepo (2017) further indicates that such automation is an outcome of increased reliance by firms on robots, which can undertake manual and repetitive tasks previously carried out by low- or medium-skilled workers. In Europe, for example, about 0.6 robots were used per 1 000 workers in the 1990s. This proportion rose to about 2.6 robots per 1 000 workers by the late 2000s. In the US this share has risen from 0.4 to 1.4 robots per 1 000 workers during the same period. The authors estimate that during 1990-2007 the US employment/population ratio was reduced by about 0.18% to 0.34% for each additional robot per 1 000 workers. Worker's wages were also affected negatively by about 0.25% to 0.5%. Although such average estimates are significant, it is noted that the impact of robotisation on employment can vary markedly depending on how closely substitutable different goods are between neighbouring commuting zones and also the responsiveness of labour supply to wages.

2.4. Skills obsolescence due to technology

With between a quarter and two-fifths of jobs at high or medium risk of automation in OECD countries, it is expected that dynamically evolving technologies will render many workers' skills obsolete while placing a high premium on others.

Cedefop's ESJS data reveal that about a quarter (26%) of adult employees in the EU labour market think that it is moderately likely, and one in five (21%) very likely, that several of their skills will become outdated in the next five years ⁽⁸⁾. Close to three in 10 (29%) respondents working in the ICT services sector believe it likely that their skills will become outdated in the foreseeable future, while the jobs of employees in financial, insurance and real estate services (24%) and in professional, scientific or technical services (23%) are also at high risk of skills obsolescence.

Combining the information collected by Cedefop's ESJS on the incidence of past technological change in workplaces, together with the anticipated likelihood of skills becoming outdated, allows investigation of the susceptibility of EU jobs to the risk of technological skills obsolescence. Such a measure captures the extent to which the skills profiles of jobs are relatively stable or vulnerable to technological change (Figure 4) ⁽⁹⁾.

About 10% of the jobs of EU employees are found to be at a high risk of technological skills obsolescence, with the highest rates observed in Estonia (23%), Slovenia (21%) and the Czech Republic (19%). These workers are both employed in jobs in which they experienced changing technologies in the previous five-year period and also believe that it is very likely that several of their skills will become outdated in the next five years.

A further 11% of EU employees believe there is a high likelihood of their skills becoming outdated in the medium-term future, although they

did not experience recent changes in workplace technologies. Some 33% saw the technologies used in their workplace change in previous years, but do not anticipate any future change in the skills required. Close to a half (46%) of the workforce has not experienced nor expects any significant alteration to their overall skill set.

Table 3 also depicts occupations that are mostly susceptible to technological skills obsolescence and those that exhibit a relatively stable skills profile that is least affected by technological change. It is evident that workers employed in ICT, health, managerial and engineering-related occupations are more likely to experience changing skills profiles in their jobs, while employees in the primary sector and in elementary or personal service occupations are relatively insulated from technological innovation.

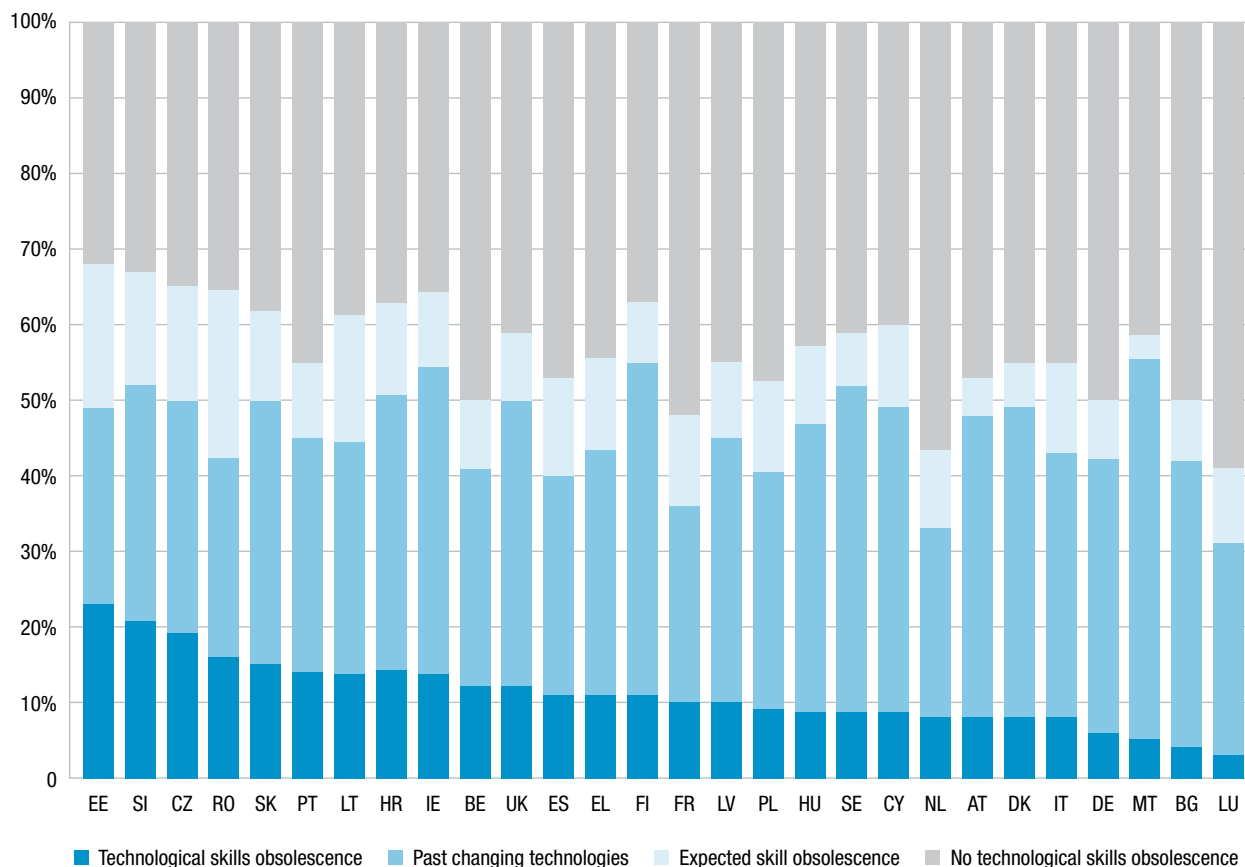
2.5. Back to the future of work

Fear that technology will substitute labour is not new, nor is the 'end of work' likely to be 'nigh'. Technological progress and ICT technologies have not only created new, typically high-skilled jobs (web applications designers, software developers, market research data analytics); they are also expanding possibilities for individuals to undertake more interesting and productive tasks at work and online, leaving the more routine activities to the robots best-equipped to do them. But the possibility that things may take a different turn this time around cannot be completely dismissed. In contrast to the past, typical innovation cycles seem to be much faster than before and automation/robotisation is creeping into a number of high-skill occupations (such as paralegals, nurses, financial analysts) and jobs involving non-routine tasks; this follows rapid advances in machine learning and visual/spatial perception (Ford, 2015). Also, new technological industries being created tend to be less labour-intensive than in the past: contrast the experiences of new

⁽⁸⁾ Cedefop's ESJS asked respondents the following question: 'On a scale from 0 to 10, where 0 means very unlikely and 10 very likely, how likely or unlikely do you think it is that each of the following may happen? Several of my skills will become outdated in the next five years'.

⁽⁹⁾ In the construction of the index of technological skills obsolescence, only those workers who responded that it is very likely to experience skills obsolescence (gave a score above 7 in a 0-10 scale) are counted.

Figure 4. Share of adult employees at risk of technological skills obsolescence, 2014, EU-28



NB: Ranking of countries based on combinations of the share of EU adult employees who either experienced changes to the technologies (machinery, ICT systems) they used in the past five years and/or expect that their skills have a high likelihood of becoming outdated in the next five years. Workers who experience both changing workplace technologies and expected skills obsolescence are classified as being at high risk of technological skills obsolescence.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

web applications companies such as Instagram with the thousands of employees who were once employed in the industry giant Kodak. Added to this are serious concerns about the fact that the historical link between higher productivity and real wage growth has been weakened and that the falling price of ICT technologies is feeding into a rising share of capital inputs in total income (Berger and Frey, 2016).

Whether job creation or destruction will prevail as a result of new technologies will depend on a number of factors, notably whether R&D investments will continue to breed product innovation, which is job friendly, as opposed to embodying them in capital goods (machinery and equipment) (Vivarelli, 2015). It is also critical that new innovation feeds into falling unit costs

and prices and superior services, which will stimulate buoyant demand in product markets; this depends on preserving a healthy degree of competition in markets, preventing oligopolistic/monopolistic practices. It will be shaped by the regulatory and institutional infrastructure as well as social barriers put in place by humans. For example, the wider proliferation of models of employee-shared capital ownership, or stronger collective bargaining institutions, could enable humans to enjoy more hours of leisure in the future, ultimately reducing inequality and technological unemployment created by just a few people 'owning the robots' (Freeman, 2014).

What is, nevertheless, clear is that the widespread transformation of the world of work will pose a great challenge to policy-makers, who

will be summoned to manage the potential displacement and skills obsolescence of many (low-skilled) individuals. The reform of vocational education and training (VET) systems in Europe will play a key role in terms of enabling individuals to meet high or emerging skill needs in labour markets, spurred by digital technologies and artificial intelligence revolutions, and coun-

teract skills obsolescence. Ultimately, the extent to which technological progress translates into a jobless society will depend on the effectiveness with which education and training reforms, combined with smart innovation, product and labour market regulations, will empower rather than disable individual skills and incomes.

Table 3. **Degree of technological skills obsolescence across occupations, 2014, EU-28**

Top occupational groups with changing skills profiles	Top occupational groups with stable skills profiles
<ul style="list-style-type: none"> • ICT associate professionals • ICT professionals • Production or specialist services managers • Electronic and electronic trades workers • Teaching professionals • Administrative or commercial managers • Science and engineering professionals/associate professionals • Health professionals 	<ul style="list-style-type: none"> • Subsistence farmers, fishers or hunters • Cleaners or helpers • Food preparation assistants • Personal services workers • Personal care workers • Labourer in mining, construction, manufacturing • Driver or mobile plant operator • Agriculture, forestry and fishery labourer • Protective services worker

NB: Ranking of occupations based on an index of skills stability, derived as the share of EU adult employees who experienced changes to the technologies (machinery, ICT systems) they used in the past five years and expect that their skills have a high likelihood of becoming outdated in the next five years.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Policy challenges for tackling skill mismatch

Cedefop's European skills and jobs survey (ESJS) highlights the complex challenges facing European VET systems. Changing technologies and structural economic change are expected to feed into a higher reliance on cognitive and interpersonal skills in future workplaces. Skill gaps are prevalent in some occupations and sectors and mostly affect population groups (re) entering the job market (such as students and the long-term unemployed), yet skills matching ranks low as a motive in individuals' job choices. Contrary to expected benefits, labour market mobility tends to favour the most skilled. Too many EU workers' skills also remain underused and unidentified. A *New skills agenda for Europe* must therefore increase the transparency and validation of qualifications and adult workers' skills and invest in better labour market and skills intelligence. This will ultimately support mobility among the groups most in need.

3.1. Hard facts for a *New skills agenda for Europe*

EU Member States in recent years have employed a number of policy levers for education and training, which affect, in different ways, the effectiveness of skill formation and matching. These policy levers aim to influence the extent to which the qualifications, knowledge, skills and competences acquired by learners and workers strengthen their employability, ability to find sustainable employment and, ultimately, their productivity and innovation.

Within the strategic framework for European cooperation in education and training (ET 2020) ⁽¹⁰⁾, as well as the Copenhagen process and revised Riga priorities for European cooperation in VET ⁽¹¹⁾, a number of key policy priorities and instruments have been set up by national policy-makers. Some of these refer to the need to promote work-based learning in all its forms, improve the quality of education and training systems, offer efficient and integrated guidance services and make validation of non-formal and informal learning feasible. Other policy initiatives are also high on the agenda, such as continued efforts to improve the transparency

and comparability of qualifications across Europe via the development of national qualification frameworks (NQFs), which link to the European qualification framework (EQF).

The *New skills agenda for Europe* recently proposed by the European Commission has suggested a number of policy actions and initiatives that will seek to strengthen these European tools. The agenda pays particular attention to the need for EU Member States to improve the quality and relevance of skill formation, make skills more visible and comparable and improve skills intelligence and information for better career choices ⁽¹²⁾.

Data from Cedefop's ESJS highlight, however, that European VET policy faces several obstacles, which will have to be overcome to be successful in achieving the aforementioned goals. Some of these key challenges – hard facts – are described in the remainder of the chapter.

3.2. Rising demand for key competences

European economies have undergone marked structural labour market transformation in recent

⁽¹⁰⁾ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3Aef0016>

⁽¹¹⁾ http://ec.europa.eu/education/policy/vocational-policy/doc/2015-riga-conclusions_en.pdf

⁽¹²⁾ <http://ec.europa.eu/social/main.jsp?catId=1223>

decades. The thrust of trends such as a declining manufacturing share of employment, growth in demand for professional, scientific and technical services or the crowding out of middle-skill jobs, is expected to carry on into the future (Cedefop, 2016). Such future employment trends also imply significant changes in the type of complementary skills likely to grow in demand.

To examine the implications of the anticipated employment structure for skill demand in Europe, Cedefop's employment projections for different sectors and occupations have been linked to the average relative importance of a bundle of skills. Information summarising the importance of a set of 11 skills across different economic sectors and occupations was collected as part of a series of survey items in the ESJS. Employing the Eurofound (2016) jobs-based approach, which relies on breaking employment down into detailed job cells (combinations of specific two-digit occupations in a specific sector), has led to the creation of a matrix of 809 jobs in the 28 Member States. The mean skill demand (and other related job characteristics), as extracted by the ESJS data, has been subsequently superimposed on each job. Assuming that historical structural employment trends in EU industries and occupations will extend into the future allows an educated guess about the profile of technologies, job tasks and skills that are likely to be in demand in the coming decade in Europe.

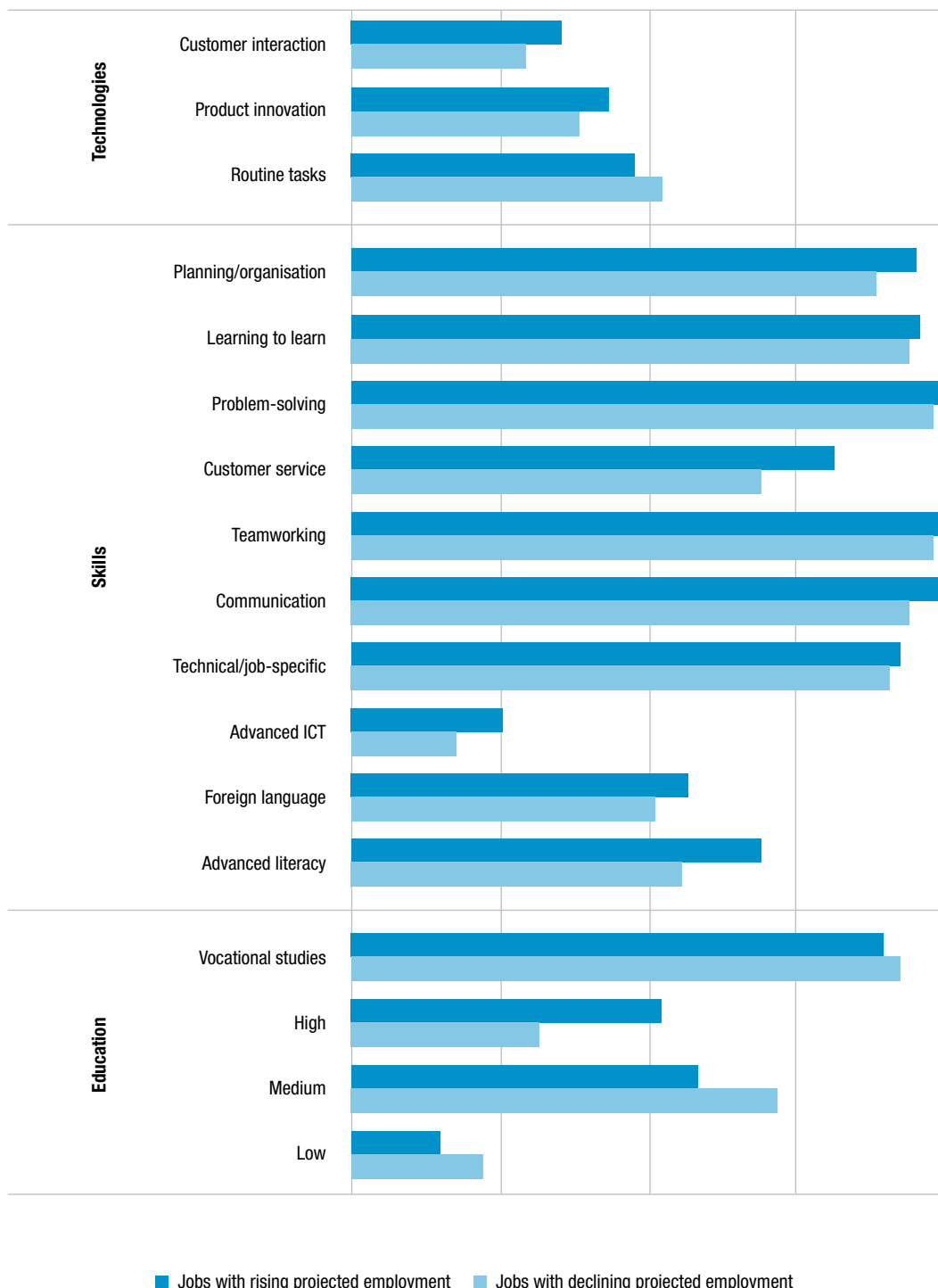
Figure 5 contrasts the skills profiles and task content/technologies of the jobs predicted to decline in employment between 2015-25 (including skilled agricultural workers, crafts and related trades, and numerical and material recording clerks) with those expected to grow (including business and administration professionals, ICT professionals, science and engineering professionals, customer service clerks, assemblers, and cleaners and helpers). The figure provides evidence that much of the anticipated employment growth in the next decade is associated with jobs that have entailed greater product innovation and customer-service orientation in recent years. It is also routine-biased, given that jobs declining in employment exhibit a greater reliance on routine tasks.

If historical employment trends continue unabated into the future, it is also reasonable to expect that there will be rising demand for higher-level skills in the EU economy. The figure shows that jobs that may experience rising employment growth are dependent on workers with higher education qualifications. Although a lot of jobs reliant on initial vocational studies are predicted to decline in the next decade, there is still strong demand for vocational graduates within the cluster of jobs with positive employment outlook (especially in non-marketed services and applied sciences). It is also evident that jobs with positive employment prospects are more likely to rely on advanced cognitive (literacy, numeracy, foreign-languages, problem-solving, learning) and socioemotional (communication, planning, customer service) skills.

Superimposing the information on average skill needs at the level of jobs and mapping future skill demands on the basis of structural changes in the employment pool fails, however, to account for any within-job changes in skill demand. It is possible with the existing data at hand to examine whether the future employment distribution of jobs is associated with jobs that already entail a higher or lower variance of skill needs, but it is impossible to predict whether this within-job variance will increase (following skill- or routine-biased technological change) or decrease (due to deskilling).

The Cedefop ESJS, nevertheless, asked adult employees whether the variety of their job tasks, and the need to learn in their jobs, has increased or decreased since the time they began their current employment. About 4% of the workforce claimed that the task variety in their jobs had decreased since the start of their employment while for 17% of employees it remained the same. More than a quarter, and close to a third of workers in some industries (cultural, retail and wholesale trade, transport and storage, accommodation and food services), have not experienced any change in task complexity in their jobs (Figure 6). The survey therefore highlights that the trend towards higher skill needs, which is undoubtedly implied by the expected structural

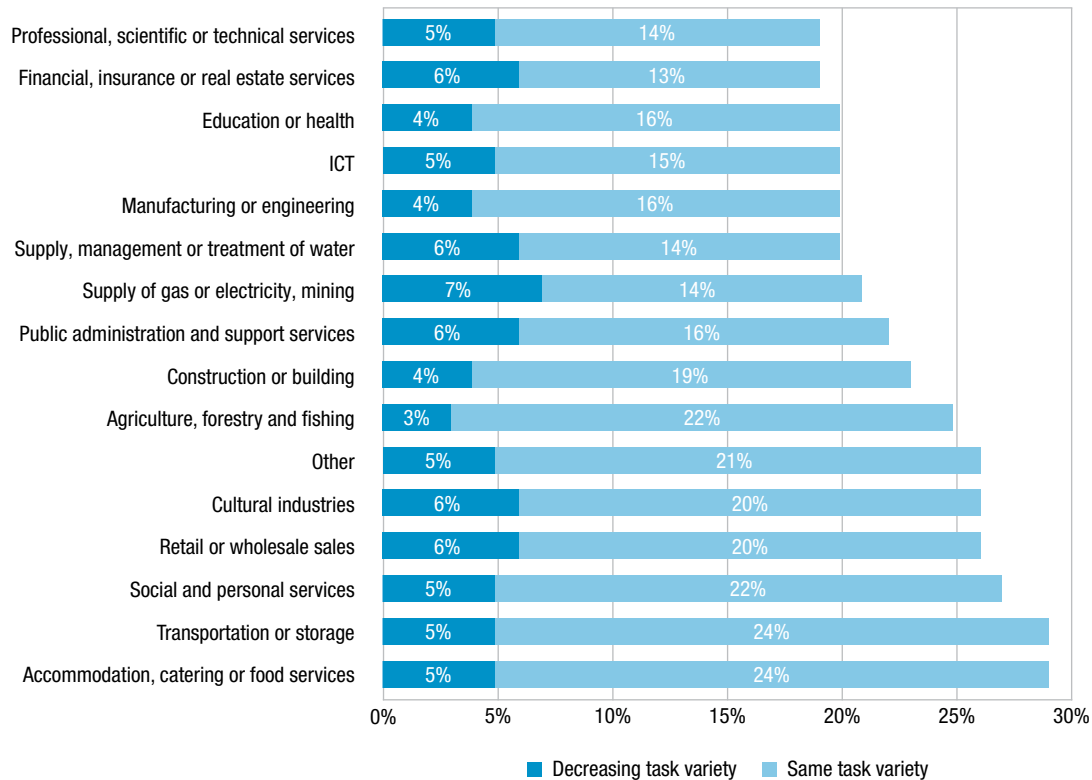
Figure 5. Change in skill demand due to anticipated job restructuring, 2015-25, EU-28



NB: The figure compares the average level of importance of a given variable between two job clusters: those predicted to have positive employment growth versus those with negative employment outlook. Jobs (combinations of two-digit occupations and economic sector) are broken down into two clusters based on the difference between current (2015) and anticipated (2025) employment. Projected employment trends per job are obtained from Cedefop skills forecasts. Information on the importance of skills, education requirements and tasks/technologies, as extracted from the ESJS, is superimposed at job level. All variables have been normalised to a 0-1 scale, where a score of 1 indicates a higher/rising mean incidence of the variable and 0 a very low incidence.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>; Cedefop European skills forecasts: <http://www.cedefop.europa.eu/en/events-and-projects/projects/forecasting-skill-demand-and-supply>

Figure 6. **Share of adult employees with stable or decelerating task complexity by economic sector, 2014, EU-28**



NB: Based on the share of responses to the question: ‘Has the variety of your tasks increased, decreased or remained the same since you started your job with your current employer? Please use a scale of 0 to 10 where 0 means it has decreased a lot, 5 means it has stayed the same and 10 means it has increased a lot.’ Decreasing task variety is captured by the proportion of employees with a score lower than 5.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

transformation of the EU economy towards higher-skilled sectors and occupations, may not necessarily manifest universally within all future jobs ⁽¹³⁾.

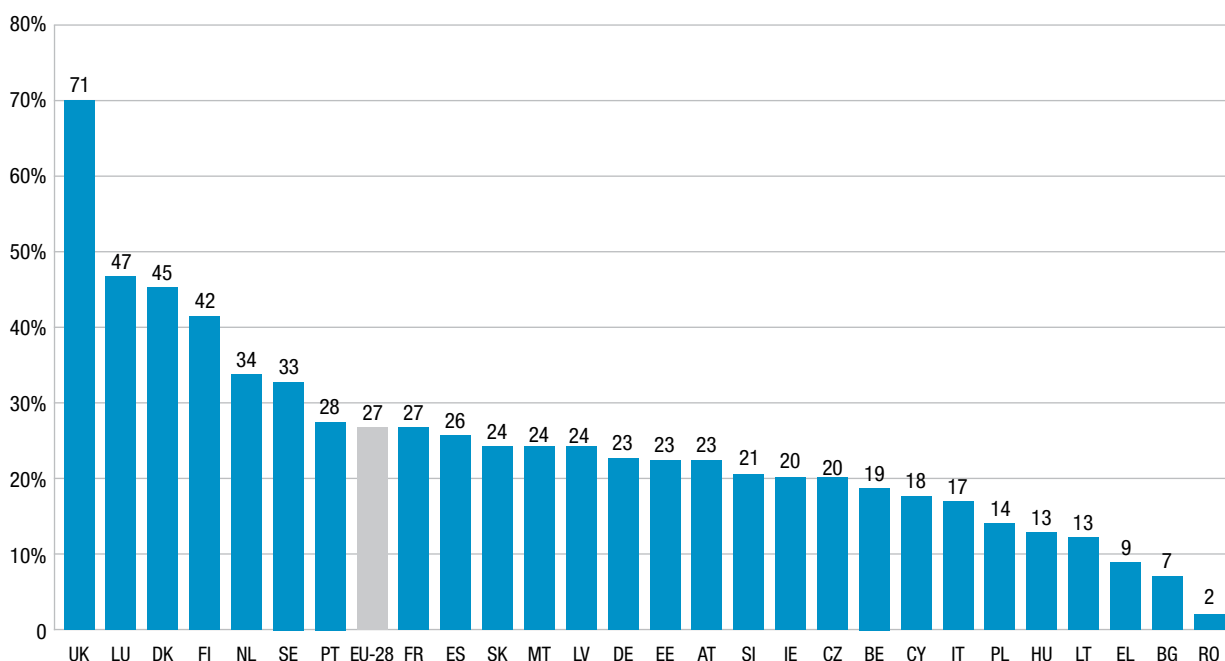
3.3. Labour market and skills information deficiencies

Since the launch of the *New skills for new jobs* initiative (European Commission, 2008), national and EU policy-makers have strongly emphasised the importance of labour market and skills intelligence (LMSI). This covers information on current and future labour market trends and skill needs as well as the availabil-

ity of relevant skill development opportunities (such as education or training courses, including internships, traineeships and apprenticeships; career prospects; alternative learning pathways), for modernising VET provision. The availability of such information is believed to help fill significant information gaps and may help prevent the emergence of labour market imbalances and mismatches in economies (Pouliakas, 2012; Pouliakas, forthcoming). The channel through which this is done is by allowing policy-makers to undertake informed decisions about the future direction of skills policies and enable labour market actors (career guidance counsellors, job-seekers, employers, students) make less uncertain deci-

⁽¹³⁾ In the UK, for instance, several occupations (senior- and lower-level public administrators and leisure and travel service occupations, such as travel agents, leisure assistants and air and rail travel assistants) have seen falling levels of discretion in their jobs over time, so their jobs seem to have become less reliant on a high skill level relative to the past (CIPD, 2016).

Figure 7. Access to information on learning possibilities, 2011, EU-28



Source: Eurostat / UOE [trng_aes_182] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=trng_aes_182&lang=en

sions about human capital investments that may generate higher return and complement their preferences.

Despite the strong policy emphasis on strengthening LMSI, less is known about the extent to which the provision of LMSI feeds into and influences individuals' VET and labour market decisions. A related Eurobarometer survey, carried out in 2014, revealed that 44% of EU citizens had looked for information about education, training and career options, as well as whether their skills and qualifications were recognised in other Member States (European Commission, 2014a) ⁽¹⁴⁾. While respondents from Denmark (63%), Netherlands (56%) and Finland (52%) were the most likely to have looked for LMSI, this was the case for only a very small share of citizens in Bulgaria (14%), Portugal (13%) and Greece (10%).

