SKILLS FOR JOBS

OECD

BETTER POLICIES FOR BETTER LIVES

Contents

Foreword

Globalisation, technological progress and demographic changes are having a profound impact on the world of work. These mega-trends are affecting the number and quality of jobs that are available, how they are carried out and the skills that workers will need in the future to succeed in an increasingly competitive landscape. Although the timing and the speed of these developments differ across countries, it is expected that changes in labour market demands will continue or even accelerate in the coming decades affecting advanced and emerging and developing countries alike.

This brochure presents empirical evidence drawn from the OECD Skills for Jobs (S4J) database developed in cooperation and with the financial support of the JPMorgan Chase Foundation. Data confirm that the shift towards a knowledge-based digital economy is already under way and that governments, workers and firms altogether face many challenges ahead. Results show that skill demands have gradually shifted towards a more intensive use of cognitive and interpersonal skills and that high-skilled occupations are in strong demand across most OECD countries.

Against this backdrop, it is crucial not only to adapt education and initial training to changing skill needs, but also to design and implement responsive adult learning programmes that enable individuals to continuously upskill and reskill in order to stay employed and/or find new jobs. The extension of the Skills for Jobs database to 9 additional countries this year allows to cover 40 developed and developing economies and enables a deeper analysis of skill demands at the sectoral and regional level. All this can help design more effective policies by providing robust information on skill demands useful to a wide range of stakeholders, from policy makers to firms and workers looking for information on how labour market demands are evolving.

The data is available on a brand-new webpage aimed at making the consultation of the OECD Skills for Jobs database easy and user-friendly for all audiences: www.oecdskillsforjobsdatabase.org

The OECD and JPMorgan Chase Foundation have joined efforts to support policy makers, firms and individuals to make the most of ongoing changes. Together we can truly contribute to 'getting skills right' and create more responsive training systems and inclusive labour markets for the world of tomorrow.

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Introduction

The demand for skills is changing as a result of several trends such as technological progress, globalisation and demographic changes. Developments such as increased labour market participation of women and greater migration flows have also changed the supply of skills and have been accompanied by significant mismatches that need to be addressed to increase productivity and to ensure that no one is left behind. In light of these changes, it is becoming increasingly important to make sure that the skills of workers are effectively aligned to the needs of the labour market.

Empirical evidence presented in this brochure, shows that the ongoing labour market and economic changes are generating significant imbalances between the demand and supply of skills. While firms struggle to find workers with adequate competencies to operate new tools and work with new technologies, workers have a hard time finding jobs that are a good match for their skills.

The misalignment between the supply and demand for skills can emerge in the form of 'skill shortages' - when adequate skills are hard-to-find in the current labour market- or in the form of 'skill surpluses' - when certain skills are in excess in the labour market relative to the demand. Both situations can lead to a sub-optimal use of individuals' skills in their job as many workers accept jobs in fields that are different from the one they specialised in (i.e field of study mismatch) or jobs below their level of education (i.e. over-qualification).

Overall, skill imbalances (shortages, surpluses and mismatch at work) have several negative effects on the aggregate economy as well as on individual firms and workers as they slow down the adoption of new technologies, delay production, increase labour turnover and reduce productivity and earnings potentials. Skill imbalances can also affect individuals in a very direct way. Over-qualified or over-skilled workers – those individuals employed in jobs for which they have higher qualifications than required – usually face a substantial wage penalty relative to workers with the same qualification level but well-matched to their jobs' requirements. Job satisfaction is also reduced in over-qualified workers who struggle in employment that do not realise their full potential.

Evidence-based policy action is needed to reduce the negative effects of skill imbalances on the aggregate economy, individuals and employers. The OECD Skills for Jobs Database is a new analytical tool designed for policy makers, practitioners and the general public to understand what skills are demanded today and where gaps are emerging in their supply.

The **OECD Skills for Jobs Database** provides country-level (as well as subnational) information on shortages and surpluses of a wide range of dimensions, including cognitive, social and physical skills. Information is disaggregated into more than 150 job-specific Knowledge, Skills and Abilities and is available for 40 countries among OECD and emerging economies. Detailed information on both qualification and field of study mismatch is also presented.

Highlights

The nature and intensity of the skills required by firms can vary substantially across countries depending on each economy's productive structure or technological advancement. On average across the OECD countries analysed by the Skills for Jobs database, more than 5 out of 10 jobs that are hard-to-fill (i.e. in shortage) are found in high-skilled occupations. These jobs range from managerial positions to highly skilled professionals in the health care, teaching or ICT sectors. Fewer than 1 out 10 jobs in shortage across the OECD are found in low-skilled occupations.