Access to information on learning possibilities (collected as part of the 2007 and 2011 waves of the *Adult education survey*) can also be used as a proxy indicator of the extent to which people have access to or use LMSI. It is clear that LMSI appears to concern a minority of EU citizens, although there is stark variation in provision across Europe (Figure 7). More than seven in 10 adults in the UK and over 40% in Denmark, Luxembourg and Finland had access to such information on learning in 2011. This was the case for less than 10% of adults in Greece (9%), Bulgaria (7%) and Romania (2%).

Important differences across population groups are also evident, such as the fact that a greater proportion of females (28%) rather than males (25.7%) enjoy access to information on learning possibilities. Younger adults (aged 25 to 34) are the most likely to have obtained skills

⁽¹⁴⁾ Unfortunately the survey did not include an option asking individuals whether they have looked for labour market information that may inform their VET choices, such as (historical or anticipated) labour market trends and other contextual labour market variables (wage levels, usual hours of work, etc.).

intelligence (35%) whereas learning access diminishes with age, rendering older workers (55 to 64) the least likely to have accessed and used such information. Access to LMSI is also dependent on individuals' skill levels, as it is more frequent among graduates from (first or second stage) tertiary education (43%), in contrast to those with medium- (23.7%) or lower-level qualifications (15.8%).

Cedefop's VET opinion survey provides another relevant source of information, capturing the extent to which individuals had received information about VET at the time of choosing the orientation of their upper secondary education. On average, 57% of respondents who followed upper secondary education in all EU 28 Member States admitted to having received such information. However, this percentage ranges from as high as 84% in Slovakia to as low as 36% in Ireland (Cedefop, 2017c; Pouliakas and Ranieri, forthcoming).

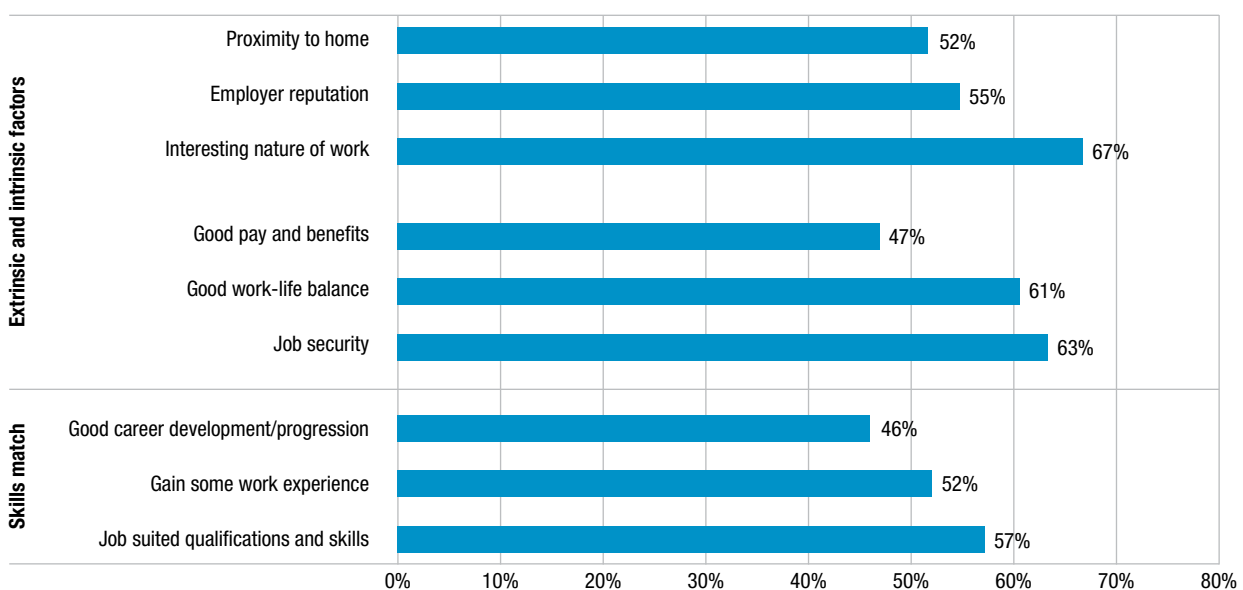
EU adult workers were further asked as part of the Cedefop ESJS to identify the importance of several factors that influenced their decision to accept their current job (Figure 8). Although

such motives for job choice are expected primarily to reflect individuals' preferences, it is reasonable to expect that the relative weight of some of them, such as whether the job suited an individual's qualifications and skills, if it entailed good career prospects, offered good pay and fringe benefits, and the employer's reputation, could be potentially influenced by the provision of up-to-date LMSI.

The survey reveals that the most important motivators driving individual job choices are the intrinsic satisfaction offered by the nature of work, the provision of job security and work-life balance. The overall match between individuals' qualifications and skills with those needed by their job, both at the time of recruitment and as their career progresses, ranked much lower in significance.

It may be reasonable, such as during the recent years of economic downturn, for individuals to place a higher premium on the security of employment. However, the lower weight put on the match of their skills with their job requirements is concerning, as it may be associated with adverse

Figure 8. Reasons for accepting current job, adult employees, 2014, EU-28



NB: Percentage of respondents who ranked each factor with a score higher than 8 on a 0-10 importance scale, where 0 corresponds to 'not at all important', 5 'moderately important' and 10 'essential'.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

long-term consequences, such as enhanced risk of skill mismatch, job loss and career instability. Analysis of the ESJS microdata confirms that there is a statistically significant relationship between an individual's job selection motivation and their subsequent probability of being affected by skill mismatch in the job. When examining comparable groups of adult employees ⁽¹⁵⁾, it is found that individuals who were driven by job security at the time of recruitment have higher probability of being overskilled in their current job (relative to those accepting their current job for another reason). The reverse is true for workers who placed a higher premium on the skill requirements of the job and on whether it offered good career opportunities.

The above findings raise concern about the extent to which the career choices of EU citizens are ill-informed or only based on partial knowledge of available education and training offers and labour market opportunities, both in their own country and in the single European market. Improving citizens' access to LMSI is important because, in the absence of any information, individuals are likely to make decisions based on societal norms (such as what is considered to be educationally prestigious) or will be driven by motives that, in the long run, are correlated with higher skill mismatch.

3.4. Work-based learning take-up fails to reflect benefits

Many authors have stressed the importance of workplace/work-based learning for enabling (younger and older) students acquire work-relevant skills (both technical and soft/behavioural skills) and improve their overall employment prospects, relative to those solely engaged in classroom-based learning (Cedefop, 2012b, 2015e; Lerman, 2014). A lack of workplace experience, with related skills and competences, is believed to have been a major contributing factor to high EU youth unemployment rates since 2008 and to have underpinned the so-called EU

skill gap (European Commission, 2013; Eichorst, 2015). This is why creating opportunities for high-quality work-based learning, including the European alliance for apprenticeships, lies at the heart of current European education and training policies.

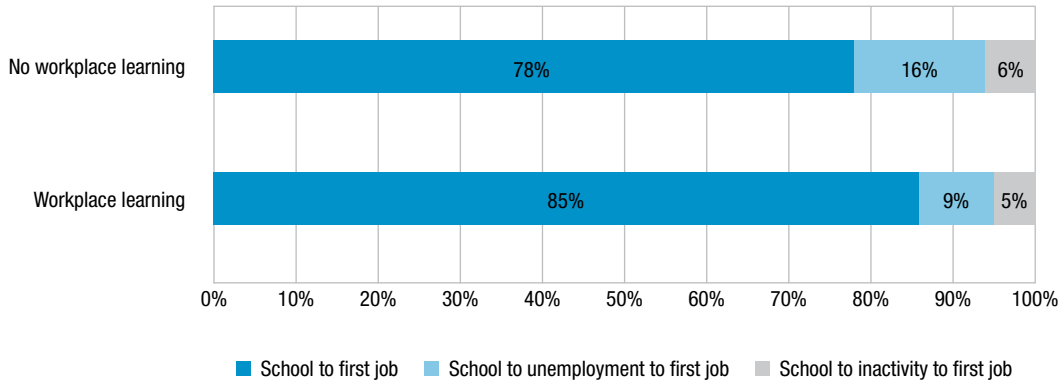
ESJS data confirm that the experience of workplace learning is positively associated with a faster transition to a first job (Figure 9). Among first job entrants who experienced some learning in a workplace during their studies, 85% went directly to their first employment after completing education and training, while only 9% entered unemployment as an interim stage prior to finding their first job. By comparison, 16% of graduates who did not spend any time at all in a workplace as part of their studies went straight to the unemployment registers and only 78% made a direct transition to a job.

The survey also highlights that workplace learning is associated with fewer chances of recent graduates entering into jobs that need lower qualifications and skills than their own (Figure 10). By contrast, more people who undertake a spell of workplace learning enter into their jobs with lower skills than needed. This higher propensity towards underskilling is a consequence of the fact that graduate jobs with some workplace learning experience are generally more skill-intensive, relative to those with only classroom-based studies. Despite their higher skill gaps, the former graduates are observed to be more satisfied with their jobs: this is presumably because they are offered more opportunities to grow their skills on-the-job, enabling them to make a faster transition towards a well-matched job, and suffer from less job insecurity.

Even though workplace learning fosters a tighter link between education and employment, the ESJS data reveal that there are large differences in its availability between EU countries and that it is still tightly knit to traditional manufacturing and health-related economic sectors. Although over 60% of EU tertiary education graduates with medicine and health-related degrees had some workplace experience while studying,

⁽¹⁵⁾ In a multivariate regression framework the analysis controls for individuals' country, age group, gender, education level, sector and occupation, and takes into account whether they were faced with financial and family constraints and vacancy bottlenecks at the time of job search.

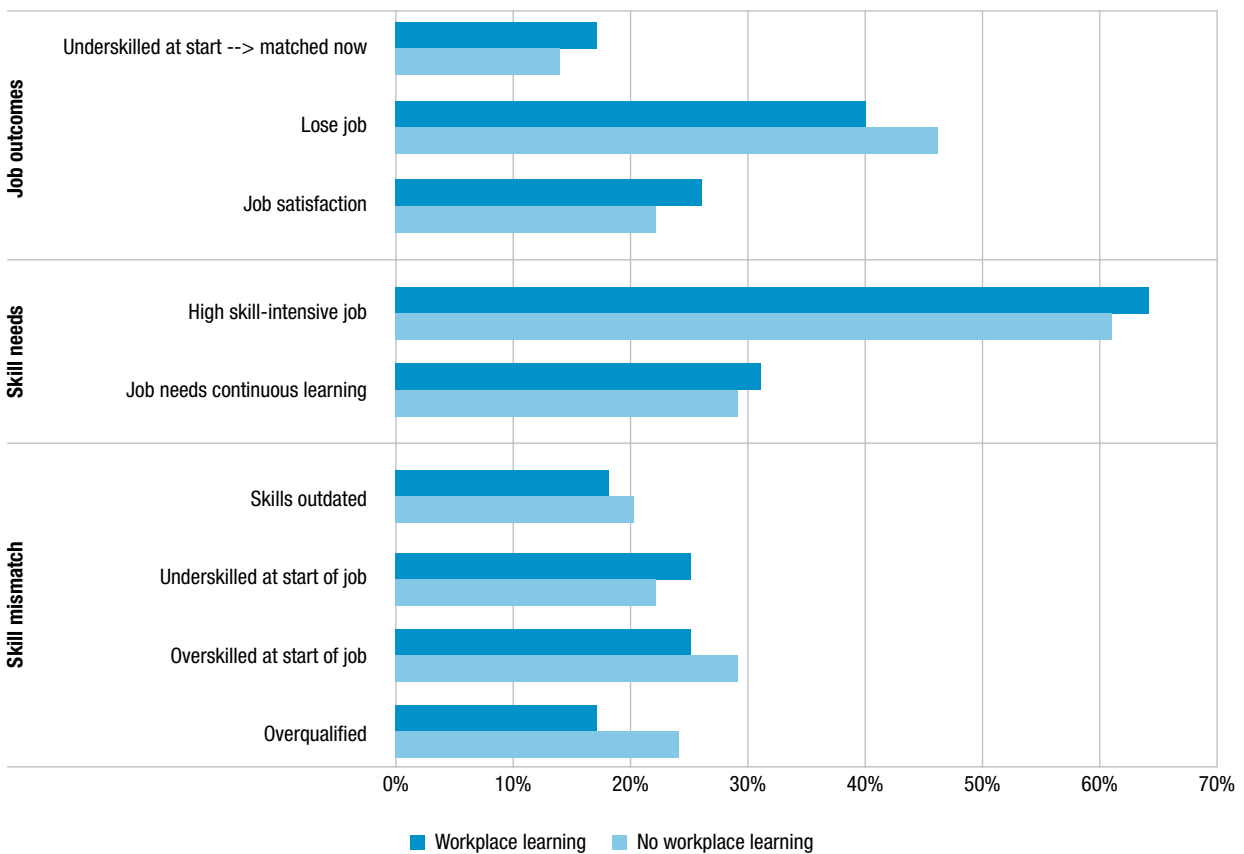
Figure 9. Transitions to a first job by workplace learning status in education, 2014, EU-28



NB: Workers were separated according to their responses to the question ‘During your studies, did you experience some learning in a workplace (e.g. through apprenticeships, internships or other forms of work-based learning)?’ The sample retained only first job holders and was broken down by their stated labour market status prior to finding their first job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

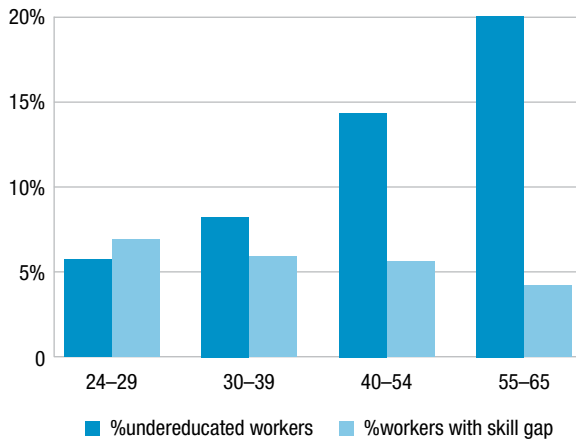
Figure 10. Difference in skill needs and mismatch by workplace learning status in education, recent graduates (2005-14), EU-28



NB: Sample refers only to those graduates who completed their studies in the past decade (2005-14) and is broken down by whether or not their education entailed spells of workplace learning.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Figure 11. **Share of adult employees underqualified and with skill gaps, 2014, EU-28**



NB: Undereducated workers are defined by comparing each respondent's highest level of education attainment with the qualification they think is needed to do their job today. Workers with skill gaps are those who replied affirmatively to the question: 'Overall, how would you best describe your skills in relation to what is required to do your job? Some of my skills are lower than what is required by my job and need to be further developed.'

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

only about 30% of STEM graduates (science, technology, engineering, maths) and less than two in 10 graduates from humanities, languages and arts degrees did so (Cedefop, 2015a).

3.5. Underusing EU workforce non-formal and informal skills

A significant pattern observed in the ESJS data, in addition to detecting a higher incidence of skill gaps among specific population subgroups (such as the unemployed and first time job entrants), sectors and occupations (including ICT, professional and scientific services), is that a non-trivial share of adult workers possess adequate skills to carry out their job tasks. This is true even if they do not have the appropriate level of qualification that would rightly correspond to their skill level. The survey reveals that many

adult employees have acquired their skills on the job or through other relevant life experiences, yet those skills are not necessarily recorded or documented in a formal qualification.

This is evident from the fact that although one in five older EU employees has a lower qualification than the job needs (and are formally underqualified), a very small share of survey respondents in this age group consider that they do not possess the necessary skills to do their jobs; they do not see themselves as underskilled or experiencing a skill gap (Figure 11).

Overall, only one in 10 EU workers with a lower qualification than needed declared in the ESJS that they have insufficient skills relative to the level needed to perform their job tasks. Of those adult workers who entered into their current job underqualified and underskilled, 86% have developed enough or more skills than required over time, as a result of their continuing non-formal and informal learning.

3.6. Limited and segmented inter- and intra-EU mobility

One of the traditional policy remedies suggested to tackle high rates of skill mismatch in market economies is to promote labour mobility. This is done by adopting policy measures that can liberalise these markets, such as the reduction of employment protection legislation, easing of business closure regulations or the removal of other barriers to mobility (including recognition of qualifications across borders and establishment of professional rights in different occupations and countries). From an EU perspective, the promotion of labour mobility is also a key principle of EU level mobility programmes, such as *Your first EURES job* and ERASMUS+. Several researchers have stressed that skill mismatch affecting individuals can only be a temporary phenomenon, as long as they have adequate career or occupational mobility to move to better matched jobs in different geographic labour markets (Sicherman, 1991; Robst, 1995).

As shown in Cedefop (2015a), the ESJS data confirm that the chances of exit from a persistent status of skill mismatch are greater for individuals who change jobs, as opposed to relying on the

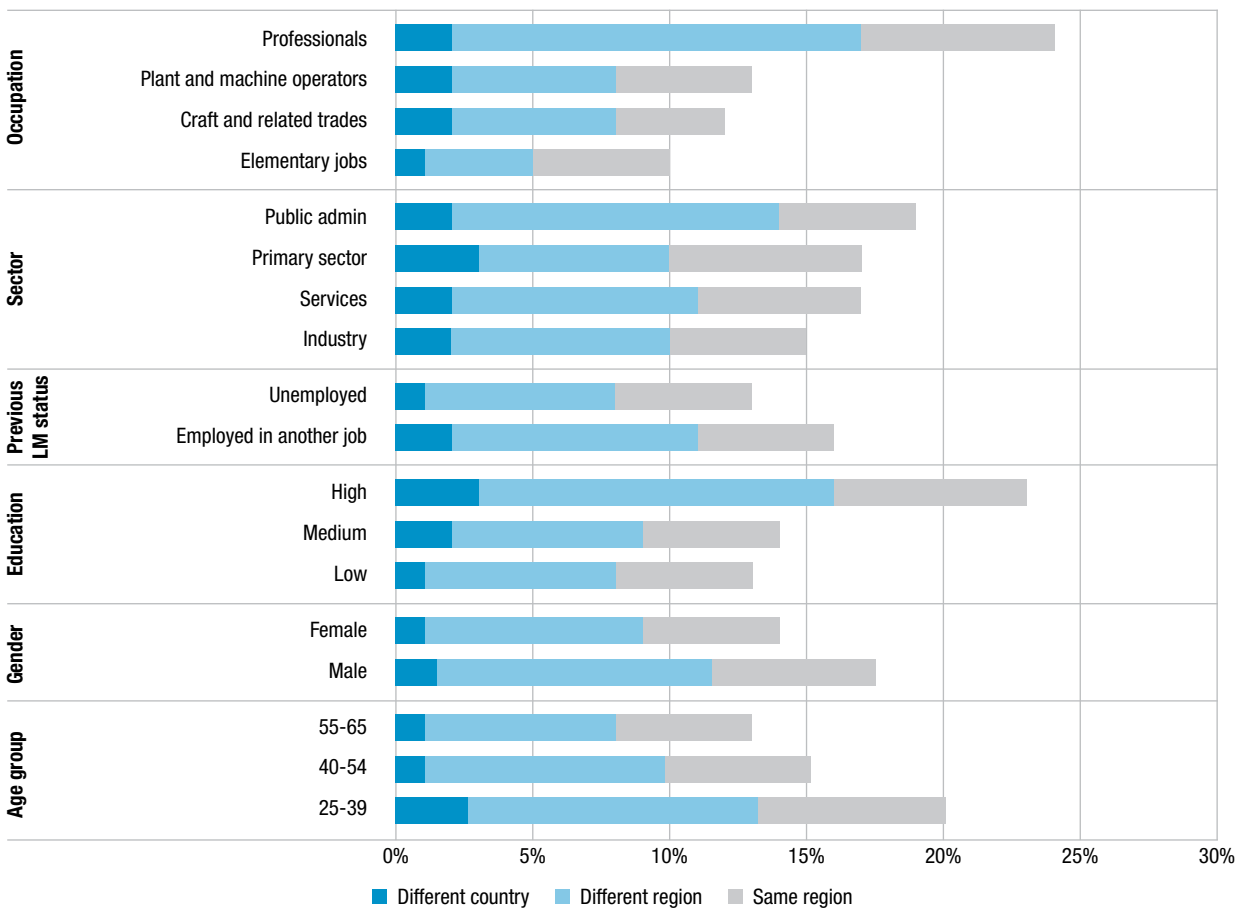
more gradual adaptation of skills to skill needs taking place within jobs. Skill mismatch is a persistent phenomenon and it is difficult for individuals to change skill mismatch status both within and between jobs (Chapter 8). But the chances of transition to a different skill (mis)match state are greater when individuals have job mobility, as opposed to changing job position and/or other forms of within-employer mobility.

Despite the fact that labour market transitions (especially job mobility) may induce better skills matching, the ESJS data confirm that geographical mobility in Europe is, on the whole, still limited. Around one in five (17%) survey respondents indicated that they had to move home when they started their job with their cur-

rent employer: 9% moved to a different region but within their own country; 6% moved but within the same region; and only 2% moved to a different EU country.

Perhaps more concerning is the survey data suggestion that those groups most in need of job mobility are exactly those least likely to engage in it (Figure 12). Younger males, the highly educated and professionals are more likely to have moved to a different country or region prior to commencing their current job, motivated by the need to advance their career prospects. By contrast, geographic mobility is less common among females, older and lower-educated individuals and those who experienced a prior spell of unemployment or inactivity before finding their work.

Figure 12. **Geographic mobility of adult employees, 2014, EU-28**



NB: Percentage of respondents with positive responses to the question 'Did you have to move home before you started working for your current employer? 1. Yes, to a different country; 2. Yes, to another region of the country you live in; 3. Yes, to the same region of the country you live in.'

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

PART 2

UNDERSTANDING
AND ADDRESSING
SKILL SHORTAGES
AND GAPS

Skill shortages in European enterprises

Genuine skill shortages in the EU affect specific sectors and occupations, plus the mostly dynamically growing, international and innovative enterprises. But a significant share of other firms face recruitment difficulties which are mostly due to job offers of poor quality or other HRM inefficiencies. In this chapter it is argued that mitigating skill shortages is a joint responsibility of private and public actors, since countries with more responsive education and training systems and firms that invest in talent management have faced fewer skill shortages in the past decade.

4.1. Matching skills with job openings

Employers having difficulty ‘finding the right skills or talent’ or ‘filling jobs’ is commonly quoted by policy-makers as the most prominent of skill mismatch types in European job markets; this is sometimes in spite of lack of research evidence to that effect (Cappelli, 2015; Cedefop, 2015b; McGuinness et al., 2017). Some four out of 10 EU firms and global employers report having faced such difficulty ⁽¹⁶⁾. Higher than average recruitment bottlenecks tend to be reported in the manufacturing, ICT and health care sectors (European Commission, 2014b), for skilled trades workers and machine operators, sales representatives, engineers and technicians, ICT professionals, workers in marketing posts and drivers and office support staff. For most employers, skill shortages can be attributed to insufficient available job candidates and a lack of both hard or soft skills and work experience ⁽¹⁷⁾.

Robust data sources measuring the incidence of, and reasons for, the emergence and persistence of skill shortages are generally lacking in the EU (European Commission, 2015). Different data sources may also paint a different picture of which EU countries are most affected by recruitment difficulties. Standard European sources (such as the European company survey) tend to indicate that difficulty in finding

talent is most pronounced in Bulgaria, the Czech Republic, Germany, Austria, Poland, Romania, and in the Baltic states. By contrast, the countries mostly affected by rising unemployment rates during the post-2008 crisis era, including Greece, Spain and Cyprus, are characterised by fewer talent shortages. There are other talent shortage surveys by consultancies, such as the frequently cited Manpower talent shortage survey which indicated that, in 2016, the incidence of talent shortages was the highest in Bulgaria, Greece, Hungary and Romania and lowest in Ireland, France and the Netherlands. High and rising talent shortages are, however, also reported by employers in Germany (49%), Poland (45%) and Slovakia (44%) (Figure 13).

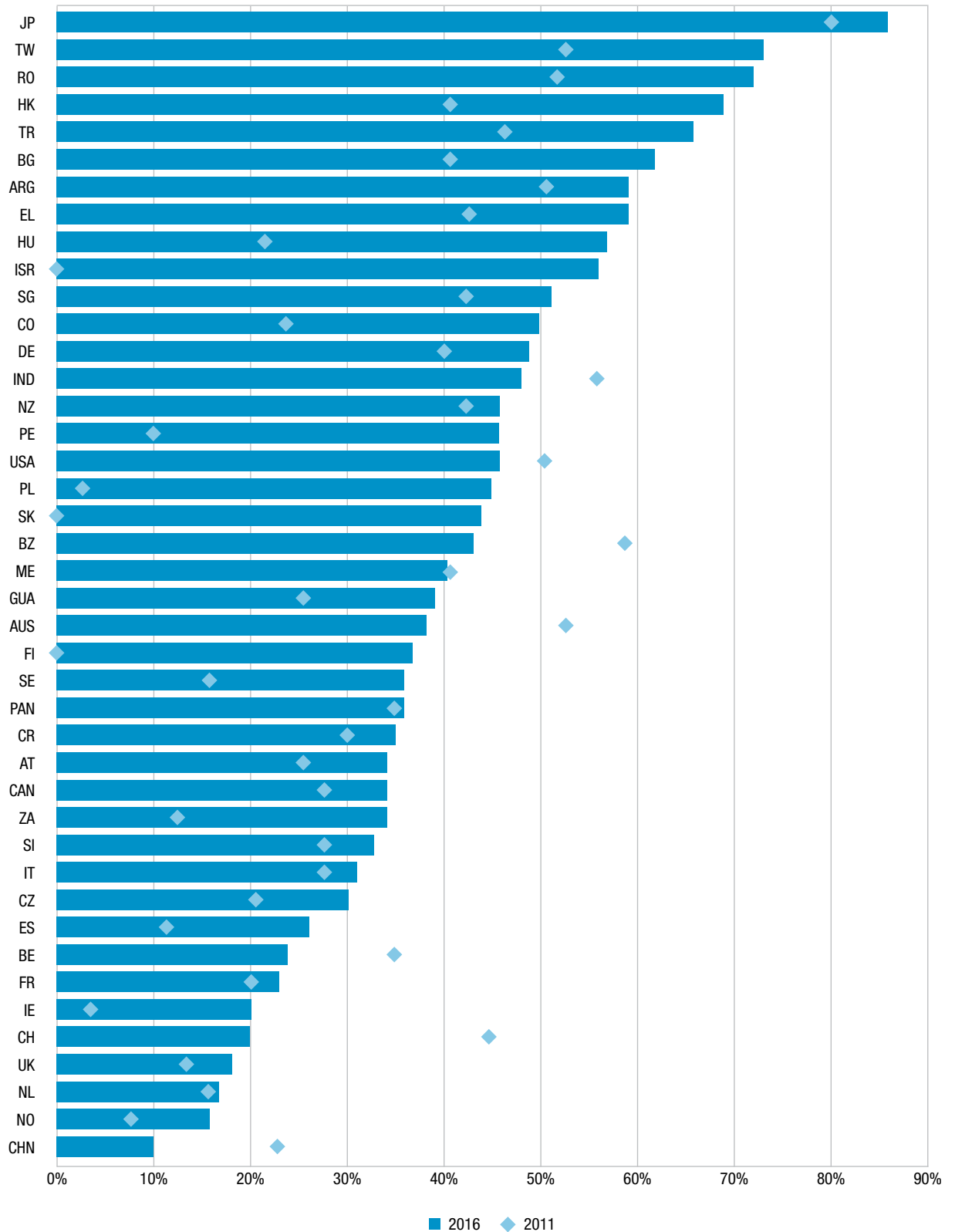
Careful scrutiny of available data sources that permit analysis of the underlying determinants and reasons for recruitment difficulties tend to present a mixed picture. They often point out that reported employer recruitment difficulties are underpinned by various factors that are not solely related to the supply of skills and cannot be reported across the board (Cedefop, 2015b).

For instance, recruitment difficulties in European enterprises are a natural outcome of mostly private sector firms that are growing in size or of companies experiencing changes in their remuneration and work organisation practices (Figure 14). Although there are marked differences across the different labour markets of EU countries, tal-

⁽¹⁶⁾ See Eurofound 3rd European company survey: <http://www.eurofound.europa.eu/surveys/ecs>

⁽¹⁷⁾ Manpower Group: Talent shortage survey 2016/17: <http://manpowergroup.com/talent-shortage-2016>

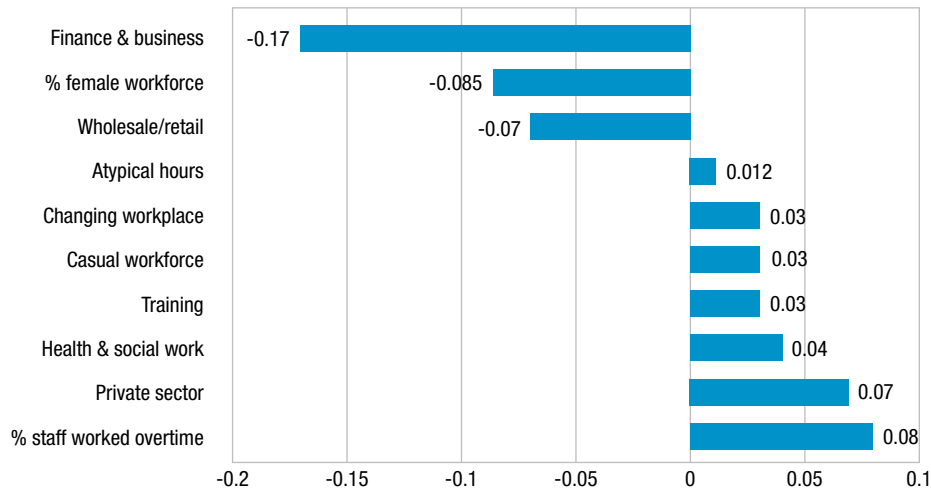
Figure 13. Percentage of employers reporting difficulty filling jobs, 2016, 44 countries



NB: Percentage of employers reporting difficulty filling jobs. No figures are available for 2011 wave for Finland, Israel and Slovakia.

Source: Manpower Group: Talent shortage survey 2016/17: <http://manpowergroup.com/talent-shortage-2016>

Figure 14. **Factors associated with employers reporting difficulty finding right skills, 2013, EU-28**



NB: Bars indicate the estimated marginal probability at the mean characteristics of the sample, following estimation of a multivariate probit regression model. The discrete dependent variable takes the value one if EU-28 employers reported 'difficulty in finding the right skills' in the survey.

Source: 3rd European company survey: <https://www.eurofound.europa.eu/surveys/european-company-surveys>

ent bottlenecks mostly affect enterprises in the health and social care sector and in advanced manufacturing, in contrast to the finance/business and wholesale and retail trade industries. The analysis also shows that companies experiencing recruitment difficulties are more likely to adopt responsive human resource management practices, such as offering training to more staff or utilising high-performance work practices, like variable pay and forms of employee empowerment. Nevertheless, it also indicates that firms with difficulty filling jobs have a higher reliance on a temporary workforce and use atypical working hours (working on weekends, shifts, overtime) to meet their skill needs. The staffing profile of enterprises that face talent shortages also tends to rely less on females and older workers.

By contrast, genuine skill shortages, defined as instances where employers cannot fill a job vacancy because job applicants do not possess the required skills even though a competitive job offer is made ⁽¹⁸⁾, arise more in high-innovation and internationally competitive sectors and occupations.

Cedefop analysis of a 2010 Eurobarometer survey capturing employer perceptions of the skills and employability of higher education graduates has shown that genuine skill shortages affect about 12% of EU firms that had recently recruited such graduates (Table 4). Depending on different measurements, about 40% to 60% of employer recruitment difficulties cannot be classified as 'genuine' under the definition provided above, since the apparent lack of job applicants with the right skills is reported simultaneously with firms' inability to offer a competitive salary or adopt a competitive recruitment strategy.

It is evident that, in these latter cases, talent shortages cannot be attributed directly to the inefficiency of education and training reforms. The problem lies with the demand side of the market and the need for improvement in firms' graduate recruitment practices, and their ability to compete more effectively in the recruitment market by improving the profile of jobs on offer. Firms experiencing genuine difficulties in hiring skilled workers are typically competing in

⁽¹⁸⁾ This is a commonly accepted definition of skill shortages by economists and is sometimes also extended or defined more narrowly to include cases where a job vacancy cannot be filled even though a competitive salary and job with good employment conditions is offered and it is at a reasonably accessible location (Australian Government, 2014).

Table 4. **Difficulties filling vacancies by bottleneck type for employers who recently recruited higher education graduates, 2010, EU-28 + TR, IS, NO**

Type of recruitment bottleneck	% of firms with difficulty filling vacancies
Genuine skill shortage <ul style="list-style-type: none"> Lack of applicants with the right skills and ability to offer a competitive starting salary 	12%
Apparent skill shortage <ul style="list-style-type: none"> Lack of right skills and inability to offer a competitive starting salary Lack of right skills and HRM inefficiency 	46%
Uncompetitive wage offer <ul style="list-style-type: none"> Inability to offer a competitive starting salary 	29%
HRM inefficiency <ul style="list-style-type: none"> Lack of offer of competitive graduate training and development programme and slow hiring process or limited resources to market vacancies 	13%

Source: Analysis of flash Eurobarometer 307 microdata; Cedefop (2015b).

international markets and operating in the private sector and higher-end product markets, which are naturally dependent on employment of highly competent staff.

Although by its design the Cedefop ESJS focuses on 'realised labour market matches', where announced job vacancies by employers were actually filled by those deemed to be suitable applicants, it provides useful additional insight into the adult employees skills match when recruited.

In contrast to widespread concern about rising skill shortages affecting the EU economy in the post-crisis years, the ESJS highlights that recent job finders were more likely to possess the skills required by their jobs at entry, relative to those who began their jobs before the onset of the economic downturn (Figure 15). The prevailing trend in the data is one of recent job finders entering into jobs demanding fewer, rather than more, qualifications and skills than they have. This may be explained by the fact that the composition of the pool of job finders in the post-crisis era was characterised by higher overall skill level, reflecting the marked increase in EU unemployment rates relative to the number of available job vacancies.

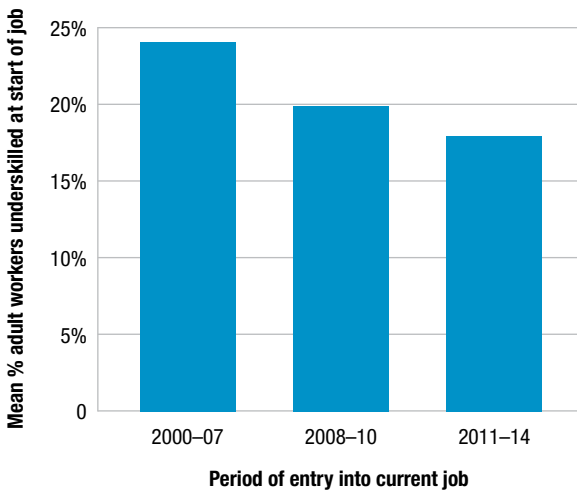
4.2. Vacancy bottlenecks across countries

Even though the evidence suggests that shortages in the quantity of labour became less prevalent in Europe in the years following the 2008 economic crisis, and that genuine skill shortages tend to be sector- or occupation-specific, continued reform of vocational education and training is still required.

While skill shortages may have been subdued in recent years, concerns about a lack of available skill are likely to become greater once there is a return to higher levels of economic activity, as is already observed to be the case in some EU countries (Germany, Hungary, Austria and Slovakia). Cedefop's analysis of the macroeconomic determinants of recruitment difficulties (Cedefop, 2015b) has confirmed that they are highly cyclical, affected by trends in the availability of skill supply. In the past decade, countries with lower and declining unemployment rates have seen their firms face greater difficulties in filling their available posts.

There is also a strong structural and institutional component to skill shortages (Table 5). Companies are less likely to have vacancy bottlenecks in countries with more responsive ed-

Figure 15. **Average share of adult employees underskilled at the start of their job by period of job entry, 2014, EU-28**



NB: Adult employees aged 24 to 65.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

education and training systems (for instance Denmark, Finland and Switzerland), or where the supply of skilled labour (including foreign labour) is greater (Figure 16).

But responsive VET systems cannot do it alone; the evidence also highlights the critical role of employers in addressing talent shortages. Such shortages are smaller in countries where employers make a greater commitment to attracting and retaining talent and offer good-quality jobs (such as adequate health and safety, adoption and implementation of ethical practices) ⁽¹⁹⁾. Enterprises in the northern European countries, particularly Denmark, Ireland, the Netherlands, Finland and Sweden, tend to have a stronger orientation towards talent management practices relative to their counterparts in central and eastern Europe (Bulgaria, Croatia, Hungary and Romania). The former have also experienced significantly smaller skill shortages than the latter. In southern European countries (Greece, Spain, Portugal)

below-average skill shortages are experienced in spite of a low commitment of firms to the talent management process. This is indicative of business cycle effects or of other factors underpinning talent shortages in their labour markets.

The analysis further highlights that the policy context governing and shaping a country's favourable attitudes and orientation towards the immigration of foreign skilled labour is an additional factor that may underpin the smaller incidence of recruitment difficulties by companies in some countries (also see OECD and European Union, 2014, pp. 315-348).

4.3. Mitigating shortages: joint responsibility

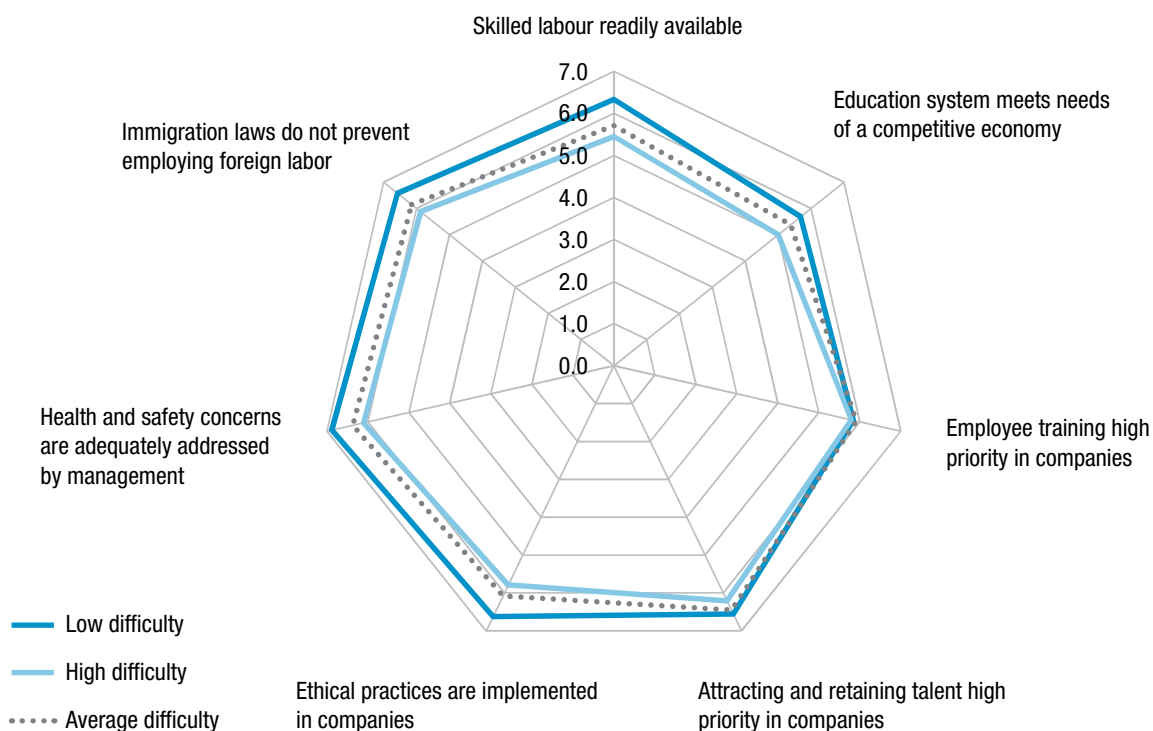
Tackling skill shortages in European economies depends critically on firms adopting a long-term approach to hiring and managing talent via the offer of good-quality jobs. The HRM strategies of firms could better target individuals on the basis of their potential rather than on accumulated prior work experience, also sourcing relatively unexploited talent (females, older workers, migrants), which tends to be largely overseen (WEF, 2014).

Companies also have much scope to offer more non-formal and informal training as part of the induction of newly hired employees (Figure 17). According to the ESJS, 75% of newly hired adult workers who did some non-formal or informal training during work hours significantly improved their skills since the start of their job; the figure for those with no training is 57%.

Increasing participation by companies in work-based training programmes is another well-established avenue for plugging skill gaps of new hires. Training that takes place directly in the workplace when studying (such as apprenticeships) is a particularly effective means of placing individuals into more skill-intensive jobs, aiding faster skill development (Chapter 3, Sec-

⁽¹⁹⁾ The insignificant difference between firms with high and low difficulties filling jobs in relation to whether employee training is a priority in companies, could be explained by the fact that vocational training is more likely to be employed as a tool by employers faced with high skill shortages in the first place. Hacıbedel and Pouliakas (forthcoming) show in their empirical analysis of a sample of EU enterprises that there is a positive and dynamic relationship between the incidence of skill shortages and the propensity of firms to use bank credit to finance their hiring and training decisions.

Figure 16. Difficulties filling job vacancies, 2006-14, EU-28



NB: The graph depicts the mean survey response to the factors shown, measured on a 0-10 index, where 0 is the lowest possible level of agreement to the statement and 10 is the highest; countries were grouped according to whether the average recruitment difficulty in a given year is higher (lower) than the 75th (25th) percentile of the distribution of recruitment difficulties in a sample of 21 European countries.

Source: Cedefop (2015b) based on analysis of Manpower Talent surveys and IMD WCY data; European Commission (2015).

tion 3.4). 16% of those who did not undertake any workplace learning as part of their studies failed to develop their skill further in their first job, in contrast to 11% of those who did, according to the ESJS data. Yet, the incidence of WBL is still low in some study fields and occupations.

Even though the mitigation of skill shortages is intrinsically dependent on private sector involvement, sometimes they necessitate State intervention. The ability of countries to prevent prolific skill shortages from arising is dependent on the speed with which they can put in place appropriate institutional frameworks and industry standards that can ensure widespread availability of skills in high demand (Bessen, 2015).

This includes the design of new vocational programmes or schools and the setting up of qualification frameworks and systems of validation and recognition of the sizeable stock of

informal skills in European labour markets. As Europe's ability to remain a forerunner in the global competitiveness race is intrinsically linked to innovative EU firms meeting their skills needs, strengthening creativity, innovation and other key competences as part of VET education curricula is also critical.

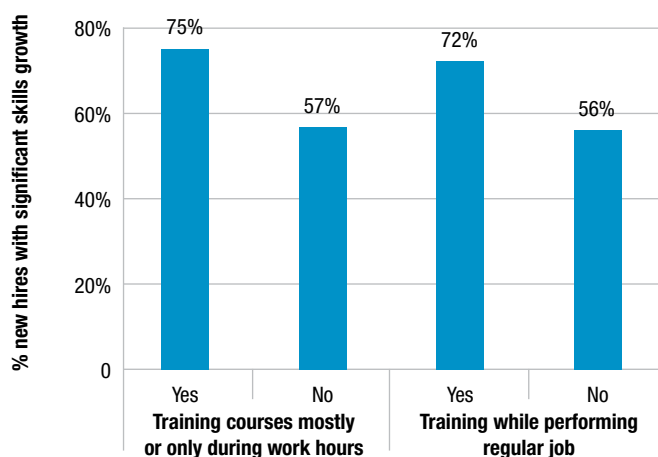
Effective skill anticipation systems, which can provide accurate and up-to-date labour market intelligence for the purposes of curricula reform, alignment of VET courses towards sectors and occupations with emerging skill needs, and provision of high quality career guidance and counselling, are also crucial instruments for preventing future skill shortages.

Table 5. **Factors associated with higher difficulties for companies in filling vacancies**

Countries with higher vacancy bottlenecks tend to be characterised by:	
Skill supply	Lower tertiary education attainment rates Lower propensity of education system to meet the needs of a competitive economy (as perceived by business executives) Fewer subsidiaries of firms based in other countries
Business cycle	Lower unemployment rates, so less availability of labour and skills
Employer talent management and human resource practices	Lower priority of attracting and retaining talent in companies Poor job quality offers (e.g. atypical hours, non-permanent contracts or casual work) Lower use of high-performance work practices
Organisational demography	Lower share of female or older workforce in firms Greater share of single owner firms
Firm growth	Higher share of firms growing in size Higher share of firms with changing work processes
Institutions	Stringent immigration laws Greater employment protection legislation Lower incidence of adult training Barriers to firms' access to credit
Sectors	Firms operating in manufacturing, construction, health and social care sectors Higher share of enterprises engaging in global market operations

Source: Cedefop (2015b); Hacibedel and Pouliakas (forthcoming).

Figure 17. **Average share of new hires with significant improvement in skills since the start of their job by incidence of non-formal and informal training, 2014, EU-28**



NB: New hires are adult workers employed for less than one year by their current employer.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Skill mismatches after recruitment

Cedefop's European skills and jobs survey (ESJS) data show that an important form of skill mismatch, correlated with a high incidence of skill shortages in job markets, is the phenomenon of underskilling or skill gaps at hiring. These arise when employee skills are lower than required by the job at the time of recruitment. The ESJS reveals that one in five Europeans are underskilled at hiring, reflecting industrial restructuring, labour market thickness and individuals' skills atrophy due to extended periods outside the labour market. Mitigating initial skill gaps is intrinsically dependent on provision of continuing non-formal and informal learning in the workplace.

5.1. Underskilling at the time of hiring

While the academic literature around skill mismatches is mostly centred on skill shortages, overeducation and skill underutilisation (McGuinness and Pouliakas, 2017; McGuinness et al., 2017), an equally pervasive aspect of skill mismatches of great concern for policy-makers is that of underskilling. This latter is defined as a situation where hired workers find their skills challenged by the work content, calling for further vocational training ⁽²⁰⁾.

At first sight, this phenomenon may seem of limited importance given that the continued development of workers' skills typically takes place at the workplace in the form of on-the-job training. It is also the case that individuals who find themselves in this situation have already secured employment, in spite of any skill mismatches that may have jeopardised their job search prospects. Nevertheless, there are implications for the economy, firms and individuals: for firms, underskilling may lower overall productivity; and for individuals, this may backfire on their wages and career development prospects, including increased risk of skills obsolescence and subsequent job loss. The ESJS confirms that 27% of employees who have remained underskilled

think their skills are very likely to become outdated in the next five years, while the corresponding percentage for those with sufficient skills for their jobs is only 18%.

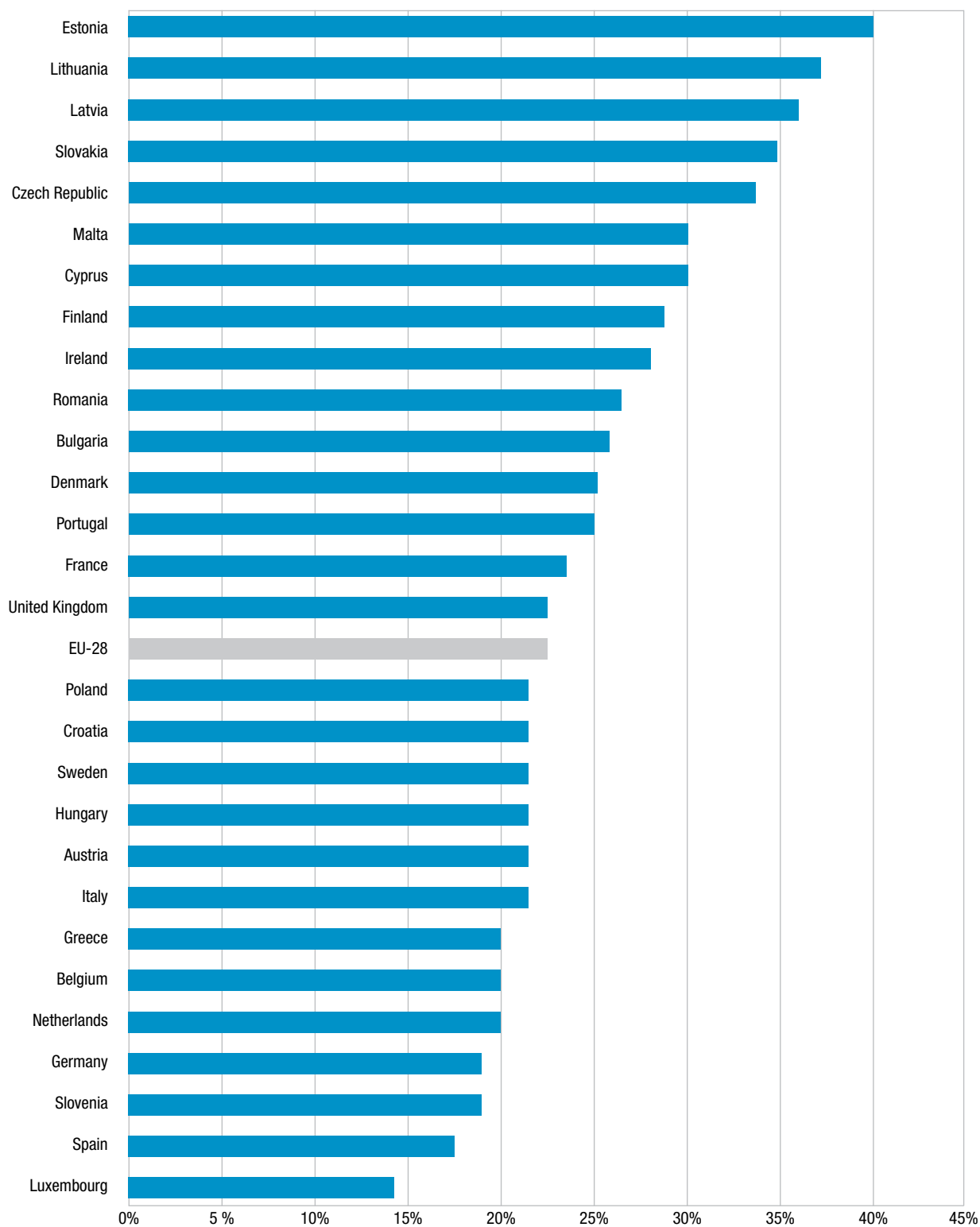
For firms, finding employees whose skills are fully matched to the requirements of jobs is a challenging task. The ESJS asked employees to assess the match of their skills with what was needed by their job when they were recruited, providing an indication of skill mismatches at the time when people engage in labour market search and mobility. The share of EU employees with lower skills than needed by the job when hired was about 22% (Figure 18). Employees in the Baltic States (Estonia, Latvia and Lithuania), are the most likely to experience mismatch between their skills and those needed by their jobs.

5.2. Rethinking underskilling

Understanding the reasons behind underskilling is necessary, especially when a large proportion of employees see their education and skill levels as higher than those needed by their job (Part 3). Many economists would find the fact that almost one in five EU employees have lower skills than needed when hired by their employers as bewil-

⁽²⁰⁾ Underskilling of employees should not be confused with skill shortages, the inability of employers to find the right skills among job-seekers (Chapter 4). Being underskilled is sometimes considered a similar type of mismatch to a skill gap expressed by employers, although the latter is usually expressed in relation to a desired level of proficiency that the workforce should have to carry out their job tasks (McGuinness and Ortiz, 2016). Cedefop (2010) can help with confusion over skill mismatch terminology.

Figure 18. Share of adult workers underskilled at the start of their current jobs, 2014, EU-28



Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

dering: why would rational employers hire workers with insufficient skills in the first place?

Nevertheless, the standard search theory of labour economics would highlight that both individuals and firms weigh the benefits and costs of prolonging their search time when seeking to apply for or fill a vacancy (Pissarides, 2000). In the context of significant industrial reorganisation in EU economies, as a result of the prolonged economic crisis, it may be reasonable for many job-seekers to look for alternative career paths demanding a different or enriched skill set than possessed. Similarly, employers faced with difficulty finding the right talent would be inclined to hire individuals with lower skills than required, saving on extended hiring costs yet offering remedial employer-sponsored training to compensate for any skill gaps among new recruits.

There are three dominant theories that can be used to conceptualise the underskilling phenomenon:

The first relates to insufficient information signals that employers may have about the candidates at the time of hiring. For example, a certain education degree, a specific academic field or even a particular education institution does not always provide the perfect signal of a candidate's labour market potential. Employers may only later come to realise that the skills of their preferred candidate are actually lower than those required. This theory is partly dependent on the quality of the hiring process as performed by the personnel management departments of companies: their ability to 'filter out' lower-quality applicants and combat the potential adverse selection problem they may face (Spence, 1973). Cappelli (2012) highlights, however, that with the advent of artificial intelligence, many firms have been inclined to downsize their HRM departments and favour the imperfect use of automated algorithms for filtering through the CVs of job applicants, with adverse consequences for the skills matching process.

The second reason sees underskilling as an outcome of the inability/difficulty employers have in attracting workers with adequate skills and capabilities, frequently related to the business cycle. Underskilling may reflect skill shortages in the economy, where the existing workforce lacks

certain skills when hired but perhaps is able to do the job at a minimum level required. This can be particularly pronounced during periods of rising economic activity or significant industrial restructuring. Firms then have to invest in the professional development of their workforce over time to mitigate any initial underskilling.

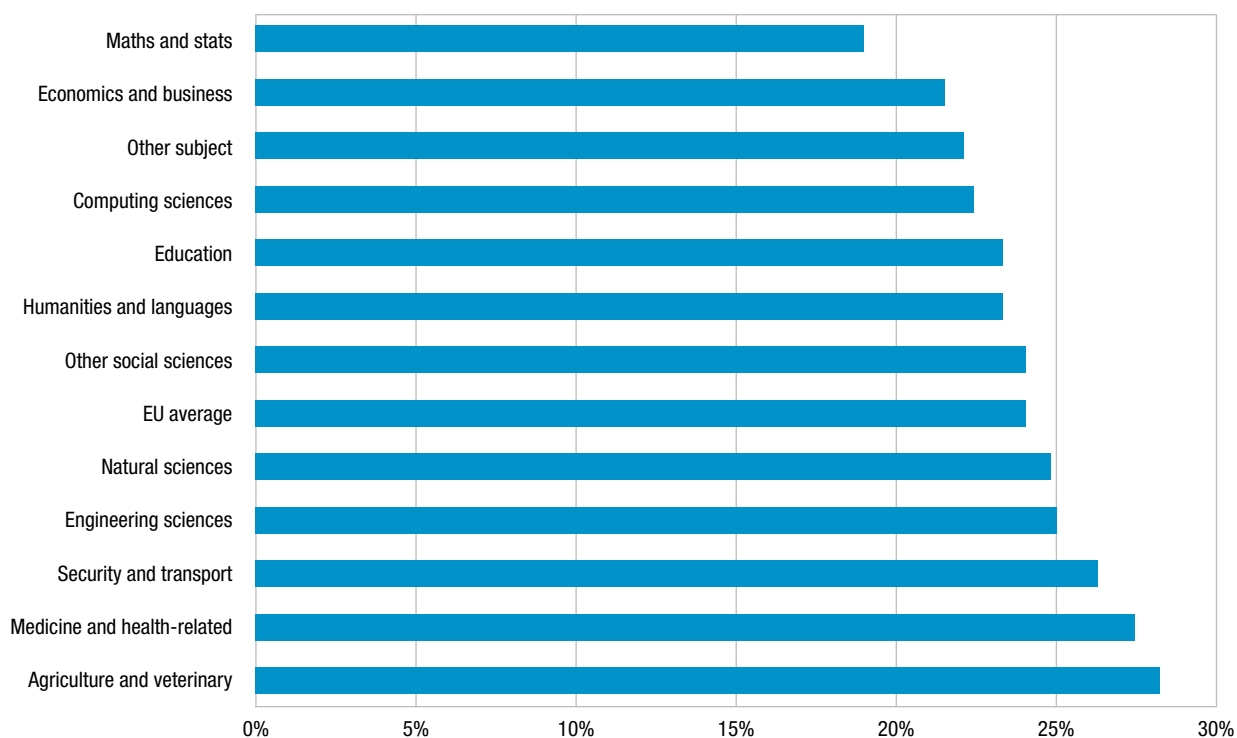
Selection of underskilled candidates may also be a part of firms' hiring practices, in which they find it cheaper to hire candidates with lower skills than required and then invest in certain training programmes and on-the-job training to bring their employees' skills up to speed. This situation varies depending on the extent to which the productive processes of firms rely on specific types of skills and fields of education. For instance, a company may heavily depend on acquisition of firm-specific skills by its staff, and less on general or transferable skills, or may require a particular skills bundle in specific posts (Lazear, 2009). In such circumstances, firms may prefer to use other mechanisms, such as the adoption of a probationary performance period, rather than that of screening at the time of recruitment, and to bear the cost of remedial training (Becker, 1964).