On average across the OECD, shortages are the strongest in the knowledge of Computers and Electronics (i.e. the knowledge of computer hardware and software, programming and applications) followed closely by substantial demand for Judgment and Decision Making Skills and Communication and Verbal Abilities that influence the acquisition and application of information in problem solving.

Results by sector show that, on average across OECD and EU countries, occupational shortages are the strongest in the Education and Information sectors. Conversely, occupational surpluses are found in the Wholesale and Retail Trade as well as in the Construction sectors where a large share of employment is in occupations in surplus or that face weak demand.

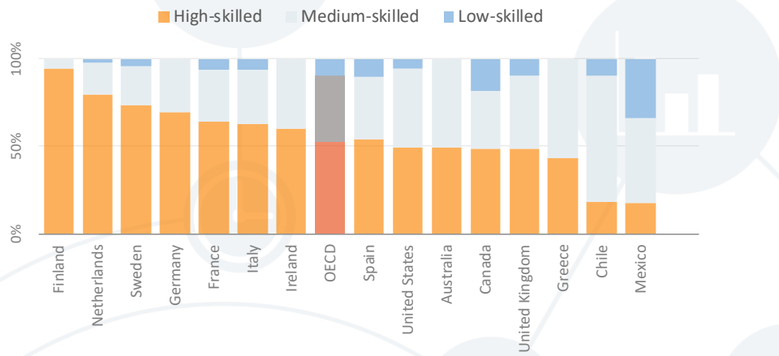
Labour market imbalances have increased in recent years in several countries denoting a relative deterioration of countries' ability to respond effectively to changes in labour market needs. Results suggest that, on average, the countries that experience more pronounced labour market imbalances also show lower productivity levels. A more efficient use of skill needs information and improved adult learning systems based on this information are needed to strengthen labour market matching and decrease the extent of skills shortages and surpluses. Despite the uncertainty that is inherent in any attempt to predict future skill needs, the analysis of past trends in skill imbalances suggests an increasing demand for high-level cognitive skills and a decrease in the demand for routine or physical abilities.

Results from the OECD Skills for Jobs database suggest the existence of a negative relationship between the risk of automation and labour market shortages. Jobs facing a high risk of automation are, on average, in surplus (where supply is higher than demand) across the countries covered by the OECD Skills for Jobs database. Vice versa, occupations in critical shortage (where demand is higher than supply) are also those facing the lowest risk of being automated. The challenges stemming from automation call for targeted policy action designed to equip low-skilled workers with the necessary tools to navigate this changing landscape and ensure that they are not displaced or excluded from the labour market in the near future.

On average across the OECD, approximately 35% of workers are mismatched by qualifications with shares of over and under-qualified workers being, on average, roughly the same (17 and 19% respectively). The prevalence of both types of mismatch speaks to an insufficient supply of talent (causing under-qualification to emerge in some parts of the labour market) as well as to weak skill demand (generating over-qualification).

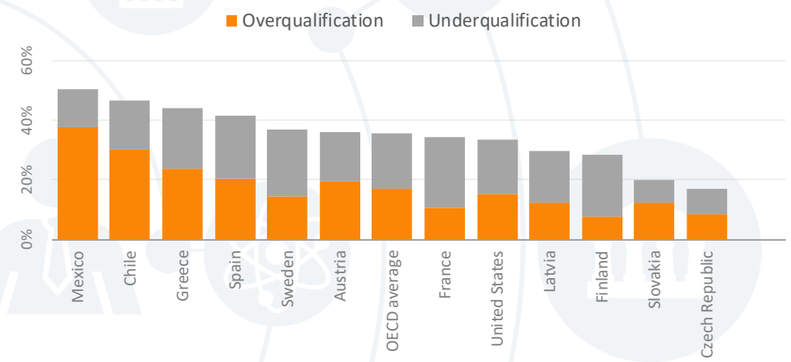
More than 7 out of 10 graduates in the field of Humanities and Arts are employed in a job that is unrelated to their specialisation.
Similarly, a substantial share of graduates in Science and Agriculture fields also struggle to find employment in those fields (60 and 51% respectively). A relative good alignment exists in the field of Social Sciences, Business and Law as well as in Health and Welfare whose graduates are able to find a job matching their fields of specialisation more easily. Strengthening career guidance and building robust information systems for families and students can help reduce the extent of these mismatches, supporting individuals in their education choices.