5.3. Drivers of underskilling

Cedefop's ESJS allows researchers to delve deeper into analysis of the factors associated with the chances of workers being underskilled when hired (Livanos and Nunez, 2017).

Focusing on the level of education, it is evident that university graduates have lower chances of finding themselves trapped in underskilling; so the ESJS data confirm that higher education is an effective signal of worker ability. However, differences in rates of underskilling also exist among tertiary graduates, related to the specific subject or field of study (Figure 19). Although differences are not pronounced, two particular cases can be examined. The first is for mathematics and statistics, which has the lowest percentage of underskilling, signalling that the skills of graduates of such schools are compatible with or are able to adjust to the skill needs of their jobs without great difficulty. Graduates from medicine and

Figure 19. Graduate underskilling at hiring by field of study, 2014, EU-28



Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

health-related disciplines have the highest initial underskilling rates. This could be explained by the ever-changing skills context of such professions due to the advancement of new technologies, working methods and techniques.

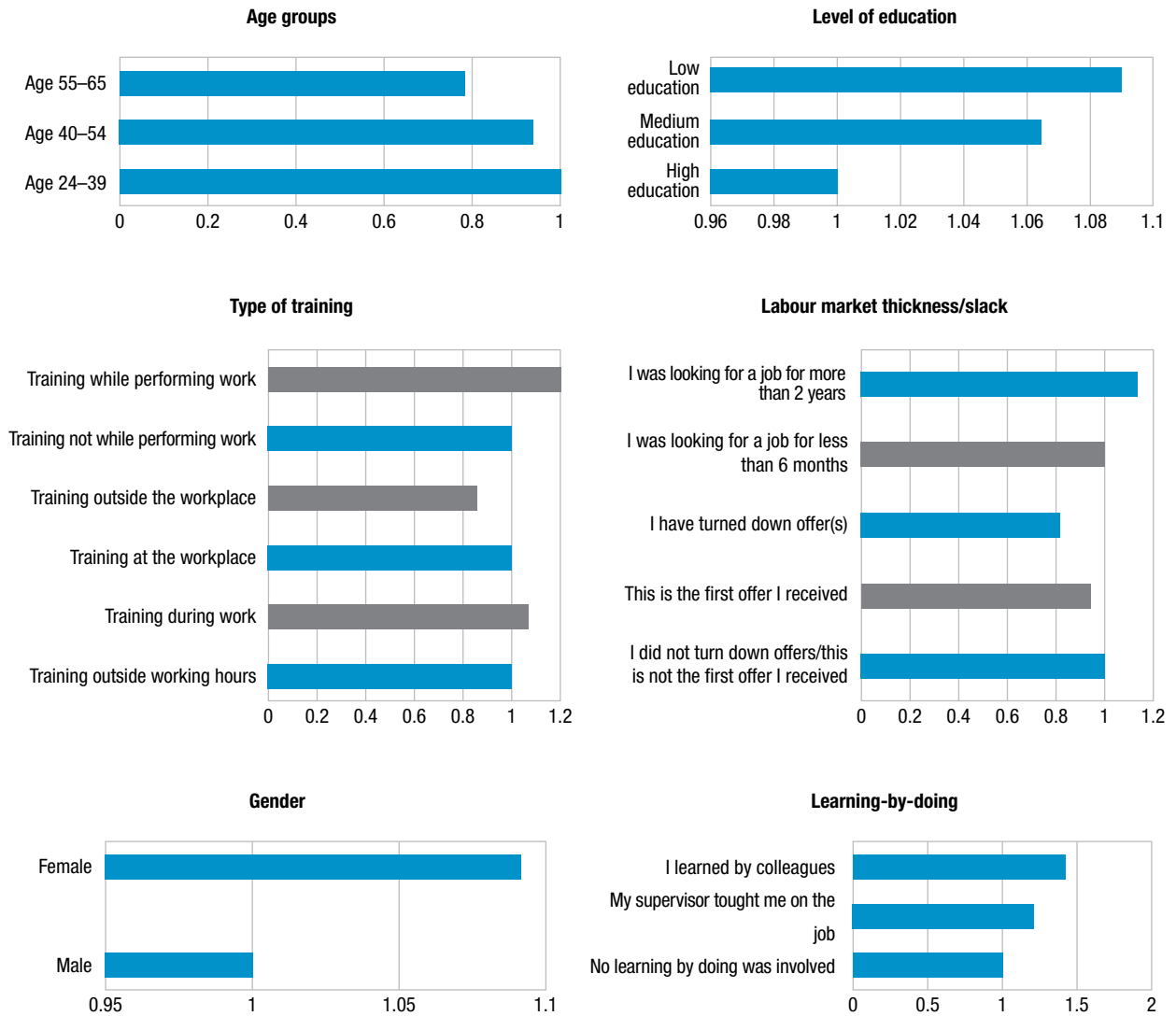
Different groups of employees may experience different levels of underskilling; in many cases, this may also be country specific (Figure 20). Underskilling affects mostly female workers, who may experience extended periods outside the labour market and face a greater challenge to reskill or upskill during labour market reintegration. It is more prominent among younger cohorts (aged 24 to 39) and those in first jobs, who lack valuable work experience and knowledge of the workings of the labour market; it is also higher in sectors that generally employ workers with lower education, such as construction, manufacturing or the primary sector and utilities. In these sectors underskilling rates often exceed 35% of the workforce, suggesting that the nature and growth of skill needs

in sectors that traditionally employ lower-educated workers is changing fast and so demands continuing vocational training.

The state of the labour market is also a significant underskilling trigger. In instances where workers had the luxury of being able to turn down offers when searching for a job, a proxy for job availability, their chances of ending up mismatched are significantly lower relative to workers left with no alternative but to accept a job offer. Conversely, entering a job after experiencing a spell of unemployment is associated with higher chances of underskilling at hiring. This is particularly so for the long-term unemployed, such as those who had been looking for a job for more than two years prior to taking up their current post.

Non-formal and informal training can have a marked impact in terms of mitigating the initial underskilling of employees. Underskilling is more evident in firms where training takes place in the form of learning-by-doing (learning from

Figure 20. **Probability of underskilling when hired across various groups of adult workers, 2014, EU-28**



NB: Marginal probabilities at the mean based on estimation of a logit multivariate regression model.

Probabilities are expressed as a share of the probability of the reference category (set as one), e.g. medium educated workers have a .07 times higher probability of underskilling when hired relative to those with high education.

Reference categories (shown in [add colour]) have been set to a value one and include: level of education = high; age group = 24-39; gender = male; labour market thickness/slack = I was looking for a job for less than 6 months / I did not turn down offers / this is not the first offer I received; type of training = training not while performing work / training at the workplace / training outside working hours; learning by doing = No learning by doing involved.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

colleagues or a supervisor), which confirms that companies that hire underskilled workers are more likely to respond by investing in skill development (also see Chapter 9).

5.4. Implications for European skills policy

The academic discourse tends to focus on the problem of overeducation, for good reasons given that such workers often get stuck in dead-end jobs or get penalised in terms of their wages and job satisfaction (Part 3). But the ESJS survey further reveals that about one in five (19%) overeducated workers simultaneously lack the skills their job needs when hired and admit to having lower skills than needed to be fully proficient in their jobs ⁽²¹⁾. This highlights that, for a small subgroup of overeducated workers, their initial qualification mismatch does not necessarily imply overskilling, as they are apparently overeducated.

The phenomenon of underskilling after recruitment impacts a large share of the EU adult workforce, reflecting information asymmetries, the state of labour market thickness and other market failures (such as inefficiencies in firms' recruitment practices). It affects certain groups of workers, such as the young, females, lower- and medium-educated and individuals returning to work after extended spells of unemployment. European skills policy needs to prioritise its attention towards the provision of customised adult learning and upskilling opportunities to these employee groups.

Even though the impact of the state of the economy on the chances of underskilling seem clear-cut, this can also be further mitigated if, for example, appropriate training courses are offered at times of labour market slack to job-seekers (especially the long-term unemployed) as part of activation strategies (Cedefop, 2017b).

The variation in underskilling across graduate fields of study calls for potential intervention by policy makers. Higher levels of underskilling in sensitive professions, such health and medical studies, place a greater burden on VET providers to continue to ensure that individuals' skills can stay up to date, while employers have to remain alert to the need to offer further vocational training to prevent initial skill gaps from becoming entrenched.

⁽²¹⁾ An additional 37% of overeducated employees have matched skills at the time of job entry, rendering the remaining 44% genuinely overeducated.

Digital skill gaps in the EU workforce

Cedefop's European skills and jobs survey (ESJS) reveals that more than seven in 10 adult employees in the EU need at least some fundamental ICT level to be able to perform their jobs. Yet, about one in three of those employees is at risk of digital skill gaps. At the same time, almost half of all employees in low-skilled occupations do not require ICT skills to do their work. The digital divide is alive and well. A high share of the EU adult workforce is still employed in a semi-analogue world, at the same time that others are faced with technological skills obsolescence. Reaping the full benefits of digitalisation will require modernisation of education and training systems and, crucially, more investment in digital capital infrastructure and continuing learning for groups excluded from the digital economy.

6.1. The need for digital skills in EU workplaces

Cedefop's analysis of the ESJS highlights that the future structural transformation of EU labour markets is tightly bound to high demand for advanced digital skills. As shown in Figure 5, there is a strong positive correlation between jobs that are anticipated to grow in employment in the next decade and the importance of advanced digital skills within such jobs.

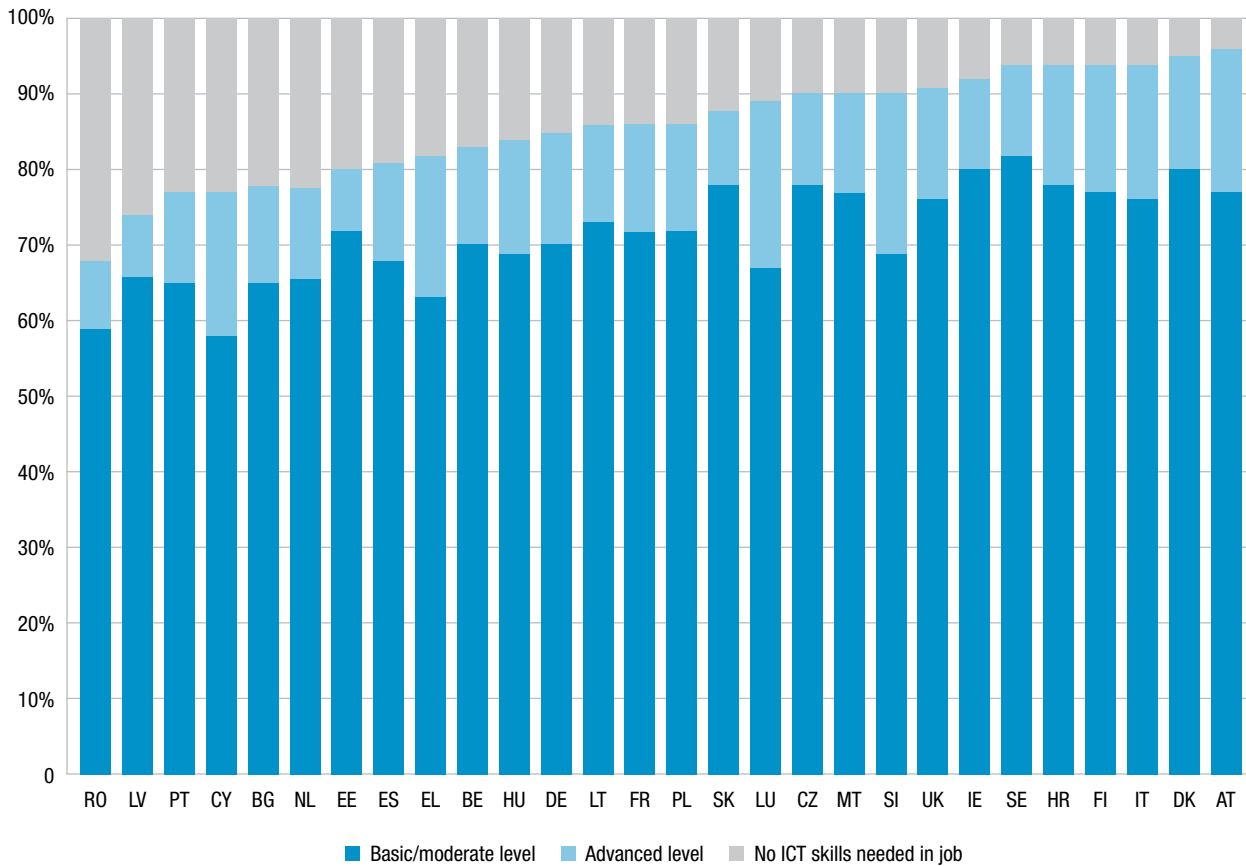
This finding agrees with a wealth of other sources, including information from Eurostat's surveys on ICT use by enterprises and households. A recent investigation by the European Commission (2016) into the job profiles of 12 occupations, which have been traditionally permeated less by ICT investment (such as dairy farmer, machine operator, industrial designer, VET teacher), has also highlighted that the use of ICT profoundly affects the work tasks and skill requirements of such jobs. Nevertheless, despite widespread acknowledgement of the importance of digital skills, there has been little information about the type of ICT skills required in EU workplaces and the extent to which employees are coping with consequent demands as part of their workplace tasks.

Cedefop's ESJS partly fills this gap with information on the highest level of ICT skills required by EU employees so that they can carry

out their job tasks (Cedefop, 2015a). The survey distinguished between three broad ICT levels needed so that workers can do their job: basic ICT level (using a PC, tablet or mobile device for emailing or internet browsing), moderate ICT (using word-processing or creating documents and/or spreadsheets) and advanced ICT skills (developing software, applications or programming, and using computer syntax or statistical analysis packages). The survey also allowed respondents to state that their job does not need ICT skills at all (Figure 21).

Most (52%) adult employees stated that a moderate ICT level is required to carry out their job tasks and another 19% require a basic level. Together, more than seven in ten (71%) EU employees need some fundamental level (basic or moderate) of digital skills to perform their jobs. About 14% need an advanced ICT level, the same proportion that stated that they need no ICT skills at all in their jobs. Denmark, Ireland and Sweden are the countries in which more than 80% of their adult workforces need at least a fundamental level of ICT skills to do their jobs, compared with Greece, Cyprus and Romania where the same holds for about six in 10 workers. In addition to these countries, Bulgaria, Latvia, the Netherlands and Portugal have the highest share of employees (over a fifth) reporting that their jobs do not need ICT skills at all.

Figure 21. Level of ICT skills needed to do the job, adult employees, 2014, EU-28



NB: Share of valid responses to the question: 'Which of the following best describes the highest level of information communication technology skills required for doing your job?'

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

6.2. Living in a semi-analogue world: the digital divide

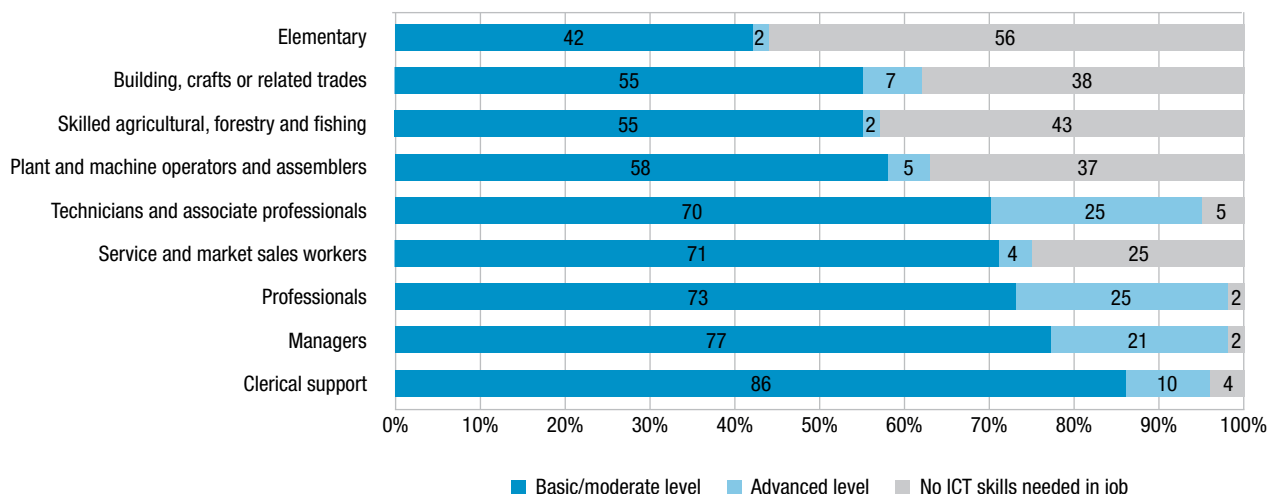
Analysis of the ESJS microdata further reveals that the digital divide – the exclusion of some population groups from the advancements of the digital era (World Bank, 2016) – is a prominent feature of the European job market. Figure 22 shows that a high share of specific subgroups of the EU workforce needs no ICT skills to do their jobs, ranging from as much as 56% of those in elementary occupations to 25% of service and market sales workers. As much as 33% of employees in the agricultural sector and 29% in the

accommodation, catering and food services sector stated that they are in no need of ICT skills for work. For these workers, manual or other skills play a more important role (Figure 23).

Individuals spend the greatest portion of their daily lives at the workplace. If they are employed in jobs that do not require or utilise digital technologies they may be less inclined to use digital technologies outside of work as well, or fail to develop the digital proficiency needed to be an active participant in society. This could contribute to the high proportion of the EU population that has low digital skills or does not use the internet ⁽²²⁾.

⁽²²⁾ European Commission digital scoreboard: <https://ec.europa.eu/digital-single-market/en/digital-scoreboard>

Figure 22. **Level of ICT skills needed to do the job by occupation, adult employees, 2014, EU-28**



NB: Share of valid responses to the question: 'Which of the following best describes the highest level of information communication technology skills required for doing your job?'

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

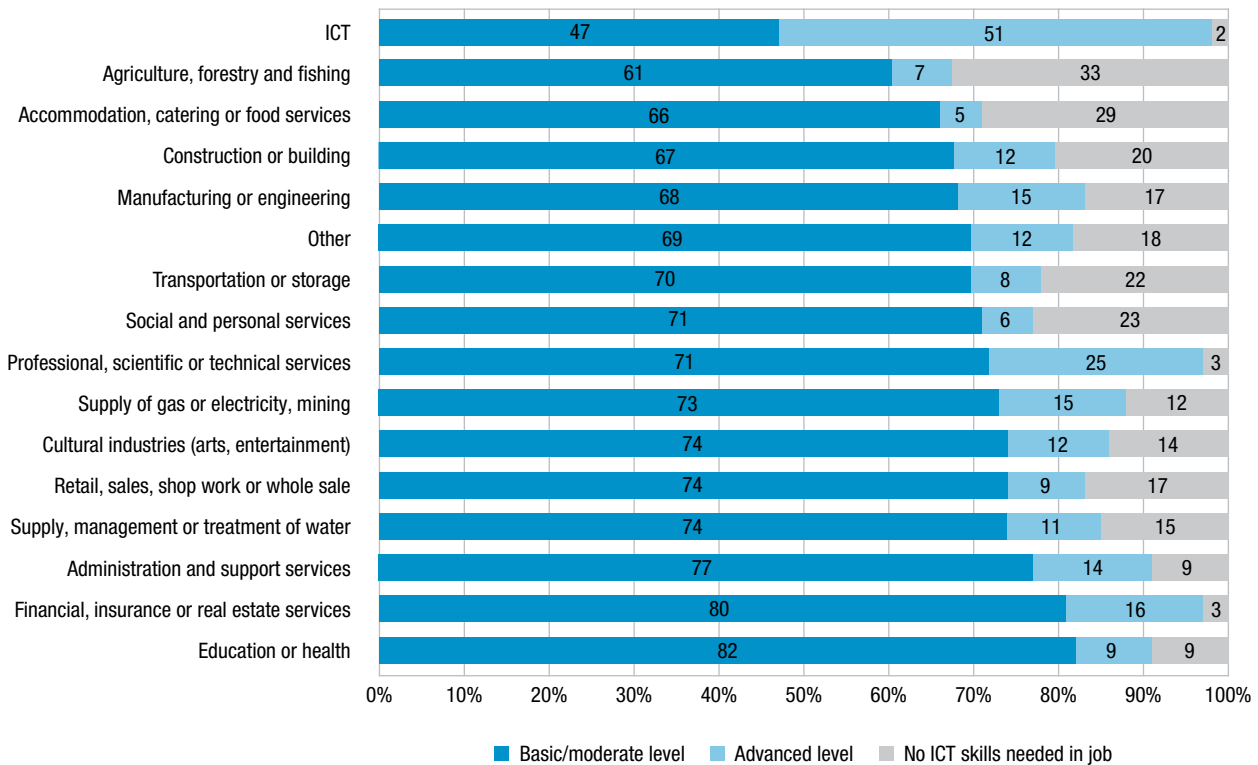
To mitigate any exclusion of specific groups from the use of ICT, many countries have taken or are preparing measures that can maximise access to ICT training and learning (Cedefop, 2015d). Several countries have put digital agendas in place that take the needs of at-risk-groups into account and promote digital inclusion for all. It is expected that the supply of basic digital skills in EU economies will progress steadily. Nevertheless, in the future world of work it is likely that advanced digital skills, in particular programming and coding, will become prerequisites for entry into many jobs and command a wage premium (Berger and Frey, 2016).

Even in today's EU job market the ESJS reveals that, after taking into account a number of important factors that determine employees' earnings (including gender, age, education attainment level, years of job tenure, aptitude for learning, occupation, industry), workers employed in jobs that depend on advanced ICT usage enjoy a statistically significant hourly earnings premium of about 3.7%, relative to workers employed in jobs that need a fundamental ICT skill level. This premium falls to 2.5% if allowing for the effect of a set of complementary skills on

earnings: cognitive (literacy, numeracy, foreign languages, problem-solving, learning to learn) and socioemotional (team-working, planning, communication, customer service). By contrast, individuals employed in jobs that do not require ICT skills receive about 8% lower hourly average wages compared to equivalent employees who work in jobs dependent on fundamental ICT skill usage. The wage premium placed on advanced ICT skills rises to as much as 7% to 8% in the UK and Germany, while employees in jobs that do not need ICT skills receive 20% lower hourly wages in the Czech Republic.

Despite the anticipated growing importance of advanced digital skills in EU labour markets, the ESJS data reveal (Figure 24) that some groups of the EU's employee population are at disadvantage. Specifically, older, low-educated and female workers have a lower likelihood of needing advanced ICT skills as part of their work. Having returned to the labour market after a period of unemployment also reduces the chances of entering into a job reliant on advanced ICT skills. The same holds for individuals who are employed in the public sector, in part-time or informal jobs (where no formal contract has been

Figure 23. Level of ICT skills needed to do the job by sector, adult employees, 2014, EU-28



NB: Share of valid responses to the question: 'Which of the following best describes the highest level of information communication technology skills required for doing your job?'

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

signed) as well as in micro- or small-sized workplaces (with less than 50 workers).

6.3. Digital skill gaps: a skills and technologies race?

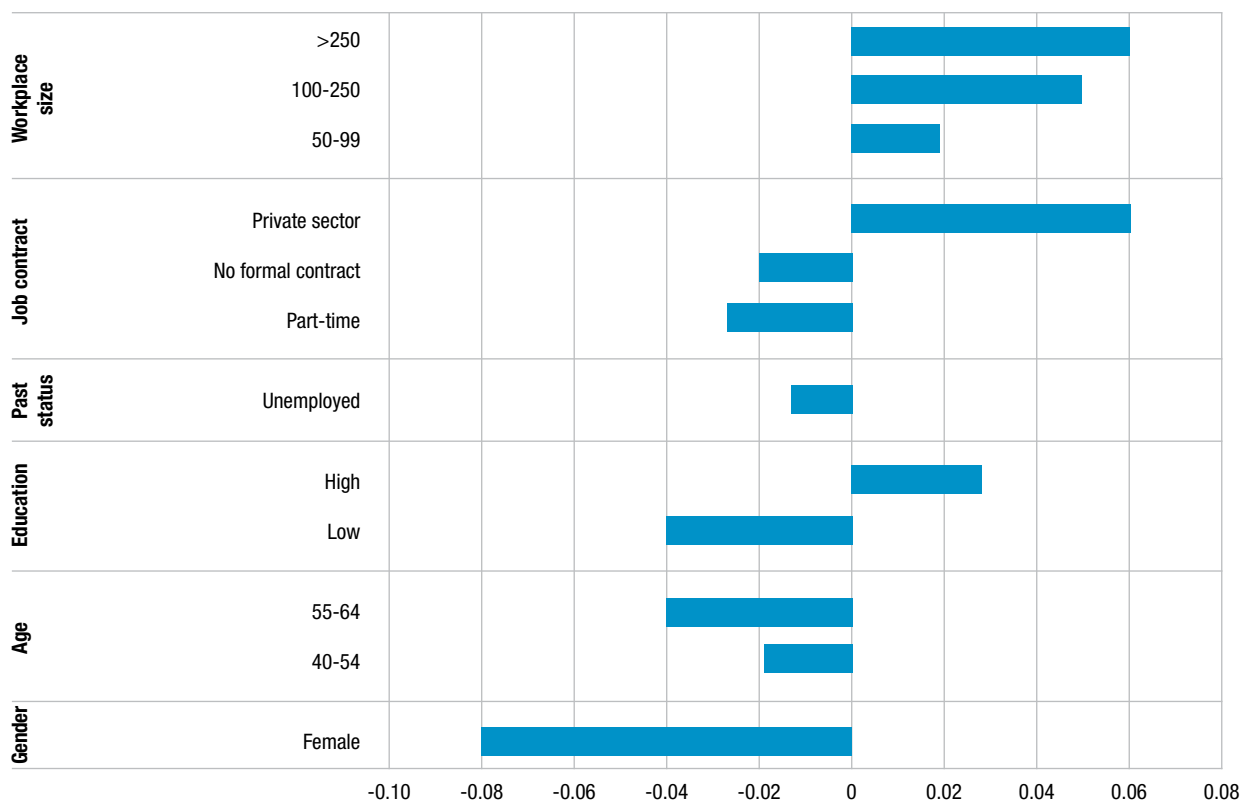
In addition to the exclusion of a sizeable part of the workforce from the digital economy, the ESJS also collected information on the (digital) skill mismatches of adult EU employees. The survey asked respondents to assess the extent to which their own skill level exceeds or lags behind those needed to do their jobs. Focusing on ICT skills, the survey asked respondents to provide

an assessment of their mismatch, conditional on the level of ICT use (basic, moderate, advanced) in their work as previously identified)⁽²³⁾.

Figure 25 depicts the share of employees in the EU-28 Member States reporting a digital skill gap, dependent on whether their job needs either a fundamental (basic/moderate) ICT level or advanced. Around 28% of the European workforce ranks their own level of fundamental digital skills lower in relation to what is required by their job. Of those employed in jobs needing advanced digital skills 22% are at risk of skill gaps. Around 40% of employees in Bulgaria, Estonia and Portugal are affected by fundamental digital skill gaps, as opposed to one in five in the

⁽²³⁾ The ESJS mismatch questions were phrased on a 0-10 scale, where 0 means that the level of an employee's (digital) skills is a lot lower than required to do the job, 5 matched to what is required and 10 a lot higher than required. Given that the distribution of the mismatch questions was skewed to the left, the analysis has classified workers as suffering from a skill gap if their response was below a value of six, which corresponds to the lower quartile of the distribution of the mismatch scale. 'Severe' digital skill gaps, corresponding to respondents who ranked their own skills at a value less than 5 in the mismatch scale, are much lower and affect 5% for users of basic ICT skills, 2.7% for those needing moderate ICT skills and 3.7% of advanced ICT users.

Figure 24. **Probability of requiring advanced ICT skills for job, adult employees, 2014, EU-28**



NB: Marginal probabilities at the mean based on estimation of a probit multivariate regression model. Base categories include: Age: 24-39; Education: medium qualification; Past labour market status: employed in another job; Job contact: indefinite; Workplace size: 1-9 employees.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Southern European countries (Greece, Italy and Cyprus). Workers in Denmark, Estonia, Portugal and Sweden are also the most susceptible to skill gaps in advanced ICT skills.

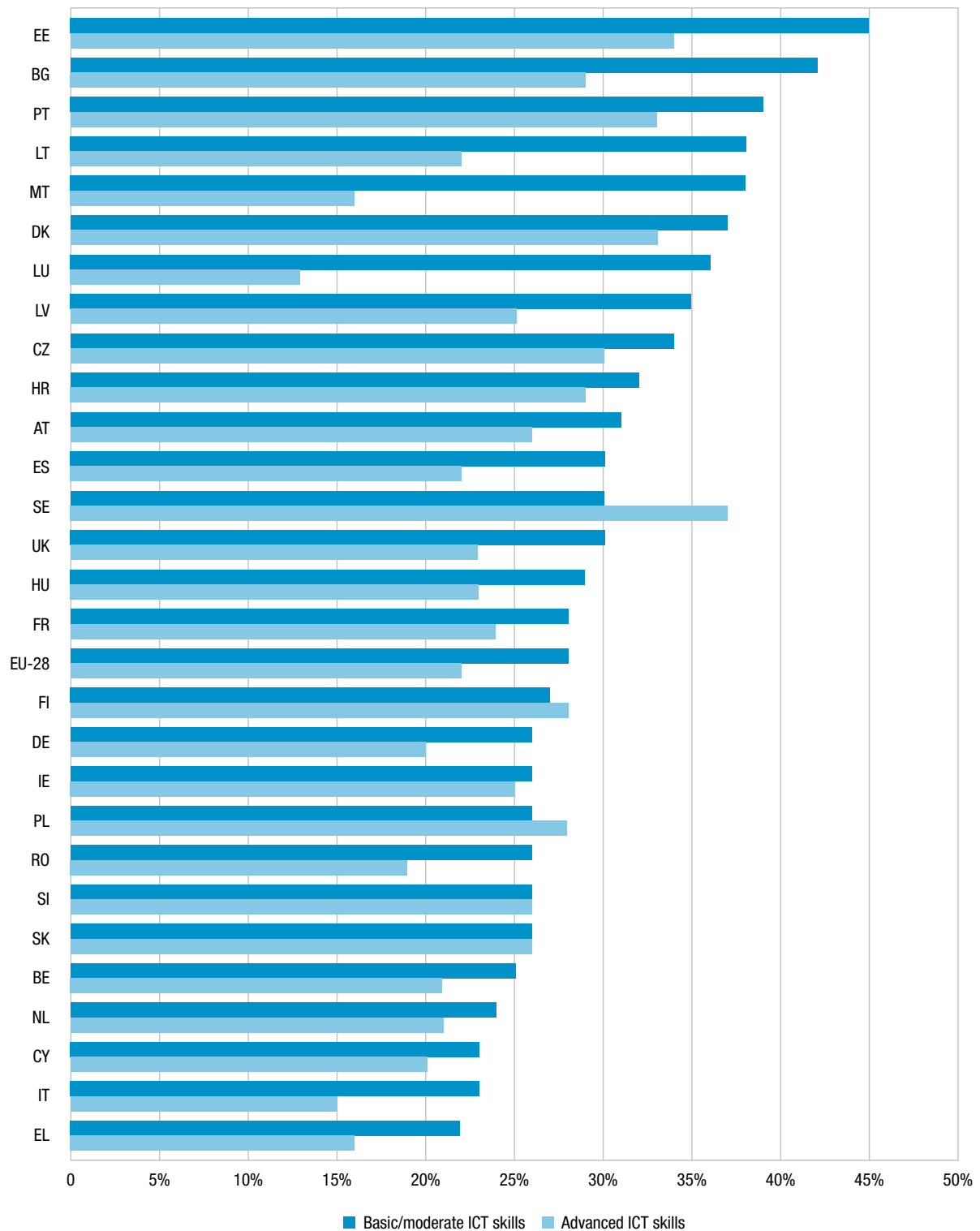
Over a third of those employed in agriculture, accommodation, catering and food services and social and personal services, are affected by fundamental digital skill gaps. By contrast, less than a quarter of workers have fundamental digital skill gaps in the ICT and financial, insurance and real estate services sectors. Figure 26 also highlights that over a third of building, crafts and related trades workers, skilled agricultural employees and individuals employed in elementary occupations are prone to fundamental digital skill gaps, as opposed to about a quarter of managers, clerical support workers and technicians. Among those whose job performance is dependent on advanced ICT usage, workers in elementary occupations, assemblers and sales

jobs are mostly affected by inadequate levels of digital proficiency.

In addition to differences in the incidence of digital skill gaps between sectors of economic activity and occupations, the ESJS also allows further breakdown and investigation of the relationship between digital skill gaps and various demographic and socioeconomic worker characteristics. Figure 27 displays the estimated probability of a worker reporting a lower digital skill level relative to their job requirement, according to a particular set of characteristics.

It is evident from the graph that characteristics that prohibit employees from being employed in an advanced digital job (Figure 24) and which sustain the digital divide (such as firm size, gender, education level) are also associated with a higher risk of workers stating that they suffer from digital skill gaps. Females, older and lower-educated workers, as well as those employed

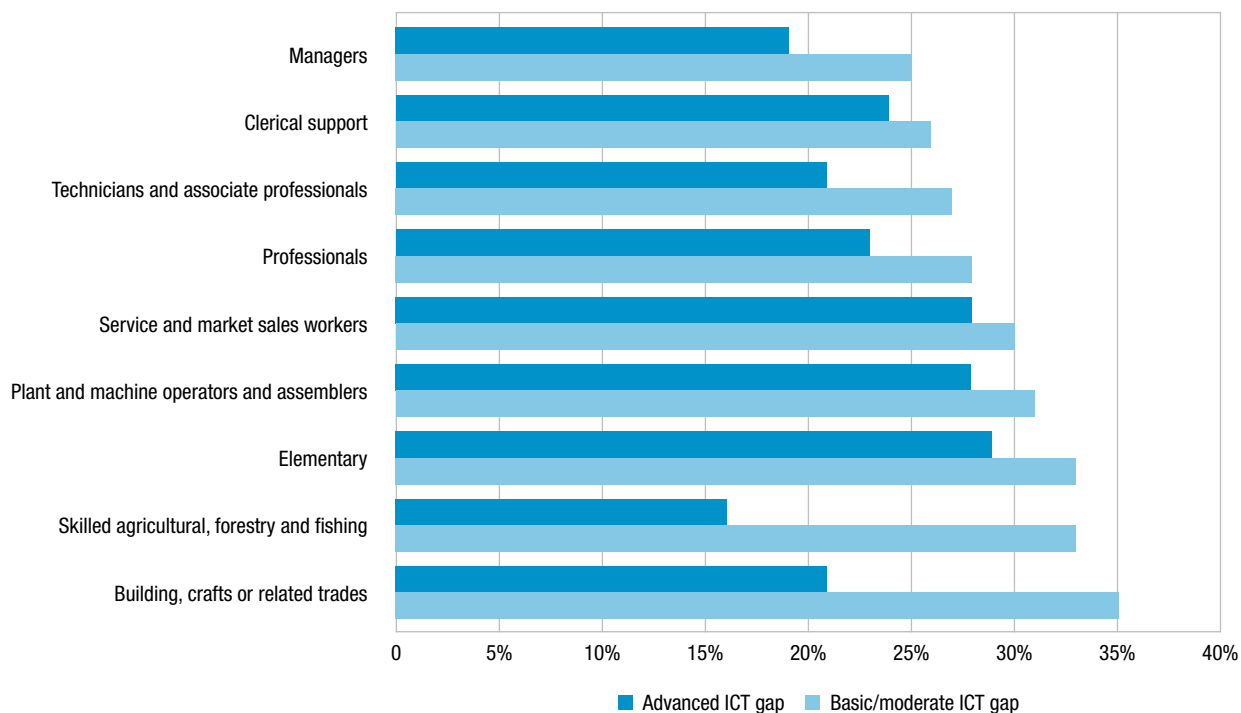
Figure 25. Incidence of digital skill gap by level of digital skill needed by the job, adult employees, 2014, EU-28



NB: Share of responses with scores below 6 to the question: 'How would you best describe your skills in relation to what is required to do your job? Please use a scale of 0 to 10 where 0 means your level of skill is a lot lower than required, 5 means your level of skill is matched to what is required and 10 means your level of skill is a lot higher than required.' Responses are conditional on level of ICT use needed in the job as identified in a prior question of the survey.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

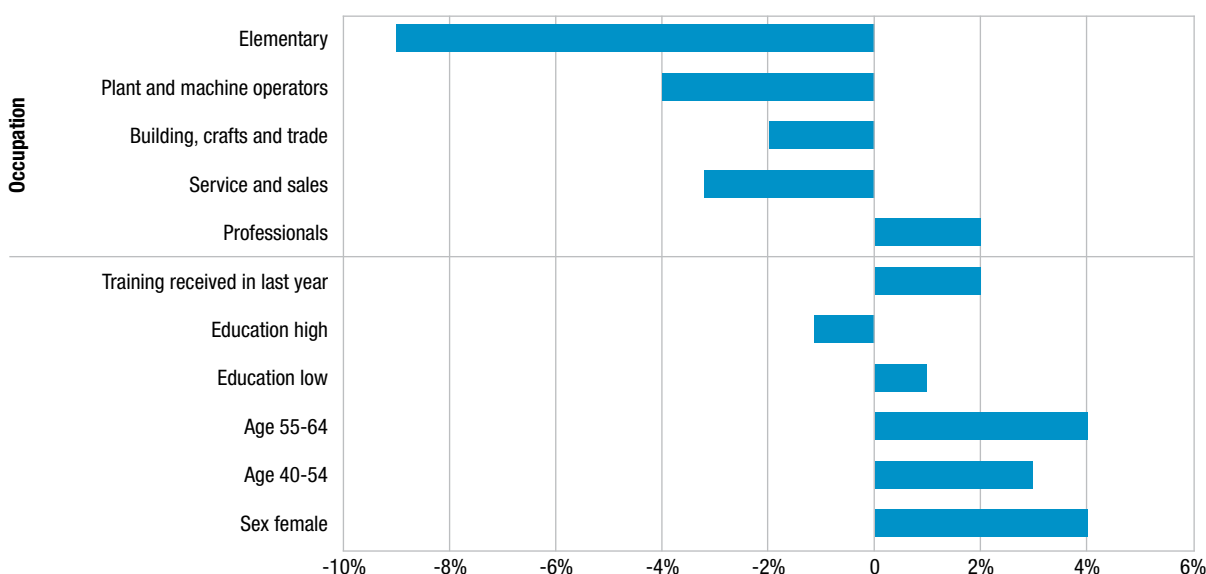
Figure 26. **Incidence of digital skill gap by level of digital skill needed by job and occupation, adult employees, 2014, EU-28**



NB: Share of responses with scores below 6 to the question: 'How would you best describe your skills in relation to what is required to do your job? Please use a scale of 0 to 10 where 0 means your level of skill is a lot lower than required, 5 means your level of skill is matched to what is required and 10 means your level of skill is a lot higher than required.' Responses are conditional on the level of ICT use needed in the job as identified in a prior question of the survey.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Figure 27. **Probability of digital skill gap, adult employees, 2014, EU-28**



NB: Marginal probabilities at the mean based on estimation of a probit multivariate regression model. Base categories include: Age: 24-39; Education: medium qualification; Occupation: managers.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

as professionals in high skill-intensive jobs, have a higher likelihood of digital skill gaps.

By contrast, employees in lower-skilled occupations have a lower likelihood of experiencing a digital skill gap, relative to those in managerial posts. The risk of a digital skill gap is found to be positively associated with the receipt of continuing training in the job, which highlights that

employers and individuals generally respond to digital skill gaps via remedial vocational training courses. Fundamental digital skill gaps are also found to be more frequently reported in micro-sized than in larger workplaces, though the size of the workplace does not have a significant effect after considering other firm characteristics.

Box 2. Decomposing the digital skill gap in EU countries

The country rankings of digital skill gaps reflect both the level of digital proficiency of the adult workforce of each country and the degree of ICT skill requirements in their labour markets: the proportion of workers with digital skill gaps varies between countries depending on the share of high-skilled workers in their economies and/or the variance in the level of digital skill intensity across jobs.

For instance, a job needing fundamental ICT skills in one country may entail higher-skilled tasks relative to what is also classified as a fundamental ICT skill job by workers in another country. What this implies is that the low fundamental digital skill gaps of some countries (such as Greece, Cyprus, the Netherlands and Romania) may be attributed to a lower average level of skill intensity within jobs that need fundamental ICT skills, regardless of the digital skill proficiency level of their workforces. By contrast, countries at the higher end of the spectrum, such as Bulgaria, Estonia and Portugal, may have a higher share of workers with fundamental digital skill gaps either because such jobs are more digitally skill-intensive or because the workforce has low digital skills.

Examination of the ESJS data reveals that there is noticeable variation in terms of the importance of digital skills, as well as other cognitive and soft skills, in the subsample of individuals who stated that their jobs need a fundamental digital skill level. Some countries (Belgium, Austria, Finland) have a higher mean level of importance of digital skills that exceeds a score of eight (on a 0-10 scale, where 10 implies that ICT skills are essential for doing the job). Others have an average score that is closer to seven (Bulgaria, Czech Republic, Spain, Croatia).

Figure 29 depicts the share of employees with digital skill gaps after purging the effect of the skill intensity of their jobs (both in terms of the importance of digital skills and the importance of a set of another 10 skills) from their raw reported skill mismatch⁽²⁴⁾. The figure highlights that the share of employees who suffer from a fundamental digital skill gap, which cannot be attributed to differential skill intensities of jobs, is approximately 17%. It ranges from a high of 31% in Estonia, 29% in Malta, 26% in Lithuania and 25% in Denmark to a low of 12% in Greece and the Netherlands.

For some countries, notably Bulgaria, Estonia, Spain, Luxembourg and Portugal, a significant portion (over a half) of the raw fundamental digital skill gap can be attributed to the skill intensity of jobs. For others (Ireland, Finland, Sweden) most of the digital skill gap can be explained by factors unrelated to skill needs (such as human capital characteristics of workers and other job features).

⁽²⁴⁾ To purge the effect of the skill intensity of employees' jobs from their reported digital skill mismatch score, a multivariate ordinary least squares (OLS) regression of the mismatch score was first performed on a set of two explanatory variables: the stated importance of digital skills; and the stated importance of a set of 10 additional cognitive and soft skills (literacy, numeracy, foreign languages, technical, communication, planning, learning to learn, team working, customer service, problem-solving). The sample consists of those employees who identified in a previous question that their job requires a level of fundamental digital skills. Based on the estimated residuals, employees have been classified as having a fundamental digital skill gap if their residual scores correspond to the lowest quartile of the distribution of responses.

6.4. Complementarity of digital and other skills

As highlighted by the OECD (2016), the transformation spurred by the introduction of digital technologies in workplaces does not only affect the demand for digital skills but also places a premium on other ICT-complementary skills. For example, the use of ICT at work affects an individual's overall ability to carry out work-related tasks. Typically, the higher frequency and availability of information associated with digital workplaces requires strong foundation skills (such as literacy) and a higher degree of planning, personal adaptability and ability to screen and filter out essential evidence. Similarly, so-called skilled-biased organisation change has involved the proliferation of horizontal hierarchical structures in firms which, in turn, call for a greater need for team-working, cooperation and leadership skills. In such digital settings, interpersonal and customer interaction skills are also affected. For example, the increasing importance of e-commerce is less dependent on face-to-face interaction, which is typical of non-digital commercial transactions.

In addition to enquiring about the ICT level needed in adult workers' jobs, the ESJS also asked respondents to indicate the importance of a set of ten other cognitive, non-cognitive and job-specific skills. Based on this information, Figure 28 depicts the (estimated) odds that the job of an ICT user is also dependent on non-ICT skills. The estimated probabilities are calculated by comparing the samples of employees who stated that their job requires a fundamental or advanced ICT level with those who do not need ICT skills to perform their tasks ⁽²⁵⁾. It was also ensured that the estimated odds ratios are not influenced by the differential sectoral or occupational distribution between ICT and non-ICT skill users, while other key demographic and socio-economic differences between the two groups

(gender, age, education level) have been taken into account; the reported odds ratios in Figure 28 are partial correlations that cannot be attributed to various external influences, such as the fact that ICT users are more likely to be males, higher-educated or ICT industry employees, characteristics which are simultaneously correlated with jobs that also need higher levels of non-ICT skills.

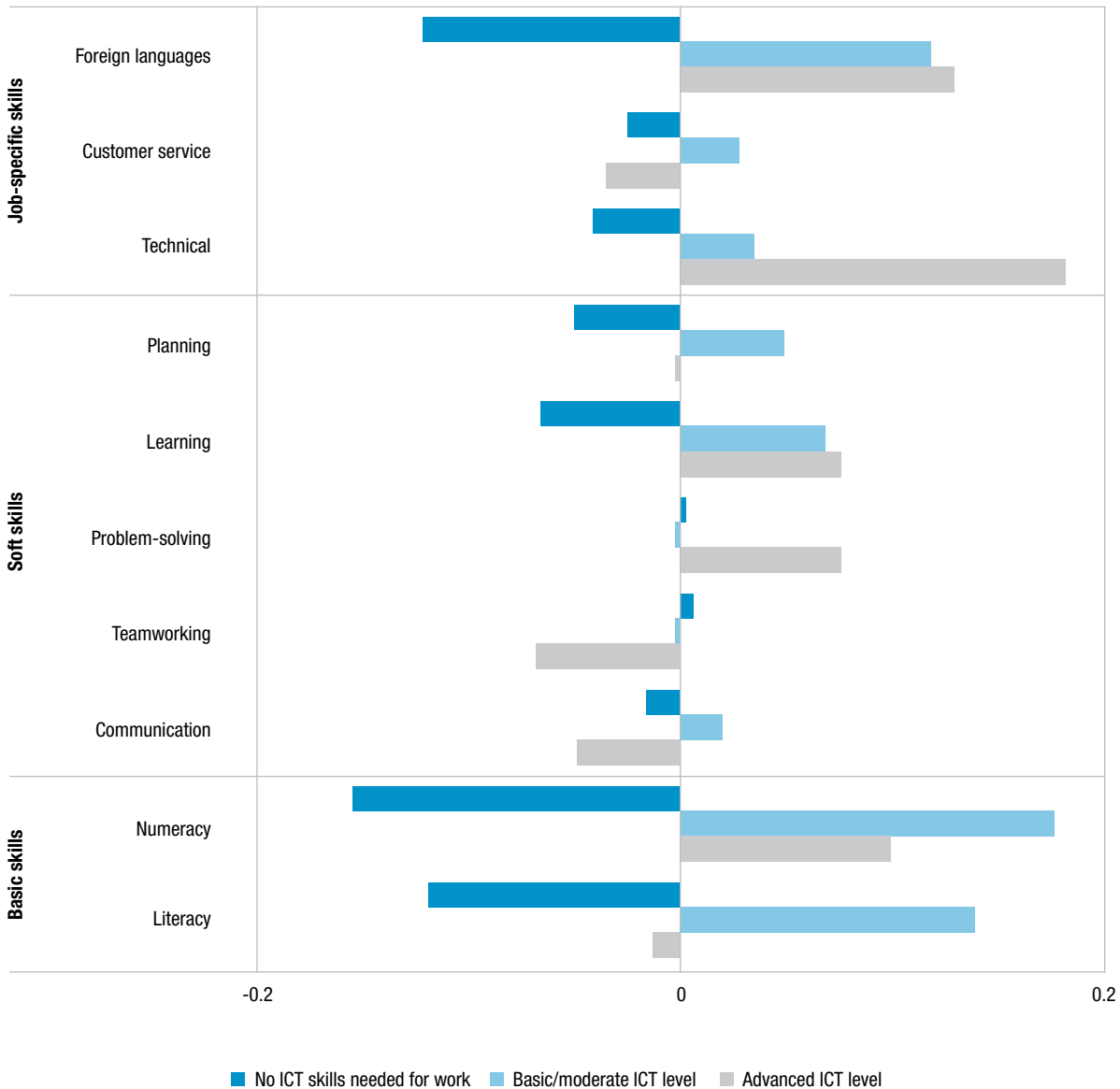
Similar to the findings of the OECD (2016), the figure highlights that ICT users are, all other things being equal, more likely to be employed in more skill-intensive jobs. A unique exception is the fact that the jobs of advanced ICT users are found to be less likely to rely on interpersonal (team-working and communication) and customer-service skills. Nonetheless, the jobs of ICT users are found to be unambiguously reliant on a higher level of cognitive skills (literacy, numeracy, problem-solving, learning to learn). Adults who are employed in jobs that require a foundation level of ICT skills simultaneously require a strong level of foundation skills (literacy, numeracy) as well as planning and organisation skills. By comparison, it is important to have strong numerical and technical skills if employed in jobs dependent on advanced ICT usage. Such jobs are significantly dependent on the ability of individuals to think of solutions to problems (problem-solving skills) as well as to learn, adapt and apply new methods and technologies at work (learning skills). There is also a positive association between ICT usage and the need for a foreign language to perform one's job duties ⁽²⁶⁾.

Given the complementarity between digital and non-digital skills in the workplace, it is also possible to explore from the ESJS data the nature of the association between an individual's digital skill gap and gaps in relevant non-ICT skills. The analysis reveals that employees who are affected by ICT skill gaps have a higher propensity to experience simultaneous skill gaps in their foundation skills (literacy, numeracy) as well

⁽²⁵⁾ Workers who declared that ICT skills are not important for their jobs (even if they previously acknowledged in the survey that their jobs require some level of ICT skills) have also been classified as none-ICT users. It is reasonable to deduce that the job tasks of such workers are likely to be mostly non-digitally intensive. For instance, an ICT specialist in a software company may be employed in a job involving mostly administrative and/or managerial tasks.

⁽²⁶⁾ The definition of foreign language skills in the ESJS was 'using a language other than your mother tongue to perform job duties'. It is, unfortunately, not possible to exclude the possibility that some ICT users may have classified some programming languages or computer syntax as a 'foreign language'.

Figure 28. **Complementarity between ICT and non-ICT skills at work, adult employees, 2014, EU-28**



NB: Estimated probability (difference of the estimated odds ratios from the value of one) based on a logistics multivariate regression model. The dependent variable is the highest level of ICT skills needed for doing one's jobs and is regressed on a set of variables capturing the importance of non-ICT skills. The empirical specification accounts for gender, age, education level, occupation, economic sector and country dummies. Interpretation of graph: the job of an average worker that relies on foundation ICT skills has an 18% higher chance that numeracy skills are also important, relative to that of a comparable worker who does not need ICT skills to do the job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

as their technical skills (specialist knowledge and technical equipment needed to perform job duties). There is also a significant positive associa-

tion between the incidence of ICT skill gaps and the inability of adult workers to continue to learn in their jobs ⁽²⁷⁾.

⁽²⁷⁾ All relevant estimated regression coefficients are available from the author on request.

6.5. Reaping the full benefits of digitalisation

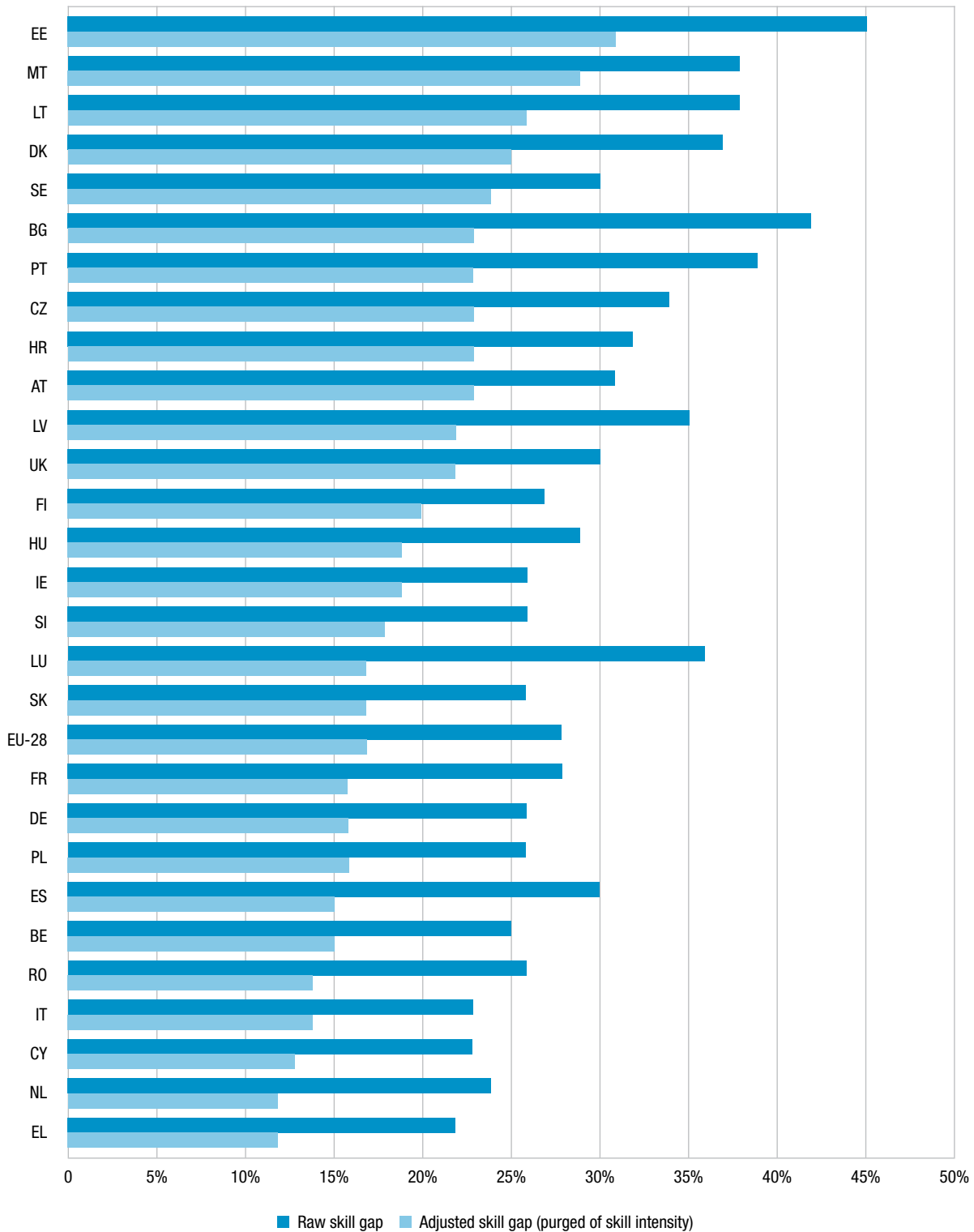
The widespread transformation of the world of work is upon us and poses a significant challenge to policy-makers: the call to implement policies that will ensure that the immense benefits of the digital revolution are enjoyed by all individuals. Bridging the digital divide and making the leap across digital skill gaps requires significant modernisation of Europe's education and training systems as well as its job markets. This is evident from the fact that the use of advanced ICT skills in EU workplaces, and the emergence of ICT skill gaps, is highly complementary with other technical and foundation skills and requires a high degree of learning aptitude on behalf of employees.