Share of employment in high demand by skill level (selected countries)



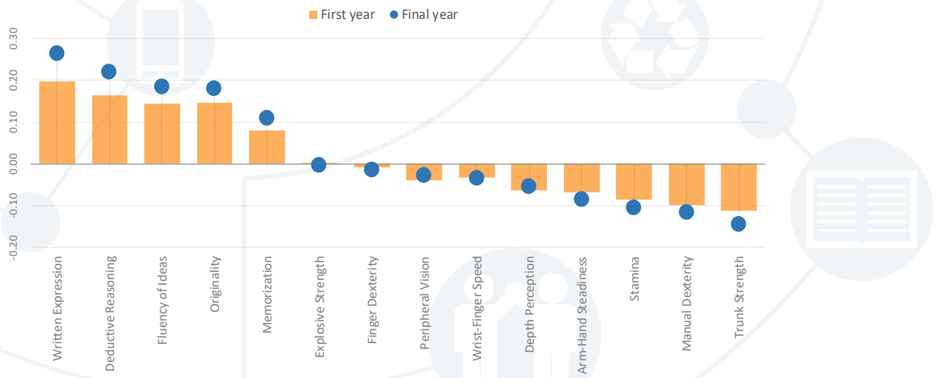
Source: Elaborations based on the OECD Skills for Jobs database (2018).

Over and under-qualification (selected countries)



Source: Elaborations based on the OECD Skills for Jobs database (2018).

Evolution of skill demands- OECD average (selected skills)



Source: Elaborations based on the OECD Skills for Jobs database (2018).

1. What does the Skills for Jobs database measure?

The OECD Skills for Jobs database defines skills as either hard-to-find (in shortage) or easy-to-find (in surplus). Skill shortages emerge when employers are unable to recruit staff with the necessary set skills in the accessible labour market and at the going rate of pay and working conditions. Skill surpluses arise in the opposite case, when the supply exceeds the demand for a given skill.

The indicators measuring these imbalances in the labour market (both shortages and surpluses) are constructed following a two-step approach that delivers two different, though related, sets of information on:

i. Occupational imbalances –measuring the extent by which jobs in each occupational group are hard or easy to fill for firms in the current labour market.

ii. Skills shortages and surpluses – measuring the extent by which each skill dimension is (or not) hard to find in the labour market.

Box 1.1. Occupational Shortage and Skill Needs indicators

Step 1: Occupational Shortage indicator

In a first step, an "Occupational shortage indicator" is calculated for 33 occupational groups at the ISCO-08 2-digit level. The Occupational shortage indicator is a composite indicator that ranks occupations in shortage or in surplus within each country based on the analysis of five sub-components:

- wage growth,
- employment growth,
- hours worked growth,
- unemployment rate,
- change in under-qualification

For each given country, occupational group and sub-component, long-run trends are compared to the economy-wide trend. This comparison sheds light on whether the specific occupational group is outperforming/underperforming the rest

For example, if wages in the occupational group of "Science and Engineering Professionals" grow faster than the average wage in a given country this trend suggests an emerging shortage of those professionals, since they are relatively more valuable to employers than other workers. Similarly, the Occupational shortage indicator increases when average hours worked in a specific occupation grow faster than the country average, as this signals that employers might be facing hiring difficulties and, as a consequence, are being forced to increase the hours worked of their current employees to satisfy rising demand.

No single sub-component perfectly signals which occupations are in shortage. Wage growth, for example, might be driven by collective bargaining agreements, rather than by occupational demands. Employment growth may signal demand for labour, but not necessarily a shortage of professionals as employment may be growing without employers facing particular hiring difficulties. The use of a composite indicator, however, minimises the impact of conflicting signals and increases the power of the final index. Weights are applied to each sub-component to come up with an aggregate figure of occupational imbalance. All sub-components are given equal weight with the exception of employment for which a smaller (half) weight is applied in light of its lower explanatory power (OECD, 2017).

Step 2: Skill Needs indicator

The Occupational shortage indicator is then used in the second step of the methodology, to build indicators of skills shortages and surpluses.

Information on skill requirements in each occupation are extracted from the O*NET database which provides categorical data about the skills required to perform the tasks of more than 800 different occupations. The values of the Occupational shortage indicators are used to weight the importance and level of the skill requirements associated to each occupational group. In other words, skill shortages are computed based on the shortages in the occupations that use the skill dimension under exam.

As an example, occupational shortages of Science and Engineering professionals will contribute to a country's shortage of 'Engineering and Technology Knowledge' as this knowledge is used intensively by professionals in that occupational group. Conversely physical or routine skills may appear to be in surplus in countries where occupations that use these 'skills' intensively are in surplus.