Remaining competitive in the global market requires consistent investment in higher-order ICT skills and their integration within education curricula as a key competence, since they are likely to become the norm in a wide(r) set of future jobs. Reinforcing the attractiveness of ICT-related subjects, and of STEM fields (science, technology, engineering, maths) in general, remains a critical concern, given low levels of participation by young people in such subjects (European Commission, 2012). One way of accomplishing this is exploiting the rising potential of new modes of online ICT education delivery, which can support further private industry involvement in e-learning and the award of new high-quality e-certificates and qualifications. Building stronger partnerships between education and training providers and employers, such as the European Commission's Digital skills and jobs coalition, is another.

But the ESJS also highlights that much of the adjustment of humans to technological obsolescence will take place within workplaces, in the form of continuous and on-the-job learning. Ensuring the continuous adaptation of skills to new digital demands depends on commitment by employers to human resource management practices that invest in people's digital and non-digital skills. It also needs significant reengineering of work methods and daily routines, especially in lower-skilled occupations and sectors. Only by

this will the digital revolution translate into workplace innovation and continuous learning for the sizeable share of EU employees who, at the moment, require no/limited ICT skills as part of their daily work. Finally, even though digitalisation has given rise to the new platform (or gig) economy, it will be critical for EU policy-makers and businesses to prevent rising marginalisation and job insecurity, ensuring that such new forms of work do not compromise the continuous skill development of individuals (Pouliakas, 2017).

Figure 29. Incidence of digital skill gap, adult employees whose job requires a fundamental digital skill level, 2014, EU-28



NB: The 'adjusted skill gap (purged of skill intensity)' is based as the lowest quartile of values of the estimated residuals, computed after an OLS regression of the raw digital skill mismatch scores of respondents on (i) an indicator of the importance of ICT skills and (ii) a summary index of the importance of 10 non-ICT skills for the job (including literacy, numeracy, and problem-solving). The estimation is done on a subsample of adult employees whose jobs require a fundamental digital skill level.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Table 6. **Use of advanced digital skills at work and risk of digital skill gaps, adult employees, 2014, EU-28**

	(1) Use of advanced ICT skills at work	(2) Digital skill gap
Age 40-54	-0.09*** (0.018)	0.10*** (0.015)
Age 55-65	-0.18*** (0.030)	0.14*** (0.023)
Male	0.43*** (0.017)	-0.12*** (0.014)
Previous labour market status		
Self-employed	0.07* (0.040)	0.05 (0.034)
Unemployed	-0.07*** (0.026)	-0.02 (0.020)
Inactive	-0.09* (0.050)	0.00 (0.033)
Highest education attainment		
Education: low	-0.24*** (0.034)	0.04 (0.023)
Education: high	0.14*** (0.019)	-0.03* (0.016)
Job characteristics		
No training in last 12 months	0.02 (0.018)	-0.05*** (0.015)
Part-time work	-0.14*** (0.031)	0.01 (0.023)
No formal contract	-0.10* (0.057)	-0.02 (0.041)
Years in job	-0.00* (0.001)	0.00*** (0.001)
Workplace site varies	-0.00 (0.040)	0.06* (0.031)
Private sector	0.32*** (0.019)	0.01 (0.015)

	(1) Use of advanced ICT skills at work	(2) Digital skill gap
Workplace size		
Size: 10-49	0.01	-0.02
	(0.024)	(0.019)
Size: 50-249	0.17***	-0.03
	(0.025)	(0.020)
Size: 250+	0.29***	-0.03
	(0.026)	(0.022)
Learning new things in job		
Always	0.48***	0.21***
	(0.058)	(0.039)
Usually	0.29***	0.20***
	(0.057)	(0.038)
Sometimes	0.07	0.18***
	(0.057)	(0.037)
I enjoy learning for its own sake	0.02***	-0.06***
	(0.004)	(0.003)
Changes in job		
Changes to the technologies used in workplace (e.g. machinery, ICT systems)	0.23***	-0.02
	(0.016)	(0.014)
Moved to different unit	-0.12***	0.04*
	(0.027)	(0.023)
Changed nature of tasks	-0.04*	0.04*
	(0.023)	(0.020)
No change	-0.12***	0.04**
	(0.021)	(0.018)
Constant	-1.90***	-0.58***
	(0.132)	(0.102)
Occupation dummies	√	√
Industry dummies	√	√
Country dummies	√	√
Observations	46 992	46 992

NB: Probit regression estimates. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; Base categories include: Age 24-39; Previous labour market status: employed in another job; Education: medium level; Contract: indefinite; Firm size: 1-9 employees; Learning new things in job: Never; Change to job role: promoted.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

PART 3

SKILL
UTILISATION
WITHIN
WORKPLACES

Safeguarding human capital investments: mitigating education mismatch in the EU

Cedefop's European skill and jobs survey (ESJS) shows that 29% of the EU adult population is affected by some form of qualification mismatch, mostly overqualification. About a quarter of tertiary education graduates work in jobs below their qualification level. Overqualified individuals are mostly younger and inexperienced, but they enter into jobs without good career prospects. They often lack information about their labour market value or are driven by other motives and external constraints and can get 'stuck' in the same state for a long time. This is a waste of public resources and can taint the value of further education in the long run.

7.1. Jobs not matched to qualifications and skills

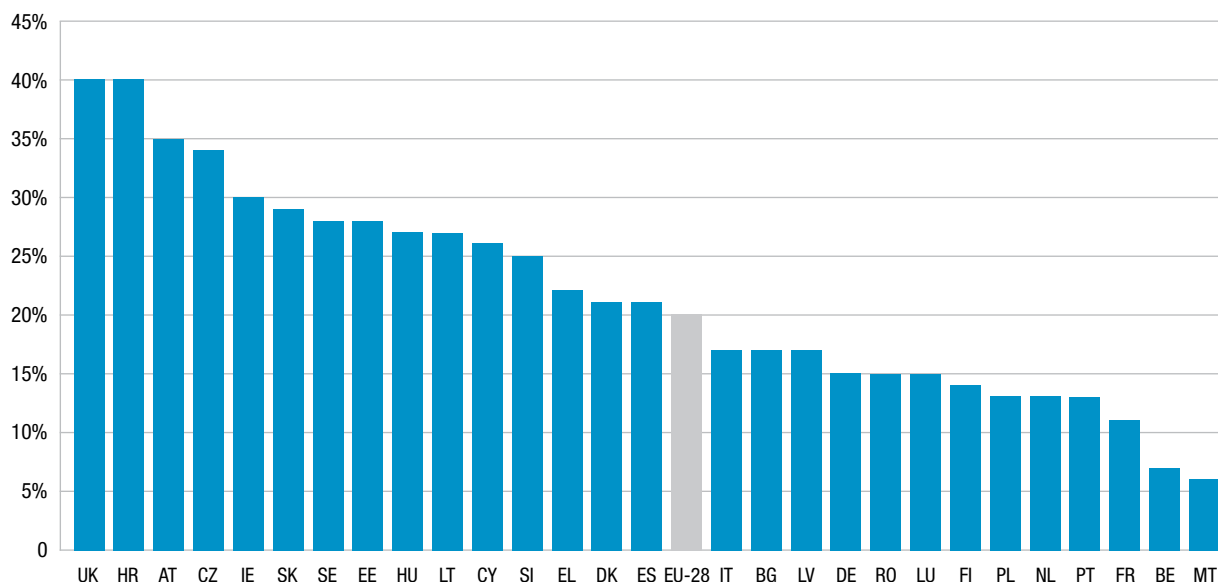
Part 2 of this report focused on what tends to be the most concerning type of skill mismatch for policy-makers: employers being unable to fill their vacancies despite high unemployment (skill shortages) or instances where workers' skills cannot cope with workplace needs (skill gaps). However, skill mismatch taking the form of underutilisation of individuals' qualifications and skills is often a more pervasive phenomenon (McGuinness et al., 2017). It is not only a problem for those looking for a job, but affects the wider workforce. Such forms of skill mismatch are commonly referred to as overeducation or overqualification, instances where a person is employed in a job that needs lower qualifications than their own. When the person is working in a job that does not fully utilise their wider skill set, this form of mismatch is referred to as overskilling or skill underutilisation (Cedefop, 2010).

Skill mismatches occurring during graduates' entry to the labour market or those that appear once at work can hamper economic productivity and individual potential, especially when higher educated people are trapped in jobs without constant opportunities to develop and use their skills.

Qualification mismatches occur when the formal qualifications held by individuals deviate from those required to be hired and perform a job. With rising levels of education attainment in most EU countries and some EU economies characterised by anaemic job growth, high unemployment rates and rising shares of low-quality jobs on offer (Eurofound, 2017), the concern is that too many young people are now accepting jobs below their qualification level. Several studies that track individuals over time have now confirmed that entry into the labour market during an economic recession breeds overqualification, which can 'scar' young graduates for many years to come (Oreopoulos et al., 2012; Liu et al., 2012; Summerfield and Theodossiou, 2017).

Finding a job that is a good match for one's qualifications has become difficult in recent times. According to the ESJS, 52% of EU adult employees who found their job after 2011 admitted to having few opportunities to secure a job matched to their skills and qualifications; the figure for those who started their job prior to the 2008 economic crisis was 32%. As a result, about a fifth of younger EU workers (a quarter of those with tertiary degrees) considered themselves to be overqualified for their jobs in 2014 (Figure 30).

Figure 30. **Average share of overqualified young adult employees, 2014, EU-28**



NB: Young adults aged 24 to 35 with higher qualifications than needed to do their job. Overqualification rates were calculated by comparing individuals' own highest level of education attainment with the qualification they consider necessary for doing the tasks in their job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

7.2. Varying overqualification effects

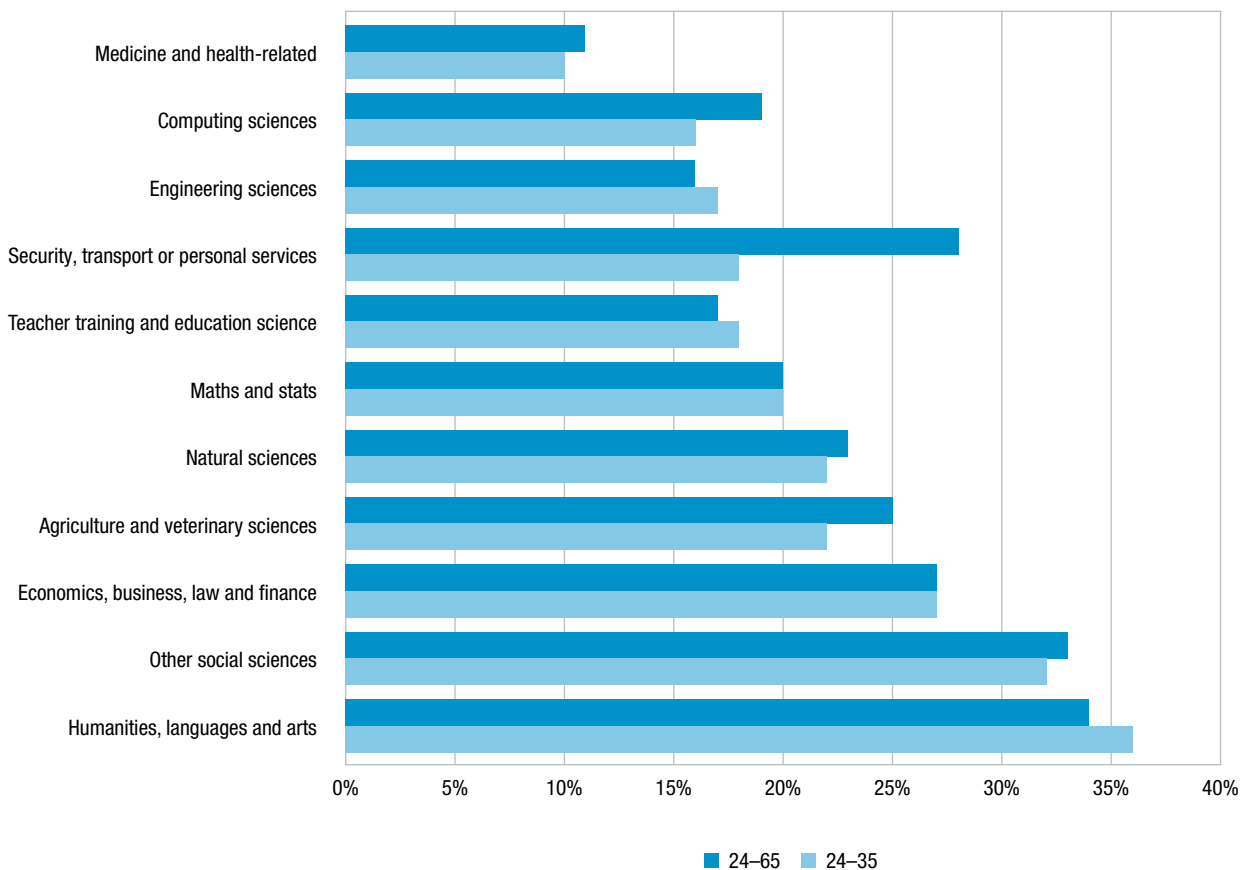
Some workers have higher chances than others of being in a job that needs a lower qualification than their own (Table 7) ⁽²⁸⁾. Overqualification rates are higher among younger cohorts of workers and tend to decline with age and additional years of job tenure. Females are characterised by a slightly higher overeducation rate in the ESJS sample (18%, in contrast to 16% for males). However, the estimated risk of overeducation is higher for males, once other important factors that are correlated with both gender status and higher chances of overeducation (such as differences in education level, type of jobs, job preferences, internal or external constraints) are taken into account. Tertiary education graduates are predominantly affected, especially those who have studied fields such as humanities, languages and arts, other social sciences but also business and law (Figure 31).

The 2008 economic crisis took its toll on the quality of education matches in the EU economy. ESJS data confirm that individuals who completed their highest level of education after 2008 have a significantly higher probability of being overqualified than older graduate cohorts. Returning to the labour market after having spent (prolonged) time in unemployment or inactivity (because of child care or illness) also maximises one's chances of being in a mismatched job; this is a worrying predicament for those individuals who were left jobless for an extended time period as a result of the economic downturn.

In addition to varying across individual demographic and socioeconomic characteristics, overqualification is more prominent in particular jobs. Individuals in non-standard contract jobs (informal or temporary agency contracts) and those employed in smaller-sized firms in

⁽²⁸⁾ Odds ratios that exceed the value of one (are below the value of one) indicate a higher (a lower) than average probability of overeducation in relation to the explanatory variable in question.

Figure 31. Share of overqualified tertiary education graduates by field of study, 2014, EU-28



NB: Tertiary education graduates with higher qualifications than needed to do their job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

the private sector are more likely to see their education underutilised. The incidence of overqualification is higher for those employed in occupational groups of lower skill intensity, such as elementary occupations, service and market sales workers, plant and machine operators and assemblers.

Even when comparing individuals employed in the same broad occupational group, the ESJS highlights that the jobs of the overeducated tend to be characterised by inherently lower skill needs.

As an example, overeducated employees have a significantly lower chance of being employed in jobs that require an advanced literacy or ICT skill level, or those that entail continuous learning. In terms of the mean level of skill needs, the jobs of overeducated tertiary graduates are found to be less skill-intensive compared to those with the same level of education, who landed a job matched to their qualifications⁽²⁹⁾. By contrast, the profile of skill demands characterising the jobs of overeducated graduates is closer to that of workers with a lower education level, but who are employed in well-matched

⁽²⁹⁾ The ESJS contains a series of questions intended to capture the level and importance of skills needed in adult employees' jobs. The survey measured aspects such as whether the need for learning in the job is frequent or has been rising since the time the worker commenced employment; and if the worker carries out mostly routine or autonomous tasks and if the task variety in the job has increased or decreased with years of job tenure. It also enquired about the level of importance of a set of basic and socioemotional skills in each worker's job. Further definitions can be found in the annex and in Cedefop (2015a).

Table 7. Risk of overeducation, adult employees, 2014, EU-28

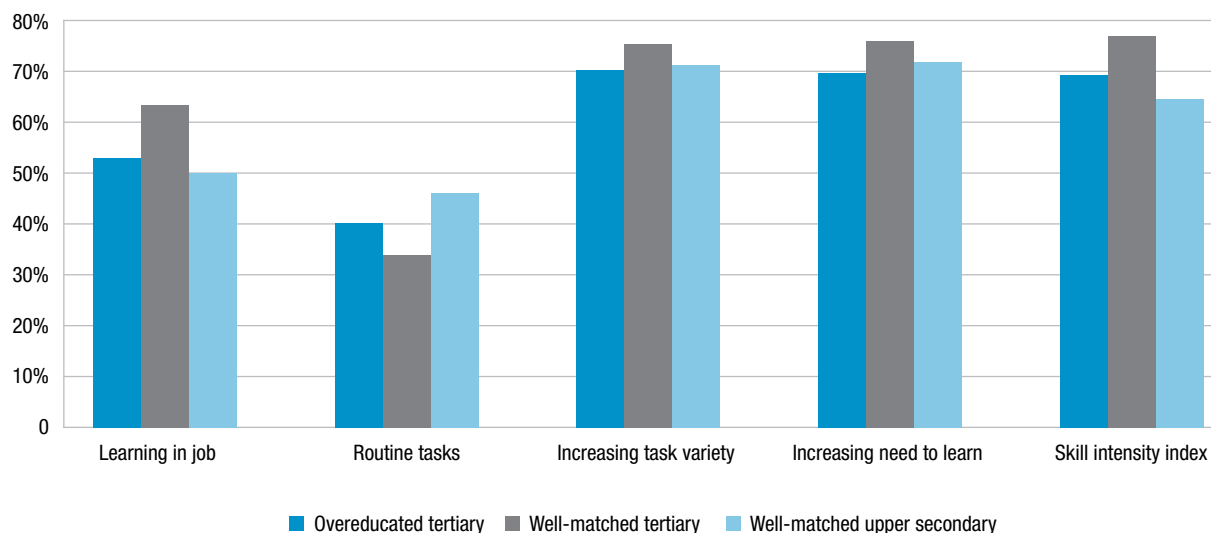
Human capital characteristics	
Male	1.14*** (0.039)
Age: 55-65	0.812*** (0.505)
Previously unemployed	1.23** (0.059)
High education	4.24*** (0.174)
Years of tenure	0.986*** (0.002)
No training	1.14** (0.042)
Job characteristics	
Temporary agency contract	1.58*** (0.232)
Size: >250	0.738*** (0.053)
Public sector	0.697*** (0.027)
Not promoted	1.23*** (0.057)
Always learning new things	0.476*** (0.042)
Importance of customer services skills	1.02*** (0.005)
Advanced literacy skills required in job	0.419*** (0.015)
Advanced ICT skills required in job	0.310** (0.019)
* Skill intensity of job (index)	0.837*** (0.008)
Individual preferences	
Job suits skills & qualifications	0.879*** (0.007)
Career progression/advance	0.940*** (0.007)
Intrinsic satisfaction	0.937*** (0.008)
Work-life balance	1.02*** (0.008)
Job security	1.05*** (0.009)
Close to home	1.03*** (0.006)
Employer's reputation	1.02*** (0.008)
Internal/external constraints	
Financial difficulties	1.24*** (0.052)
Few suitable job opportunities	1.10*** (0.038)
Moved to different occupation at start of current job	1.60*** (0.090)
Did not move country at start of current job	1.33** (0.171)

NB: Estimated odds ratios based on logistic regression. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Reference categories include: Age: 24-39; Previous labour market status: employed; Education: medium level; Contract: indefinite; Workplace size: less than 10 employees.

* estimate when the regression includes an overall skill intensity index, measured as an average of the degree of importance of several skills (basic, technical and generic) in people's jobs, in place of three variables capturing the importance of literacy, ICT and customer services skills for the job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Figure 32. Comparison of skill needs between groups, adult employees, 2014, EU-28



NB: Columns (1)-(2): mean share of adult employees whose job ‘always’ or ‘usually’ involves ‘Learning new things’ and ‘Routine tasks’. Columns (3)-(4): mean score of ‘increasing task variety’ and ‘increasing need to learn’ on a 0-10 scale (0 = decreased a lot; 10: increased a lot). Column (5): index of skill intensity measured as an average of the degree of importance of several skills (basic, technical and generic) in people’s jobs (0: not important at all; 10: extremely important).

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

jobs (Figure 32). As with Handel and colleagues (2016), it seems that in the European labour market the jobs of overeducated graduates mirror more closely the jobs of their ‘fellow workers’ rather than of their ‘classmates’.

7.3. The price of skill underutilisation

When individuals find jobs beneath their qualification level they are paid less and are more dissatisfied, relative to individuals with the same education who are in matched jobs (Hartog, 2000; McGuinness, 2006; Cedefop, 2010; McGuinness and Pouliakas, 2017). The ESJS data reveal that, on average, overqualified EU adult employees receive 22% lower gross hourly earnings than comparable workers in matched jobs; for tertiary graduates the ‘overqualification wage penalty’ rises to 24% (Figure 33).

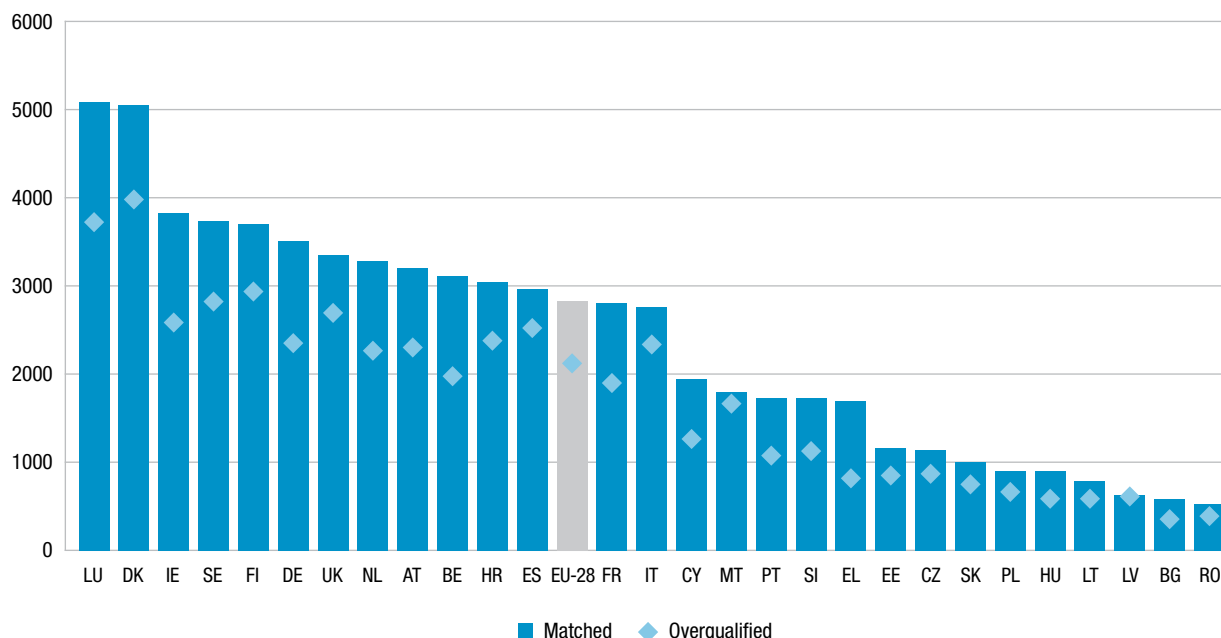
Understanding why overqualified individuals receive lower pay than other graduates with the

same academic credentials is less than straightforward (Box 3).

Economists agree that lower wages reflect inferior productivity. It is difficult to disentangle whether this arises because the overqualified have lower skills and abilities than other tertiary graduates; or if they receive less training on and off their job; or because their everyday work tasks are routine and lower-skilled, posing a constraint on potential productivity.

Others believe that individuals temporarily find themselves in a mismatched job due to information gaps between job applicants and employers at the time of hiring; or that individuals deliberately select such jobs because of particular amenities or job attributes (the location of the job, work-life balance considerations, job security) that compensate for lower wages. For some, overeducation is a natural and transitory state that arises because younger graduates either ‘experiment’ with part-time or lower-skill jobs at earlier stages of the school to work transition, or because overeducated entry jobs are perceived as stepping stones to future desired careers.

Figure 33. **Average gross monthly wages of tertiary education graduates by overeducation status, 2014, EU-28**



Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>; McGuinness and Pouliakas (2017).

Box 3. Theories of overeducation and skill mismatch

Economists have advocated several theories that can explain the so-called overeducation wage penalty, the stylised empirical fact whereby the wages of overeducated workers are lower relative to comparable well-matched employees with the same education level. Some of the most prominent theories are described below:

- a statistical artefact (human capital theory): since wages equal the marginal productivity of individuals, which reflects people's skills and abilities acquired during education, the lower wages of the overeducated in the data may arise because the non-formal and informal human capital of mismatched workers are not generally observed in the data (Becker 1964);
- asymmetric information (search theory): the overeducated may be characterised by a lack of appropriate job networks, poor search skills, lack of support during job search, all of which could conceal the true abilities of individuals, distort employers' perception of the skills of their new recruits and delay revelation of the true 'match quality' of the employment relationship (Jovanovic, 1979);
- job productivity constraints (job competition/assignment theory): the overeducated may experience inability to earn their full marginal product due to binding job characteristics/low skill needs that also determine the equilibrium allocation of skills to jobs (Sattinger 1993; Thurow, 1975);
- individual preferences: overeducation status may reflect conscious individual choices. Individuals may accept lower-skill jobs either because of compensating job attributes (McGuinness and Sloane, 2011) or driven by career motives (Sicherman, 1991).

Source: Cedefop (2010); McGuinness and Pouliakas (2017).

The richness of Cedefop’s ESJS data allows us to put the theories to the test. It is possible to decompose the difference in wages between overqualified and matched workers and understand the underlying reasons for the lower pay of the former (Figure 34).

Focusing on higher education graduates, who are affected the most by overqualification, it is clear that the overqualified and matched groups diverge in terms of their human capital characteristics and this accounts for a significant part (14%) of their wage gap.

The overqualified receive lower wages as they are mostly of younger age and have spent fewer years with their employer improving their skills. They also lack opportunity for continued skill accumulation as they receive less job-related training. They are more likely to have been unemployed prior to accepting their current job. Studying for a degree in engineering or education science leads to higher wages than studying humanities, yet the overqualified are more likely to have graduated from the latter.

The overqualified are also typically employed in small-sized workplaces and in the private sector. Basic literacy and ICT skills suffice for their jobs and they are less in need of other higher-level generic skills. Together the characteristics and the skill intensity of graduates’ jobs account for a significant share (9%) of the pay gap between matched and overqualified employees.

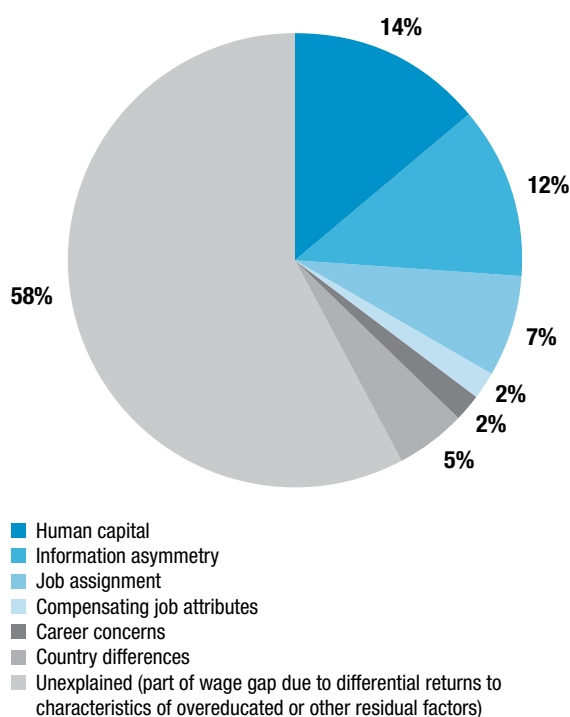
The data fail to support the so-called career concerns theory. People who stated in the ESJS that they chose their job for reasons of career progression are found to be less likely to be overeducated. Keeping other factors constant, the overeducated are also less likely to have been promoted in their jobs since the time they commenced employment. Such findings cast doubt on the argument that overeducation reflects people’s willingness to enter into a lower entry level post in anticipation of stepping up the career ladder.