2. What are the jobs in high-demand and where are they?

The intensity and the nature of the skills required by firms can vary substantially across countries depending on each economy's productive structure or technology level. For instance, when a country has several firms at the technology frontier that produce and adopt new technologies employers struggle to find workers with adequate skills to operate these innovations. In those labour markets, therefore, the demand for high-skilled professionals may be substantial, creating shortages at the high-end of the skill distribution.

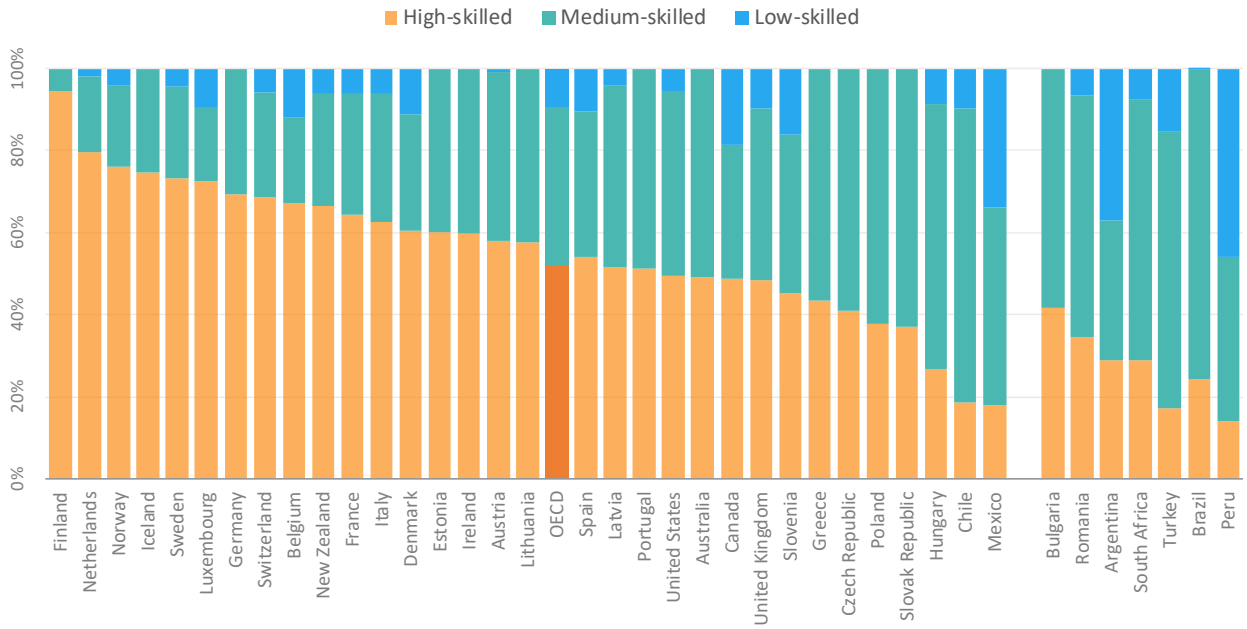
Conversely, labour market demands in certain countries may be linked to more traditional productive patterns or to the use of well-established technologies for production. In these economies, the demand for medium or even low-skilled workers may be prevalent as firms' production is concentrated in sectors with relatively low value added, outdated productive strategies or obsolete technologies. As these countries invest in higher education to upskill their workforce, they may find themselves in a situation where low-skill requirements by firms generate temporary surpluses in high-level skills.

On average across the OECD countries analysed by the Skills for Jobs database, more than 5 out of 10 jobs that are hard-to-fill (i.e. in shortage) are found in high-skilled occupations (**Figure 2.1**). These jobs range from managerial positions to highly skilled professionals in the health care, teaching or ICT sectors. A relatively large share of OECD occupational shortage (approximately 39% of total jobs in that are hard-to-fill across the OECD) is also found in medium-skilled occupations, such as personal service workers or electrical and electronic trades workers. Fewer than 1 out 10 jobs in shortage across the OECD are found in low-skilled occupations.

The intensity with which high-skilled workers are needed, however, varies significantly across countries both within the OECD and in developing countries. In Finland, for instance, more than 9 out of 10 jobs in shortage are of the high-skilled type. In other countries like Mexico, Peru or Chile, the demand for highly skilled professionals is significantly lower with less than 2 out of 10 jobs in shortage being "high-skilled" and the majority of jobs in shortage being found, instead, in medium to low-skilled occupations.