The labour market intelligence tertiary graduates have at the time they select their jobs can weigh heavily on their chances of receiving less pay. When selecting a job, the overqualified are less likely to have been motivated by information about its suitability for their qualifications

and skills or by knowledge of the job’s prospects (such as salary, fringe benefits). Instead, the main drivers for choosing their jobs are proximity to their home or the promise of job security, both of which are factors associated with lower average pay.

The circumstances affecting tertiary graduates at the time of their job hunting also affect their chances of accepting a mismatched job, though to a lesser degree. Prior to accepting

Figure 34. **Decomposition of raw wage gap between overqualified and matched tertiary education graduates, 2014, EU-28**



NB: Based on use of the Oaxaca wage decomposition technique. The set of variables used to proxy the theoretical blocks displayed in the graph include: Human capital = field of study, age groups, seniority, training, time out of work; Job assignment = importance of basic, digital, soft skills for job; Information asymmetry = motive for selecting job was the match with qualifications/skills or the pay and benefits; Compensating job attributes = type of contract, workplace size, motive for selecting job was work-life balance/job security/home proximity/employer reputation/ intrinsic satisfaction; Career concerns = motive for selecting job was desire to acquire work experience or good career prospects; individual has been promoted since start of job.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>; McGuinness and Pouliakas (2017).

their current job, the overqualified faced greater personal and labour market constraints and were more likely to have moved to a completely different occupation than the one they previously had, presumably due to greater need to find an alternative job quickly than to remain without one.

Even with this rich set of factors taken into consideration by the ESJS, a large part (57%) of the wage discrepancy between overqualified and matched workers cannot be explained. Other individual or job characteristics, not considered in the analysis as they were not measured in the survey or are unobserved, are important. It is also the case that the overqualified receive smaller rewards in the labour market, even if they possess the same characteristics as workers in matched jobs, which may be a potential sign of discrimination against them.

7.4. Overqualified yet underskilled?

Not all workers who accept a job that does not match their qualification are unfit for their jobs nor do they lack the need for continuing skill development. As the ESJS data show, four of 10 overqualified workers still admit to having considerable scope to improve their skills to become fully proficient in their jobs. Enterprises that hire overqualified workers are also expected to enjoy positive productivity gains from the extra creativity and innovation that the overqualified may bring to their jobs, relative to their lesser educated colleagues (Kampelman and Rycx, 2012).

Nevertheless, most of the overqualified remain in dead-end jobs, with limited opportunities to continue to improve their skills or to progress in their careers. While 31% of those in jobs matched to their qualifications had been promoted since the time they started, this was true of only 22% of the overqualified, according to the survey data.

From this analysis it is clear that only multifaceted policy solutions can mitigate overqualification. Some overqualified workers will eventually progress with age towards more suitable workplaces but, to avoid the continued underuse of their skills from becoming ingrained, employ-

ers and policy-makers should seek to improve workplace innovation and job quality. Innovative stimuli for learning are required, since standard training instruments may be less effective for such workers, who already possess a high level of technical expertise relative to colleagues. Incentives for labour market mobility have to lead to jobs with upward potential and assist individuals who may be forced to move occupation or location, with targeted VET, housing and social policies. What the ESJS makes clear is that there is significant value in the continued dissemination of labour market intelligence to students and their parents, better informing education and training, as well as career, choices.

Understanding skill mismatch transitions

Although proponents of the career mobility theory advocate that skill mismatch is a temporary state – a stepping stone until individuals find better matched employment – Cedefop's European skills and jobs survey (ESJS) highlights that taking a mismatched job can become a long-term state. Little evidence is found that workers affected by genuine skill underutilisation move to jobs that are a better match for their skills; they remain trapped in a perpetual overskilling state, with little improvement in wages over time relative to comparable matched employees. Changing skill mismatch status is more likely when people engage in inter- rather than intra-job mobility, although within-job changes in skill mismatch are feasible with additional years of seniority.

8.1. Labour market mobility policies and skills matching

As matching the skills of individuals to dynamically changing jobs is becoming a key area of policy concern following the global financial crisis, mobility policy programmes, such as *Your first EURES job*, have assumed greater significance. Other EU-wide tools aimed at supporting the transparency of workers' qualifications and skills, such as the European qualifications framework and systems of validation of non-formal and informal skills, have also been designed in the belief that they may foster labour market mobility and better skills matching in the single market.

A recent comparative analysis using the OECD survey of adult skills has highlighted that skill mismatch has negative consequences for labour productivity in advanced economies (McGowan and Andrews, 2017). An important underlying reason for this is that skill mismatch is associated with lower labour market reallocation; for instance, less productive ('zombie') firms typically hoard an overskilled workforce, preventing reserves of skills from being deployed and put into better use in other more productive enterprises. Policies that seek to support labour market mobility across firms (such as making employment protection legislation less stringent, relaxing business closure regulations, subsidis-

ing child care and housing) could aid better skills matching and raise labour productivity among countries with high overskilling rates.

Though it is widely acknowledged that skill mismatch that persists over time imposes real costs on individuals, enterprises and societies, most of the available evidence has been limited to insights based on cross-sectional data, with few exceptions that have focused on the 'time' element in more depth (Lindley and McIntosh, 2009; Mavromaras et al., 2012; Baert et al., 2013; Kiersztyn, 2013; Meroni and Vera-Toscano, 2017). This has prevented meaningful conclusions being drawn about skill mismatch processes, its dynamics and the causal nature of its relationship with important economic variables (such as productivity, job satisfaction, job mobility).

Much of the literature on the mobility aspects of skill mismatch has focused exclusively on the transition patterns of overeducated graduates (Verhaest and van der Velden, 2013). However, it has consequently ignored the potentially significant transition patterns that also take place among workers who are in (what appears to be at the outset) a matched job, yet who subsequently move into mismatched jobs for various reasons not well-understood. This distinction is particularly important in light of evidence pointing out that qualification mismatch and skill mismatch are two distinct phenomena, with different implications for labour market outcomes

(Mavromaras et al., 2013a; Quintini, 2011; Pouliakas, 2012).

Analysis based on longitudinal data of the match between individuals' skills and jobs are needed to make definitive statements about skill mismatch transitions. Such data enable a clearer assessment of the extent to which employees get stuck in mismatched employment, or if the negative repercussions of mismatch are reversible as employees accumulate more years of job tenure (McGuinness and Sloane, 2011; Mavromaras et al., 2013b).

This chapter examines the determinants and consequences of skill mismatch transitions in EU countries, based on the novel data made available by the Cedefop ESJS. Although this new European source is not a panel data set, it adopted a longitudinal perspective to understand better changes and transitions in the skill mismatch status of adult employees, by asking questions on the match of their skills to the skill demands of their job at three distinct points: in the previous job, at the start of their current job and at their current job post.

Important contextual information regarding the individuals' circumstances and job search motives prior to job entry, their degree of occupational and geographic mobility, and the extent of labour market thickness and job search strategies, permit identification of the factors underpinning the changing skill mismatch status of workers during their transition between jobs (inter-job mobility). Similarly, the survey collected important information about the career progression of employees (intra-job mobility), the degree and means of on-the-job skill development (including receipt of non-formal and informal training) and the nature of changing job tasks during their tenure. Investigation of such between- and within-job determinants of skill mismatch transitions can reveal important insights into theories underlying worker mobility decisions and their relationship with skill mismatch behaviour and changes over time.

8.2. Labour market mobility and skill mismatch

Earlier studies espoused a negative relationship between the incidence of overeducation and age or labour market experience. Sicherman (1991) demonstrated that there is a positive relationship between overeducation and job mobility in the US. This supported the claim that skill mismatch temporarily affects individuals as they may accept jobs for which they are overeducated at the beginning of their career, yet accumulate sufficient experience to obtain a job commensurate with their skills over time.

Other authors have noted, however, the persistence of skill mismatch, particularly skill underutilisation. Lagged mismatch status in previous years is invariably and strongly related to the probability of present mismatch. Using Australian panel data, it has been estimated that employees who were skill mismatched (overqualified) in the previous three years are 40 (70) times more likely to be mismatched in their current job than graduates who had been well-matched in all three previous years (Mavromaras et al., 2012). Even though this high degree of state dependence partly reflects differential aptitudes and abilities of mismatched workers, those who are genuinely affected by skill mismatch (such as those who are both overeducated and over-skilled) are still found to have very high chances (24% to 36%) of remaining in the same state as in previous years.

Sloane and colleagues (1999) also reported that even though overeducated workers have shorter job tenure than the comparably educated well-matched group, the former are more likely subsequently to experience involuntary job separations and exit into unemployment. Battu and colleagues (2000) showed that the state of overeducation can have long-lasting consequences, since there is limited evidence of convergence over time in their earnings gap, job satisfaction or other job characteristics (such as promotion prospects) relative to those in matched employment. Büchel and Mertens (2004) also find that overeducated workers in Germany experience slower wage growth relative to well-matched workers and have less access to on-the-job

training. In a study of Northern Ireland university graduates, McGuinness (2003) further demonstrated that while overeducated workers do have higher rates of job mobility, as predicted by career mobility theory, they are more likely to move to another state of mismatch than to fully matched employment.

Using a timing of events approach, Baert and colleagues (2013) have recently traced the progression of young Flemish unemployed graduates who began searching for a job immediately after leaving formal education but accepted one below their education level. They examined whether the acceptance of a mismatched job (as opposed to having no job) could accelerate or delay the transition into a matched job. The authors find that overeducation is a trap and not a stepping stone when concerning the school to work transition of Belgian youth. By accepting a job for which one is overeducated rather than only accepting adequate job matches, monthly transition rates into adequate employment fell by 51% to 98%, depending on the elapsed unemployment duration. Any short-term benefits of policies that generate quick transitions into employment must be traded against the long-term costs of an inadequate job match.

8.3. Country differences in skill mismatch transitions

Marked variation in the extent to which skill mismatch is transitory or persistent is generally also found between countries, with their different levels of labour market flexibility and types of welfare regimes. Studies from Belgium, Germany, Poland and the UK have indicated significant persistence effects, in contrast to the relatively faster transition trends observed in the earlier literature for the more flexible job markets of the US and Netherlands (Sicherman, 1991; Robst, 1995; Groot and Maassen van den Brink, 2000; Rubb, 2003; Groeneveld and Hartog, 2004; Kierzstyn, 2013).

In a more recent analysis of career dynamics in the US job market, Clark and colleagues (2014) demonstrate that overeducation is fairly persistent at both the aggregate and individual

level, with 66% of US workers remaining overeducated after one year. They also show that overeducation affects particular subgroups of the population (such as blacks, lower ability individuals), lowering both their current and future wage.

Verhaest and van der Velden (2013) have used a comparable data set of a cohort of graduates in 15 European countries and Japan to investigate the extent of persistence of overeducation during entry and after five years of job market tenure. The authors link such cross-country differences in skill mismatch to various structural and cyclical factors. They find that cross-country variance in overeducation can be linked to the nature of imbalance between fields of study demand and supply in the labour market, the business cycle and the relative supply of human capital. No evidence of significant association between overeducation and employment protection legislation is found, in contrast to other studies that rely on samples of the wider workforce (Brunello et al., 2007; McGowan and Andrews, 2017).

8.4. Labour market mobility and skill mismatch dynamics

Despite widespread acknowledgment in the literature of the severity of skill mismatch, there is disagreement over the extent to which it is a temporary or long-term phenomenon, although recent studies are increasingly converging towards the latter. Understanding the nature of skill mismatch dynamics and whether or how changes in people's skill mismatch status may unfold in response to job/career mobility is still a challenge in literature.

Predictions using the career mobility hypothesis anticipate a change in individuals' skill mismatch status in response to a job transition. This should be linked to whether a change in a worker's role since the start of employment (perhaps being promoted) is positively associated with improvement in skills matching, or if an individual's primary motives for selecting the mismatched job in the first place were the acquisition of work experience and/or promising career opportunities. It would also be expected that the

most typical transition patterns of overeducated graduates would be movements towards better matching of their skills to job requirements.

Human capital theory (Becker, 1964) argues that workers' wages always mirror their marginal productivity. Therefore, any wage deficit between overeducated and well-matched workers should be a reflection of the lower abilities of the former, or their unobserved stock of non-formal and informal skills. Any mismatches and wage penalties that may arise at the start of an employment relationship, such as those that may be attributed to imperfect information about the 'match quality' at the time of recruitment (Jovanovic, 1979), will be temporary and quickly addressed, as firms swiftly adapt their production processes to be in alignment with the workforce's revealed skills. Under this framework, the overeducation wage penalty and any initial skill mismatches should diminish with extra years of job tenure, as worker's skills become fully revealed to employers over time.

Both assignment theory (Sattinger, 1993) and the job competition hypothesis (Thurow, 1975) stress the importance of the available distribution of jobs in determining earnings. Under the job competition model, workers compete for a given distribution of jobs by investing in more education; however, the productivity resides entirely in the job and nothing the employee can do while in the job can change this. This suggests that skill mismatch will change only slowly with additional years of tenure, since the required skill intensity of jobs is relatively fixed, while it may be more responsive to between-job movements. A high correlation between the persistence of skill mismatch and the level of skill demand in jobs would also be expected.

A similar trend may be expected under assignment theory, which represents a middle ground between human capital theory and the job competition model; wages will be determined by a combination of worker and job characteristics. If assignment theory is true, skill mismatch should decline as a consequence of both intra

and inter-job transitions, although the speed of change should be more sluggish relative to what would be anticipated under purely supply-driven theories (human capital, career mobility).

The theory of compensating differentials (Rosen, 1986) suggests that workers will require additional compensating wages to accept a job with undesirable attributes or, conversely, will be willing to forgo earnings to take a job with other intrinsic benefits. This relationship has been explored in the context of mismatch by McGuinness and Sloane (2011), who found that overeducation may, in part, simply represent a compensating wage differential for positive job attributes.

This theoretical framework opens the possibility that workers may consciously transition from a matched to a mismatched job, thereby foregoing earnings, in order to benefit from other compensating job attributes, such as intrinsic satisfaction, improved work life balance, etc. The data would be expected to show that the between-job changes in skill mismatch status of individuals are positively correlated with their choice of jobs for reasons of work-life balance, intrinsic nature of work, proximity to home, and job security.

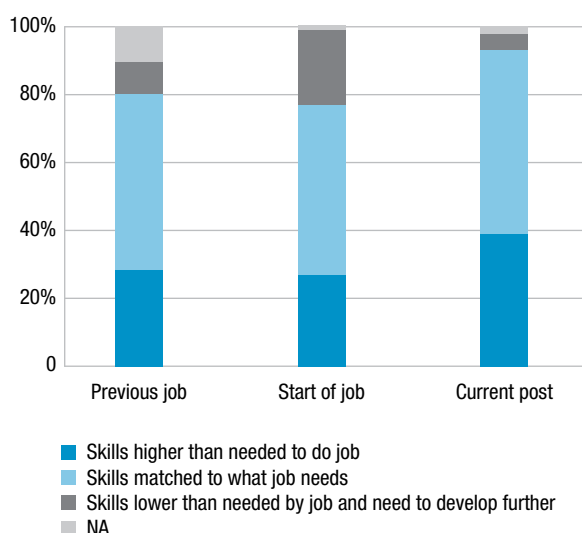
8.5. Skill mismatch dynamics in the EU

The ESJS data provide fertile ground to test these hypotheses. A key contribution of the new survey is that it takes a longitudinal perspective, with some of these questions asked several times, referring to distinct time periods and enabling dynamic analysis of skill mismatch among EU employees ⁽³⁰⁾. The data highlight that there is a considerable degree of churn in the types of skill mismatch affecting individuals at different points in time (Figure 35).

Table 8, which plots the changes in adult EU employee skill mismatch between previous job, start of current job and at the time of the survey,

⁽³⁰⁾ Respondents were asked in the survey to describe their skills in relation to what is required to do their job (i) at the current time period (ii) when they started their job with their current employer and (iii) when working in their previous job. They were asked to do so by choosing among three potential options 'My skills are higher than required by my job', 'My skills are matched to what is required by my job' and 'Some of my skills are lower than required by my job and need to be developed further'.

Figure 35. **Skill mismatch status in previous job, at start of current job and at time of survey, adult employees, 2014, EU-28**



Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

shows that a sizeable share of workers alter their skill mismatch status both between and within jobs. Almost four in 10 workers with matched skills in their previous job moved to another job, even if their skills were not matched to their new job duties: 20% of the previously matched and 17% of formerly overskilled workers accepted a new job in which their skills were lower than needed, while about half (47%) of those in underskilled posts remained in the same state. Such turnover ultimately manifested in skill gaps that affected about one in five (22%) EU workers when they transitioned to a new job.

Similar patterns are evident when workers transit within employment, although a key revelation of the data is that there is a stronger degree of persistence within jobs rather than when workers decide to change their jobs entirely. This is particularly marked for overskilled workers. About eight in 10 employees who entered into a job demanding fewer skills than their own remained in such a state. The same is true for 70% of employees who started their current job

Table 8. **Inter- and intra-job skill mismatch transitions, 2014, EU-28**

		Start of current job		
Previous job		Overskilled	Matched	Underskilled
Overskilled		46.4%	36.4%	17.2%
Matched		19.6%	61.8%	18.6%
Underskilled		15.9%	37.3%	46.8%

		Current post		
Start of current job		Overskilled	Matched	Underskilled
Overskilled		80.6%	17.6%	1.8%
Matched		26.3%	70.3%	3.4%
Underskilled		21.1%	64.8%	14.2%

		Current post		
Previous job		Overskilled	Matched	Underskilled
Overskilled		59.10%	36.60%	4.30%
Matched		31.72%	63.66%	4.62%
Underskilled		30.90%	56.92%	12.18%

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Table 9. **Distribution of adult workforce by skill mismatch transition status between and within jobs, adult employees, 2014, EU-28**

Skill mismatch transition	Transition from previous job to start of new job	Transition from start of new job to present
Matched-matched	32%	35%
Matched-overskilled	10%	13%
Matched-underskilled	10%	2%
Overskilled-overskilled	13%	21%
Overskilled-underskilled	5%	0.5%
Overskilled-matched	10%	5%
Underskilled-underskilled	5%	3%
Underskilled-matched	4%	14%
Underskilled-overskilled	2%	5%
Missing values	10%	2%

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

with matched skills. Nevertheless, even within jobs there is non-trivial movement, with about one quarter (26%) of workers who started their job with matched skills claiming to have become overskilled over time, while 18% of adult employees experienced the opposite trend.

The ESJS data generally indicate that the most substantial inter-job skill mismatch transitions in the EU labour market are those whereby formerly matched workers move to a mismatched job (from matched to underskilled or overskilled) or when formerly overskilled workers commence new employment with matched skills (overskilled-matched). Other important intra-job changes in skill mismatch status take place when underskilled workers align their skills to the level needed by their jobs (underskilled-matched), or when matched workers see many of the skills become underused with additional years of tenure (matched-overskilled). Nevertheless, it is clear from the data that the greatest share of the EU adult workforce typically remains in the same mismatch state over time, especially when individuals' skills are either matched or exceed those needed at work (Table 9).

8.6. Determinants of skill mismatch transitions

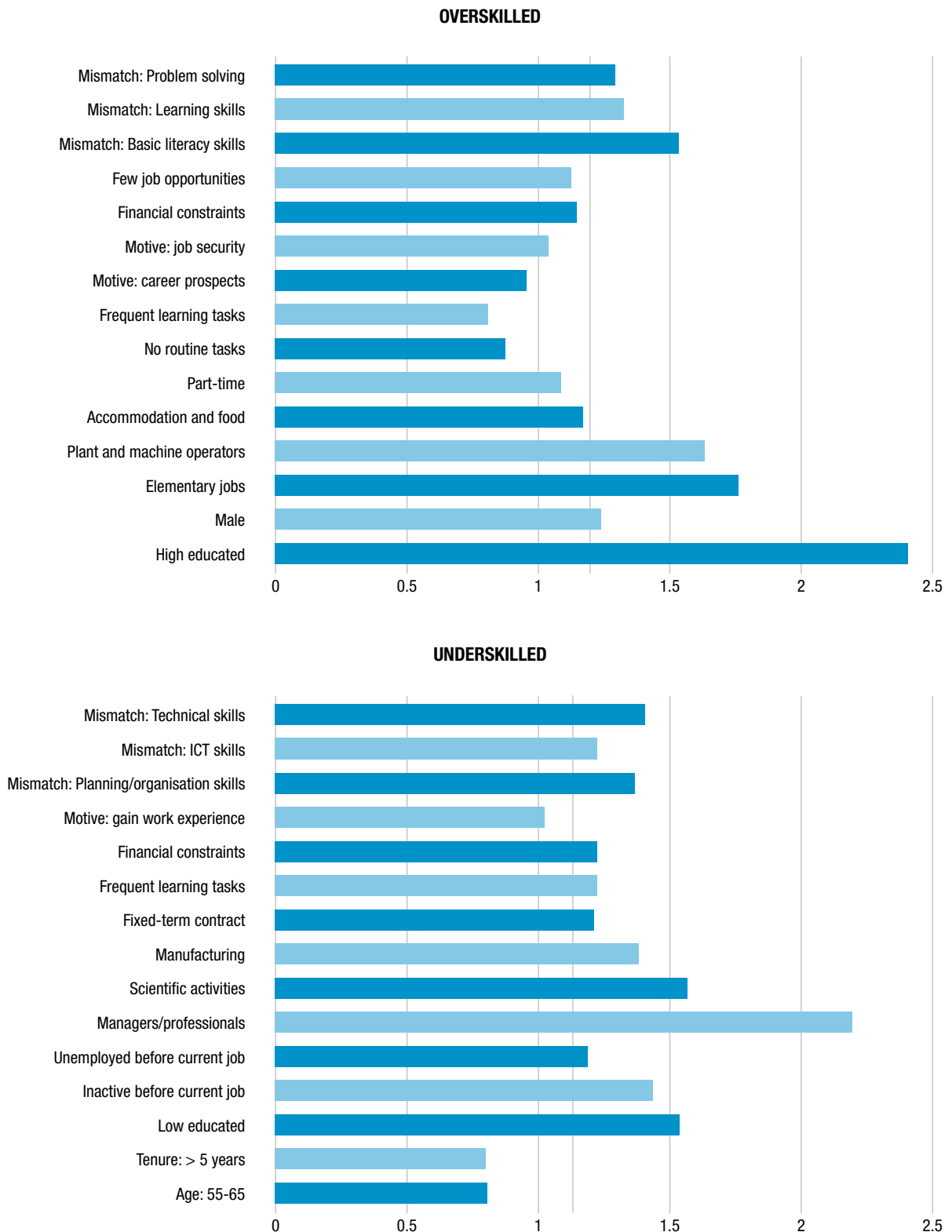
8.6.1. Factors related to skill mismatch

The ESJS analysis reveals some interesting patterns in terms of the relationship between individual and job characteristics and different types of skill mismatch affecting adult workers, as well as their skill mismatch transitions ⁽³¹⁾.

Figure 36 displays some of the most significant explanatory variables in the data correlated with the probability that adult EU workers are either overskilled or underskilled for their jobs. All other things equal, the overskilled are mostly higher-educated male workers, typically employed in middle- or lower-skilled occupations (plant and machine operators, elementary jobs) and certain sectors (hospitality, arts and entertainment). The skill needs of their jobs tend to be lower than comparable employees in matched jobs. For example, overskilled employees have higher chances of being employed in part-time jobs and those that entail execution of routine tasks or are characterised by a lack of learning

⁽³¹⁾ The results of all multivariate regression analyses, estimating the probability of (a dynamic change in) skill mismatch status on a set of relevant explanatory variables, are available from the author upon request.

Figure 36. **Determinants of skill mismatch, 2014, EU-28**



NB: Estimated odds ratios based on logistic regression.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

opportunities (including on-the-job training). Nevertheless, even though for some the probability of being overskilled at work arose as a result of financial constraints or due to vacancy shortages in the job market, for others mismatch is partially driven by their motives underlying job choice. Workers whose primary reasons for selecting their job was the desire to strike a better work-life balance and job security are found to have higher skills than needed by their jobs.

The ESJS data further enable disaggregation of the specific type of skills that may explain why workers consider themselves to be overskilled as a whole. The chances of being overskilled are highly related to underutilisation of people's basic literacy skills, a marker of a relatively very low skill level demanded in their jobs. Overskilled employees are also more likely to experience significant mismatches in their problem-solving and learning skills, another consequence of the inadequate demand for cognitive skills in their jobs.

The typical profile of underskilled workers is different. This group mostly comprises younger, inexperienced adults. Those with lower skills than required by their jobs tend to have a lower education level and are more likely to have experienced an intermittent period outside the labour market (unemployed or inactive) before finding their current employment, possibly contributing to skills atrophy (Cedefop, 2017b). The extent to which workers' skills fall behind their job's skill requirements diminishes as they accumulate additional years of experience, which implies that seniority is a prerequisite for enabling workers build up their stock of skills. This may explain why the odds of being underskilled are higher for workers on fixed-term contracts, relative to those on indefinite contracts.

The data further reveal that what lies behind the insufficiency in the total stock of employees' skills are skill gaps that are more job-specific in nature (such as lack of digital skills and other specialised knowledge of particular products/services or inability to operate specialised equipment). Nevertheless, it is not only the low-skilled who are affected by skill gaps. Regardless of their level of education, the incidence of underskilling is higher for individuals employed in more skill-intensive industries (managers and

professionals, technical and scientific activities) and jobs involving frequent learning. Skill gaps are in this case a reflection of worker's learning capacity; a measure of their ability to engage in continued skill development in intellectually challenging jobs (van der Velden and Verhaest, 2017; Pouliakas, 2016).

8.6.2. Determinants of skill mismatch transitions

In addition to the determinants of workers' current skill mismatch status, disentangling the effect of explanatory variables on the probability of skill mismatch transitions provides further insight into the validity of different theories of skill mismatch and the dynamic nature of the relationships.

Males are found to have a greater tendency to remain in the same skill mismatch status than females, who typically move to new jobs with lower skills than required. Older and higher-educated workers have a greater tendency to move towards or remain in overskilled jobs. Job-seekers who find a new job after having spent their time in education or outside the labour market (unemployed or inactive) are inclined to enter into it as underskilled and remain so. Changing skill mismatch status is also more likely for employees who moved to a completely different occupation when changing jobs.

The findings provide some support to the theory of career mobility, since it is found that individuals who were promoted in their job are less likely to have remained stuck in overskilling: they gravitate towards job posts in which their skills are either matched to or deficient relative to their skills needs. However, there is little evidence to suggest that people who selected their job for career reasons experienced a change in their skill mismatch status. Although, as would be expected from the career mobility hypothesis, some overeducated employees declared that their initial surplus skills converged to a matched equilibrium, the odds are higher that overeducated workers either remain or become overskilled with the passage of time (Table 10).

Overeducated workers who remain genuinely mismatched over time (overskilled-overskilled) have the highest wage penalty among all pos-

Table 10. Relationship of overeducation risk and overeducation wage penalty with skill mismatch transitions, adult employees, 2014, EU-28

Skill mismatch transition (from start of job to current post)	(1) Risk of overeducation	(2) Interaction with overeducation wage penalty
Matched-matched	[ref]	[ref]
Matched-overskilled	1.65*** (0.856)	0.004 (0.027)
Matched-underskilled	0.95 (0.128)	-0.06 (0.084)
Overskilled-overskilled	2.25*** (0.103)	-0.08*** (0.023)
Overskilled-underskilled	1.45 (0.348)	0.13 (0.092)
Overskilled-matched	1.47*** (0.121)	-0.08** (0.039)
Underskilled-underskilled	1.00 (0.096)	-0.003 (0.057)
Underskilled-matched	0.87** (0.495)	-0.02 (0.026)
Underskilled-overskilled	1.73*** (0.132)	-0.06* (0.036)
Overeducation dummy	[.]	-0.16*** (0.017)

NB: Column 1 depicts estimated odds ratios based on logistic regression, which includes a set of additional control variables as shown in Table 7.