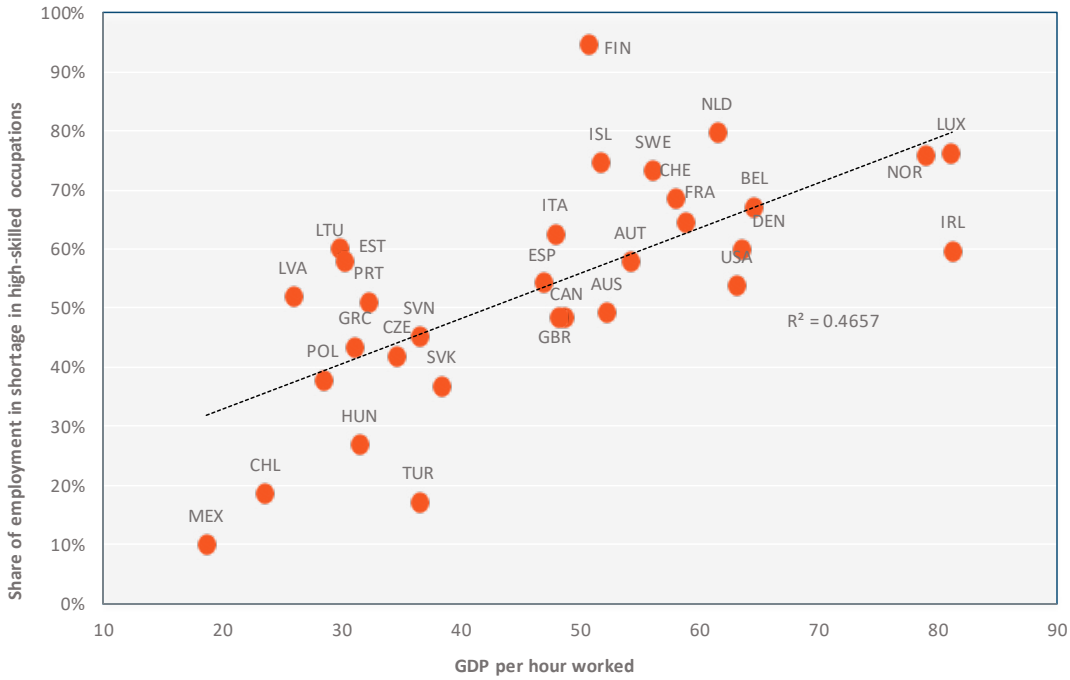
Evidence suggests that more advanced countries with higher productivity levels tend to face shortages concentrated in high-skilled occupations compared with less productive economies. Measures of productivity (GDP per hour worked) are positively associated with larger shortages of high-skilled professionals (**Figure 2.2**). Previous analysis (OECD, 2017) also showed that, across OECD and EU countries, a substantial proportion of workers are in workplaces that have introduced new technologies and/or undergone significant restructuring in the way jobs and tasks are carried out. Countries like Finland, Sweden or Denmark for instance experienced substantial restructuring in the workplace and show stronger pressures (shortages) in Administration and Management knowledge, leadership and other soft skills such as *'co-ordination with others'*. These skill demands are linked to shortages of high-skilled professionals across different sectors.

Figure 2.1. Share of employment in high demand by skill level



Note: High, medium and low skilled occupations are ISCO occupational groups 1 to 3, 4 to 8 and 9 respectively. Shares of employment in each skill tier are computed as the corresponding employment in each group over the total number of workers in shortage in each country. Data refer to the latest year for which information is available
Source: Elaborations based on the OECD Skills for Jobs database (2018).

Figure 2.2. Demand for high-skilled workers and productivity



Note: Note: Data refer to the year 2015 or latest available year.
Source: OECD Skills for Jobs database (2018) and OECD.stat.

3. A closer look at the extent of Labour Market Imbalances

Some degree of skill mismatch in inevitable as rapid technological change requires constant skill development that can be achieved only with some lag. However, persistent mismatches may be the symptom of labour markets functioning sub-optimally. Evidence below show how some countries are more efficient than others when it comes to react to skill challenges and matching the supply and demand of workers' skills in the labour market. Countries where several occupations are in critical shortage or surplus experience a relatively high degree of overall labour market imbalance as this paints a situation where many employers struggle to find workers with adequate talent (shortages) and many workers face low demand in their national labour market (surpluses).