Column 2 shows estimated regression coefficients based on OLS estimation of a Mincer earnings function that accounts for gender, a quadratic age term, highest education attainment level and receipt of training in past year.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

sible transition states. No evidence is found in the ESJS data to suggest that workers who move away from genuine overeducation (such as those who began their jobs overskilled, but moved over time to being matched/underskilled) experience a significant reduction in their wage gap. Instead, the continued overeducation wage penalty borne by those who have matched their skills over time, despite being genuinely overeducated at the start, signifies that early qualification mismatch can have prolonged adverse consequences for individuals' pay.

The evidence further highlights the strong responsiveness between intra-job skill mismatch transitions and the duration of the job. Additional years of work experience tend to be associated with several changes in individuals' skill mismatch status relative to the time they started their employment. Given the strong relationship between job tenure and the extent to which workers improve their skills on-the-job (typically via both non-formal and informal learning methods, see Ferreira et al., 2017), this finding hints that human capital theory

is largely consistent with observed patterns of skill mismatch transitions in the data set.

By contrast, the relatively weak sensitivity between changing skill mismatch status and the level of skill intensity of the job raises some doubt about the weight of job competition theory. However, skill-intensive jobs (such as those that involve an increasing need for learning) tend to shield workers against a continued risk of overskilling, raising the chances of workers departing from this state in a previous job to commence new work with matched skills. Remaining overskilled even after switching jobs is also more likely when individuals are constrained by job availability in the labour market, the latter offering a proxy for individuals' need to enter into a 'job queue'. From this it is not possible to completely dismiss the relevance of skill demand for determining changes in individuals' skill mismatch status, which is in alignment with assignment theory.

There is some evidence that compensating job attributes come into play when individuals

remain for a long time in a job that underutilises their skills. Employees who selected their jobs because of suitability with their qualifications and skills are generally more likely to make the transition to a well-matched job. Individuals who gave priority to jobs that offer job security or work-life balance or because of proximity to

one's home are more likely to have become or stay overskilled. By contrast, choosing the job due to a desire to accumulate work experience, good career prospects or because of the intrinsic nature of job tasks maximises the chances of underskilling when beginning a new job.

Skill utilisation is skill formation

Cedefop's European skill and jobs survey (ESJS) shows that about 39% of EU employees have skills that are not being fully used in their jobs and so do not have potential to develop their skills further. The jobs of overskilled workers typically entail a low level of task complexity and are lacking adequate learning opportunities. Increasing skills utilisation and formation is linked to creation of value added and competitiveness and should be at the core of EU policies aimed at promoting economic growth through investment in skills.

9.1. Designing jobs to utilise skills better

Skills formation is one of the main pillars of the EU 2020 strategy for economic growth. However, skills are not a source of growth *per se*; abundant and better skills can help the EU recovery and sustain growth only if they are put to work. Skills are embodied in people. They translate into productivity and innovation when they are deployed by workers in the execution of job tasks. It follows that reaping the benefits of investment in skills undertaken by states, businesses and individuals is intrinsically dependent on people being able to make good use of their skills in jobs; when this happens, skills can become a root of economic growth.

Though skills are a necessary condition for growth, they are not sufficient. A necessary next step, following investment in initial education and training, is to create and design jobs in the labour market that can make the most of workers' skills.

Organisations have an important role to play when it comes to skills utilisation, because they command the way in which tasks are grouped together into jobs and define the autonomy or discretion workers have in their execution (Lazear and Gibbs, 2009). Tasks entail different degrees of difficulty and complementarity in production and hence put varying degrees of strain on workers' skills.

Complex jobs (jobs consisting of complex tasks) put high demand on workers' skills for a variety of reasons: the number of decisions to be made (problem-solving); uncertainty surrounding the expected outcomes from choices; the number of alternative courses of action; large amount of information needed to be processed to reach satisfactory outcomes in complex situations; need to use and integrate information from many different sources.

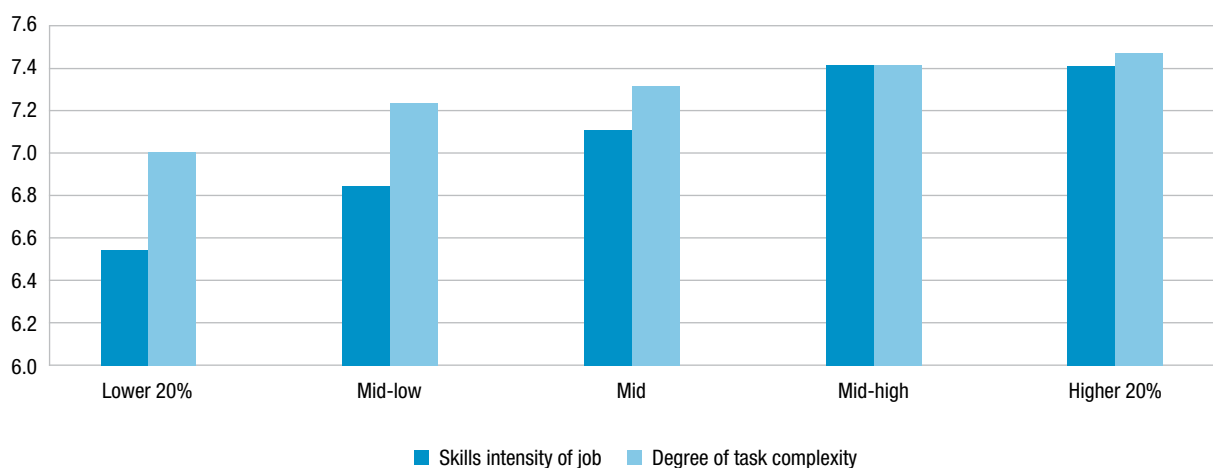
Pouliakas and Russo (2015) show that jobs with more complex tasks, involving abstract reasoning (being confronted with complex problems) and greater job latitude (being able to choose and plan one's sequence and content of tasks), are positively associated with higher skill requirements. The ESJS data confirm that even within a same job cluster⁽³²⁾, workers employed in jobs with more complex tasks generally also need a higher skill set to carry out their work. Such jobs, which are characterised by greater reliance on learning-intensive, non-routine and autonomous tasks, tend to occupy the greatest share of higher-paid ('good-quality') employment in the EU (Figure 37).

9.2. Skills develop ... and jobs change

The above highlights that the manner in which employers design the content of jobs in their or-

⁽³²⁾ Following Eurofound's (2016) job-based approach, a job cluster is defined by the sector-occupation combination in the data (such as managers in the hospitality sector; engineers in the ICT sector). The mean wage of the job clusters is subsequently calculated and ranked according to their place in the wage distribution (broken down in quintiles).

Figure 37. **Mean degree of task complexity and skill intensity of jobs by position in wage quintile, 2014, EU-28**



NB: All possible job clusters (two-digit sector-occupation combinations) in the ESJS sample were derived and the mean gross monthly wage per cluster calculated. The implied mean wage distribution of EU jobs was subsequently split into quintiles and the average degree of task complexity and skill intensity of each job cluster is depicted by quintile. Degree of task complexity since a worker started their job was measured on a 0-10 scale (0 = decreased a lot; 10: increased a lot). The index of skill intensity was measured on a 0-10 scale as the average of the degree of importance of several skills (basic, technical and generic) in people's jobs (0: not important at all; 10: extremely important).

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

organisations will also have implications for workers' continued capacity to develop their skills in the workplace.

There is a significant variance in the manner in which firms manage the production process and their talent within establishments. Bloom and colleagues (2017), for instance, find an enormous dispersion of management practices across US manufacturing plants, with 40% of this variance found across plants within the same firm. This management variation accounts for about a fifth of the spread in productivity.

This disparity in talent and overall human resource management practices may cause similarly educated/skilled workers to experience varying degrees of skill utilisation at work. Workers with skills close to those needed to perform in their job will generally put their stock of skills to good use. But if workers have more skills than required, their skills are under-utilised. Of course, workers' skills can also be below the level demanded by their job.

These situations are not fixed in time, as shown in Chapter 8. Transitions between different skill mismatch states are ultimately a result of the relative speed at which skill requirements shift in

jobs and the speed at which workers' skills develop – through learning and training – or depreciate through the process of skills obsolescence.

Take as an example one of the most prominent intra-job movements of skill mismatch status, as shown in Table 9: an individual joining an organisation with lower skills than needed (underskilled), subsequently moving to a matched post. To account for such movement, skills formation must have outstripped the rate of increase in job requirements during their years of tenure. Figure 38 reveals that close to eight in 10 initially underskilled employees in the ESJS sample experienced a significant (above median) improvement in their skills since the start of their job, while six in 10 simultaneously saw changes in the task variety of their jobs. Change is also characteristic of the experience of matched workers. More than half of workers who started in a matched position (70% of which remained matched) saw changes in both their skills and the complexity of their jobs.

9.3. Skills develop ... as jobs change

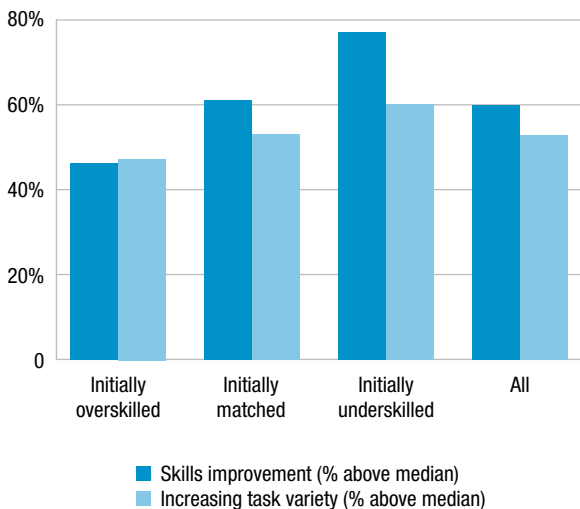
The key lesson to draw from such data is that to progress or remain in a prolonged matched situation requires that workers' skills develop in conjunction with changes in job-skill requirements. Even though complex jobs may put a strain on workers' skills, at the same time they are associated with more learning opportunities. Complex jobs confront incumbent workers with difficult choices and hard-to-solve problems, nudging them out of their professional comfort zone and, by so doing, inducing learning and skills development. As shown in Figure 39, drawing from ESJS data, there is a positive association between the degree of task complexity of workers' jobs (defined as jobs that frequently involve learning, autonomous and non-routine tasks) and the rate

of skills improvement they underwent since the start of their job (Russo, 2017).

The figure also highlights that there is a positive relationship between job stability (measured by years of job tenure) and learning on-the-job. Mirroring a learning curve (Arrow, 1962), the time path of skills formation shows that deep learning takes place in the initial years of tenure but the slope of the curve gradually becomes less steep. This highlights that the provision of incentives for stable employment relationships for all types of workers can be supportive to their continuing learning.

By contrast, instances of skill underutilisation affecting employees are detrimental to skills development. Most overskilled workers fail to experience any change in job tasks and improvement in their skills throughout their job tenure. This reflects fewer learning opportunities

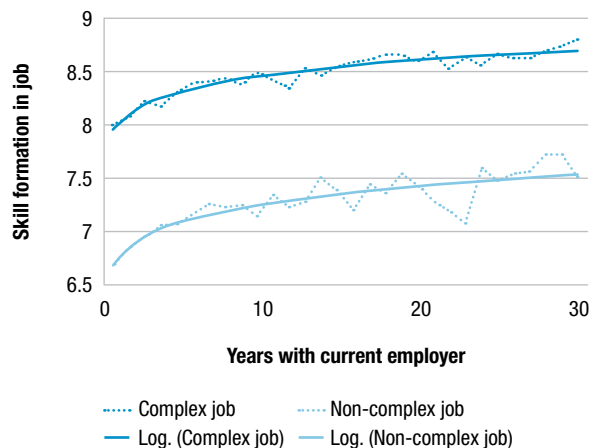
Figure 38. **Skill formation and task complexity by initial skill mismatch status, 2014, EU-28**



NB: Skill improvement was measured on a 0-10 scale (0: worsened a lot; 10: improved a lot) based on the question: 'Compared to when you started your job with your current employer, would you say your skills have now improved, worsened or stayed the same?' Task variety was measured on a 0-10 scale (0: decreased a lot; 10: increased a lot) based on the question: 'Have the variety of tasks increased, decreased or remained the same since you started your job with your current employer?' The figure displays the share of adult employees with responses above the median scale value for each question (i.e. 8).

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Figure 39. **Continued skill development by degree of job complexity, 2014, EU-28**



NB: Skill improvement was measured on a 0-10 scale (0: worsened a lot; 10: improved a lot) based on the question: 'Compared to when you started your job with your current employer, would you say your skills have now improved, worsened or stayed the same?' Complex jobs are defined as those that always or usually involve the execution of autonomous and non-routine tasks and a need for learning new things.

Source: Cedefop European skills and jobs survey (ESJS): <http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

and stagnancy in task variety in their jobs, which dampens the positive reinforcement between job complexity on skill formation. Figure 40 further exhibits this relationship at the country level; a high incidence of skill underutilisation (overskilling) at the start of employment tends to be accompanied by a low degree of subsequent skills development among employees.

9.4. Skills utilisation and skill formation: a win-win

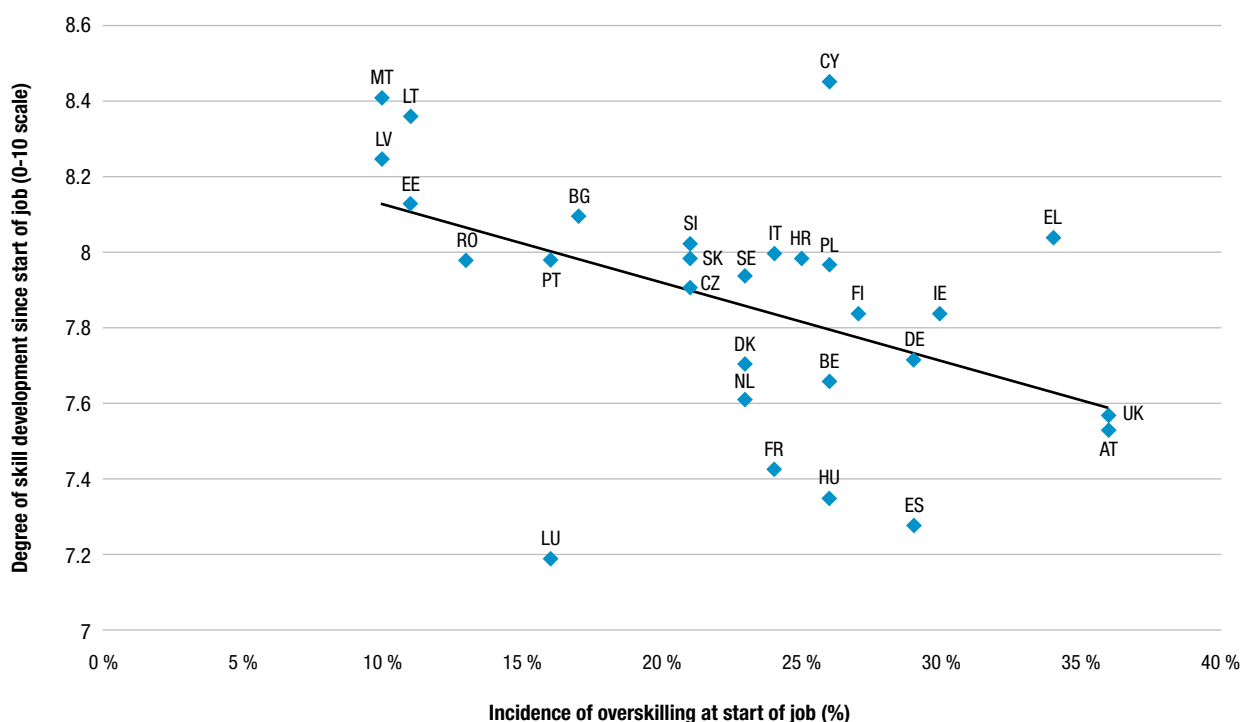
Organisations have a crucial role to play in achieving better skills utilisation and have an interest in maintaining a healthy balance between shifting skill requirements in jobs and workers' skills. Providing training – in cooperation with training providers – and supporting on-the-job

learning are effective means that organisations can use to ensure the desired balance when jobs become increasingly complex.

Changes in the degree of job complexity are intrinsically linked to organisational changes: the introduction of new products, the adoption of new production processes and of new technologies, and other HRM changes.

Not being able to make better use of workers' skills impinges on organisations' ability to compete successfully in product markets and to contribute to their innovation potential (Sung and Ashton, 2015). Therefore, policy programmes that can support organisations in designing jobs that improve skills utilisation should be at the core of EU policies aimed at promoting economic growth and competitiveness. Such programmes are also a recipe for fostering investment in continuing vocational training and adult learning.

Figure 40. Incidence of initial skills utilization and skills development among EU countries



List of abbreviations

ESJS	European skills and jobs survey
LMSI	labour market and skills intelligence
OLS	ordinary least squares
STEM	science, technology, engineering, maths
VET	vocational education and training

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Cedefop European skills and jobs survey

<http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Eurofound 3rd European company survey

<https://www.eurofound.europa.eu/surveys/european-company-surveys/european-company-survey-2013>

European Commission digital scoreboard 2016

<https://ec.europa.eu/digital-single-market/en/digital-scoreboard>

Manpower Group talent shortage survey 2016/17

<http://manpowergroup.com/talent-shortage-2016>

Annex

Annex

Definitions of skill mismatch

Table A1. **Definition of skill mismatch**

Skill shortage	Demand for skill exceeds supply at prevailing rate of pay and working conditions
Skill gaps or underskilling	Individuals lack the skills and abilities necessary to perform the current job (as perceived by employees)/perform the job proficiently (as perceived by employers)
Skill deficit	Individuals lack the skills and abilities necessary to perform the current job relative to a given benchmark
Skill underutilisation (or overskilling)	Individuals are not able to fully utilise their skills and abilities in their current job
Skills obsolescence	Skills previously utilised in a job are no longer required or have diminished in importance (economic)/employee has lost them (physical)
Over(under) qualification	Individuals have a higher (lower) qualification than current job requires; also known as vertical mismatch in contrast to horizontal (field of study) mismatch
Genuine/real mismatch	Individuals are mismatched in both qualifications and skills/mismatched and low job satisfaction

Source: Cedefop (2010).

The Cedefop European skills and jobs survey (ESJS)

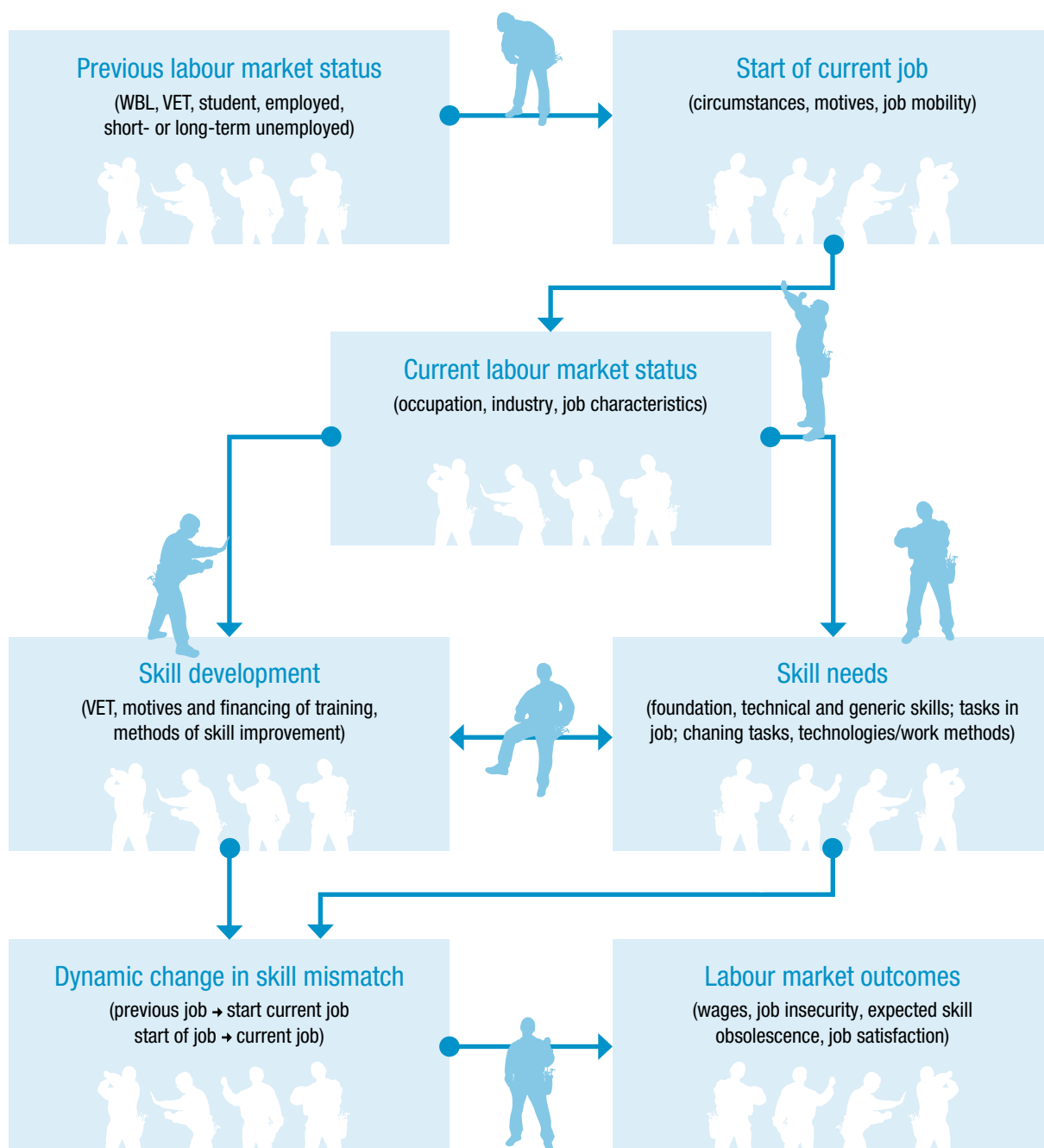
The Cedefop ESJ survey is a state-of-the-art survey of adult employees (aged 24 to 65) carried out in the 28 Member States of the European Union. The survey focused on collecting information on the match of adult workers' skills with the skill needs of their jobs. It was financed and developed by the European Centre for the Development of Vocational Training (Cedefop), in collaboration with a network of experts on skills (Cedefop, 2015a). The aim of the survey is to help inform the development of European policies on initial and continuing education and training and employment policies. To do so, it seeks to understand how individuals' qualifications and skills are matched (or not) to the

changing skill demands and complexities of their jobs. The survey also looks at the extent to which employees' skills are developed and used in their workplaces over time.

A mixed methodology approach ensured that the data collected provided a representative sample of the adult working age population in each of the EU-28 countries. The survey was carried out using quota sampling by the survey company Ipsos MORI and its network partners in each country between 7 March and 26 June 2014. In total, 48 676 respondents from different demographic groups took part either by telephone (9 154 employees) or online interviewing (39 522 employees)⁽³³⁾. In most countries about 1 000 to 1 500 employees were interviewed, although the sample varies between them. The sample was augmented to 4 000 observations in

⁽³³⁾ The questionnaire was translated into the national languages of the EU countries using a strict translation protocol, managed by Ipsos MORI. Prior to administering the survey, extensive cognitive and pilot tests took place to validate the content and validity of the survey instrument.

Figure A1. Structure of Cedefop European skills and jobs survey



the case of five large EU labour markets, such as Germany, Spain, France, Poland and UK, 3 000 cases for Italy, and 2 000 cases in Greece and Finland, while 500 individuals were surveyed solely by telephone in each of the three smallest countries (Cyprus, Luxembourg and Malta) ⁽³⁴⁾.

A schematic description of the structure of the ESJS, including key variables and information collected within each block, is provided in Figure A1. For further details about the ESJS data collection methodology, readers may consult Cedefop (2015a) and Polacheck and colleagues (2017) ⁽³⁵⁾.

⁽³⁴⁾ To control for any erratic variance in the mode of sampling, the empirical analysis in this report has included as an additional explanatory variable a dummy variable that identifies whether a given observation was approached via online or telephone interviewing.

⁽³⁵⁾ All relevant and updated information about the survey is available at the following link:
<http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey>

Measuring skills, skill needs and skill mismatch in the Cedefop ESJS

Table A2. **Measuring educational/skill mismatch**

Over- (under) education	<p>Highest educational qualification</p> <p>Field of study (higher education graduates)</p> <p>If someone was applying for your job today, what qualifications, if any, would they need to get the job?</p> <p>What are the educational qualifications, if any, that someone actually needs to do your job today?</p>
Over- (under) skilling	<p>Overall, how would you best describe your skills in relation to what is required to do your job?</p> <ul style="list-style-type: none"> • my skills are higher than required by my job • my skills are matched to what is required by my job • some of my skills are lower than required by my job and need to be further developed

Table A3. **Measuring skill mismatch dynamics**

Skill mismatch dynamics	<p>When you started your job with your current employer/working in your previous job, overall, how would you best describe your skills in relation to what was required to do your job at that time?</p> <ul style="list-style-type: none"> • my skills are higher than required by my job • my skills are matched to what is required by my job • some of my skills are lower than required by my job and need to be further developed
Skills deficit	<p>Think about the level of skills needed to do your job as well as possible. How would you rate your own skills level? (0-100 scale, 0 need to develop all skills, 100 have all skills)</p>
Skill development /obsolescence (physical)	<p>Compared to when you started your job with your current employer, would you say your skills have now improved, worsened or stayed the same? (0 worsened a lot, 5 remained the same, 10 improved a lot)</p>
Skills obsolescence (economic)	<p>How likely or unlikely do you think it is that several of your skills will become outdated in next 5 years? (0-10 scale, 0 very unlikely, 10 very likely)</p>

Table A4. **Measuring skill needs/specific mismatches**

Skill needs	<p>Which of the following best describes the highest level of 'skill j' needed to do the job?</p> <ul style="list-style-type: none"> • numeracy, literacy (basic, advanced, no ICT skills needed) • ICT (basic, moderate, advanced, no ICT skills needed)
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	<p>How important are “skill j” for doing your job? (scale 0-10, 0 not at all, 10 essential)</p> <ul style="list-style-type: none"> • cognitive (numeracy, literacy, ICT, problem-solving, foreign language, learning) • socioemotional (team working, planning/organising, communication, customer handling) • technical/job-specific
Skill ‘j’ mismatch	<p>How would you best describe your skills ‘j’ in relation to what is required to do your job? (0-10 scale, 0 a lot lower, 5 matched, 10 a lot higher)</p>

Table A5. **Measuring changing skill needs**

Job-task complexity	<p>How often, if at all, does your job involve the following?</p> <ul style="list-style-type: none"> • responding to non-routine situations • learning new things • choosing yourself the way in which you do your work • working as part of a team <p>(Likert scale, 1. Always, 2. Usually, 3. Sometimes, 4. Never)</p> <p>Have the following increased, decreased or remained the same since you started your job with your current employer?</p> <ul style="list-style-type: none"> • the variety of tasks • the difficulty of the tasks • the need to learn new things <p>(scale 0-10, 0 decreased, 5 the same, 10 increased)</p>
Workplace change	<p>In the last five years OR since you started your main job have any of these changes taken place in your workplace? (Yes/No)</p> <ul style="list-style-type: none"> • changes to the technologies you use (e.g. machinery, ICT systems) • changes to your working methods/practices • changes to the products/services you help to produce • changes to the amount of contact you have with clients or customers

Insights into skill shortages and skill mismatch

Learning from Cedefop's
European skills and jobs survey

Skill shortages and skill mismatch are major concerns for policy-makers. With mass job destruction and sectoral restructuring following the recent economic crisis, four in 10 EU employers had difficulty finding people with the right skills, while unemployment rates peaked. Rapid digitalisation and technological skills obsolescence has also raised concerns about the extent to which the EU workforce is adequately prepared for the fourth industrial revolution. Yet, despite worries of increasing skill shortages and gaps, about 39% of adult EU employees are overskilled and trapped in low quality jobs. This publication analyses Cedefop's European skills and jobs survey, a new data set covering about 49 000 EU-28 adult employees. Compiling different data insights, the report highlights that skill mismatch is a complex, multidimensional and dynamic phenomenon. It calls on policy-makers to adopt a different mindset for tackling skill mismatch, focused on sustainable activation, continuous learning, job-task reengineering and promotion of higher-end product market/managerial practices.



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