Results in **Figure 3.1** show the overall degree of labour market imbalances across countries and over time (see **Box 3.1** for an explanation of the calculations). Countries like Lithuania, Spain and Ireland present the strongest labour market imbalances driven by pronounced occupational shortages and surpluses. On the other hand, labour market imbalances are the lowest in countries such as France, the Netherlands and Switzerland.

Figure 3.1 also shows the evolution of labour market imbalances over time. Occupational imbalances have increased in recent years in many countries and part of this result is probably linked to the different ability of some countries to cope with the challenges brought by the global economy crisis. The increase in labour market imbalances has been particularly intense in countries such as Iceland, Portugal and Greece, denoting a relative deterioration of their ability to respond effectively to changes in labour market demands, eventually causing the emergence of substantial shortages and surpluses. Other countries, namely Ireland, Lithuania but also the USA and Mexico have experienced a relative decrease in overall labour market imbalance, signalling that the magnitude and relative dispersion of their occupational shortages and surpluses have decreased between 2010 and 2014.

There may be several reasons behind the different performance of the countries analysed. For instance, more flexible labour market regulations in some countries may allow talent to move quickly from one job to the other as labour market demands change, ensuring that skill gaps are filled quickly[1] . Similarly, some adult learning systems may perform better than others at reskilling workers and jobseekers to fill new openings.

1 Other countries may have developed more responsive education systems that would allow anticipating skill needs and creating the necessary supply of talent to match future demands.

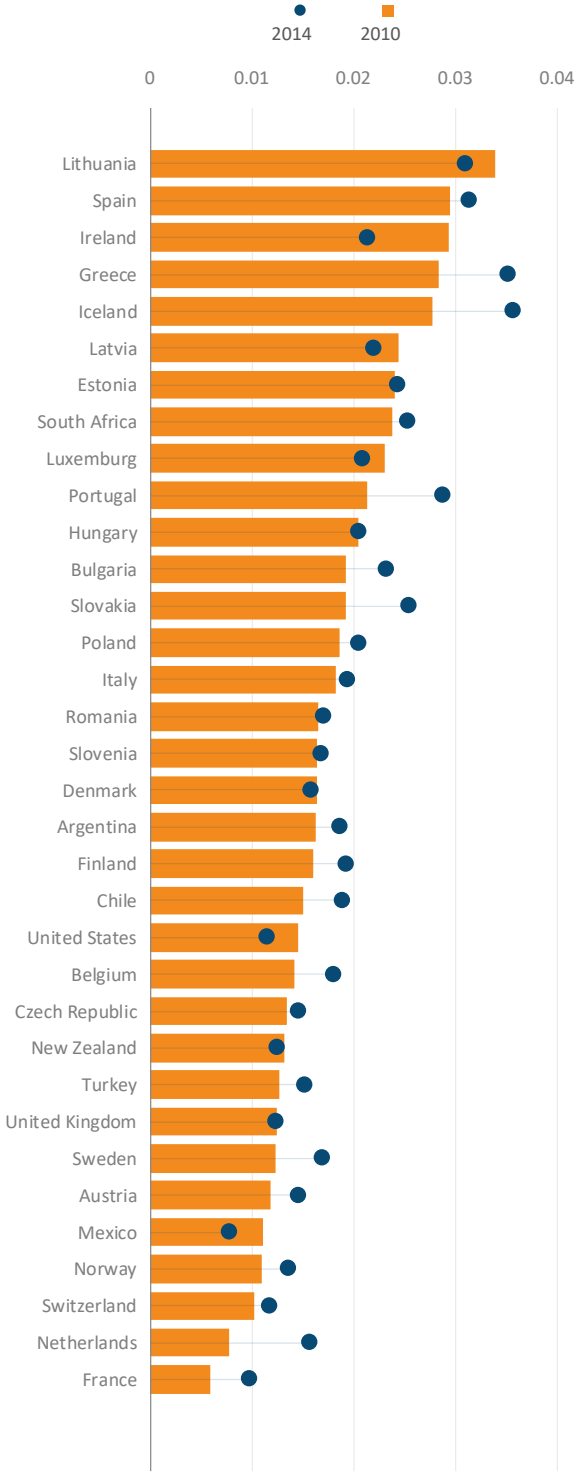
Box 3.1 How to interpret Figure 3.1?

Strong occupational imbalances (i.e. substantial shortages and/or surpluses) reflect a situation in which countries struggle to match the supply and demand of labour and skills. Information on the magnitude and distribution of shortages and surpluses at the occupational level (i.e. the variability in the occupational shortage indicator- its standard deviation) can be used to approximate the efficacy with which labour markets are able to match workers' skills to the demand of firms.

The degree of labour market 'imbalance' can, therefore, be computed as the average dispersion (standard deviation) of each sub-indicator used in the computation of the occupational shortage indicator. The larger the extreme values and, the higher the dispersion of imbalances and the overall index of labour market imbalances.

Taller bars in **Figure 3.1**, therefore, denote larger aggregate imbalances and identify countries with less effective labour market matching mechanisms.

Figure 3.1. Degree of labour market imbalance across countries



Note: The degree of labour market imbalance is the average of the standard deviations calculated across occupations in each sub-indicator used to compute the Occupational Shortage index (e.g. wages, employment, hours worked, unemployment and under-qualification). Higher values denote larger labour market imbalances.
Source: Elaborations based on the OECD Skills for Jobs database (2018).

4. The link between labour market imbalances, skills supply and productivity

To face the challenges of rapidly changing labour markets, countries need to equip their workforce with adequate foundation skills. Results from the OECD Survey of Adults Skills (PIAAC) show that a poor skills supply severely limits people's access to high-quality and rewarding jobs. Similarly, when workers lack basic skills (literacy, numeracy or problem-solving skills), economies find it more difficult to introduce productivity-enhancing technologies and organise work in new and innovative ways in order to boost economic growth (OECD, 2016).

…but how does the quality of a country skill supply relate to labour market imbalances?

Results from the OECD Skills for Jobs database highlight the existence of a negative correlation between the average skill proficiency of a country's adult population and the magnitude of its labour market imbalances (the extent by which shortages and surpluses are pervasive in the economy).

Interestingly, countries where education systems have been able to create favourable conditions for skill development (i.e. high average skill proficiency of adults) are also those where labour market imbalances are generally the lowest. Quality education systems, hence, seem to go hand-in-hand with labour markets that are more efficient in matching skill supply to firms' demands.

The correlation between scores in digital problem solving recorded in the Survey of Adult Skills, on the one hand, and the degree of aggregate labour market imbalances (**Figure 4.1**), is particularly strong and negative. The results seem to suggest that strong labour market imbalances are closely linked to the ability of countries to develop technology-relevant skills and, to a lesser extent, to develop foundation skills such as literacy and numeracy.

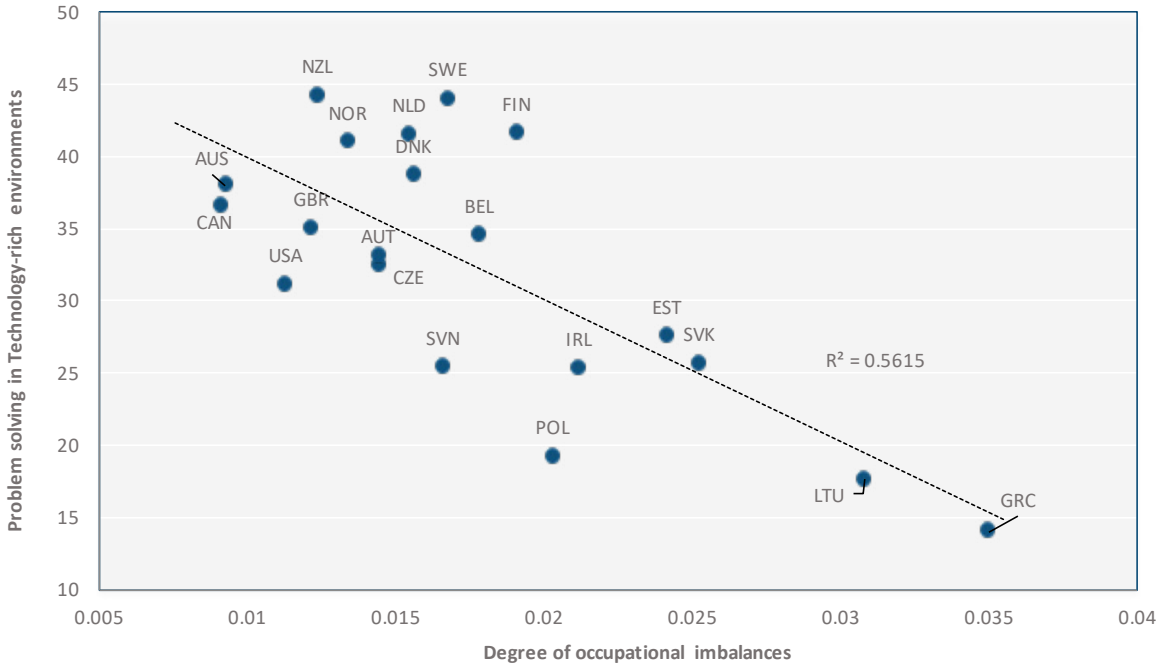
…and how does the extent of labour market imbalances relate to productivity?

Poor skills development and labour market imbalances may both have an adverse effect on technology adoption and productivity. While the negative impact of weak skills on productivity has been the focus of previous analysis (OECD, 2016), results from the OECD Skills for Jobs database shed light on the relationship between labour market imbalances and cross-country productivity.

Results in **Figure 4.2** seem to suggest that, on average, countries that experience more pronounced labour market imbalances also show lower productivity levels. This is the case, for instance, of Greece, Lithuania or the Slovak Republic where GDP per hours worked is below average and the extent of shortages and surpluses (i.e. the degree of occupational imbalances) is, instead, among the highest across the countries analysed. Conversely, countries with higher productivity levels experience less pronounced shortages and surpluses as their workers not only show higher skill proficiency but they are also better aligned to labour market demands, a situation likely to lead to gains in productivity (see also (Adalet McGowan and Andrews, 2017).

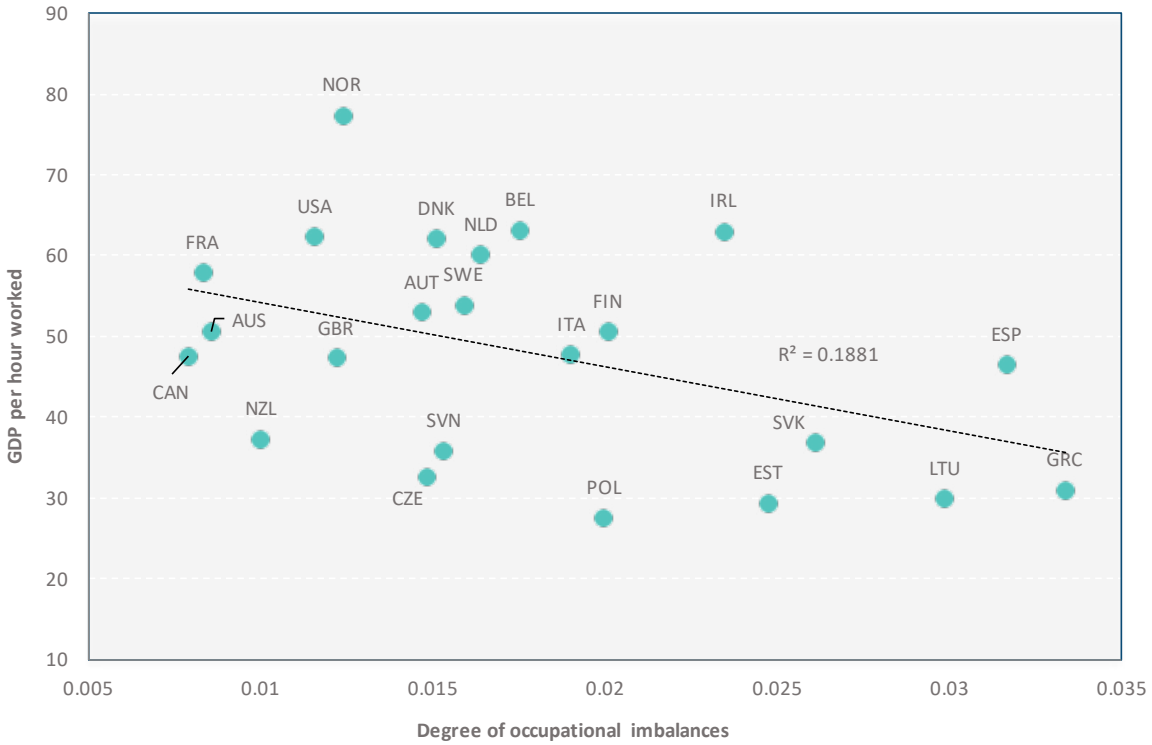
Further analysis is needed, however, to disentangle the specific effect of labour market imbalances on aggregate productivity at the country level as the correlation presented in Figure 4.2 is relatively weak and does not mean direct causation.

Figure 4.1. Degree of Occupational Imbalances and PIAAC scores-PSTRE



Note: Data refers to the year 2012
Source: OECD Skills for Jobs database (2018) and PIAAC (2012).

Figure 4.2. Degree of Occupational Imbalances and GDP per hours worked



Note: GDP per worker is measured in USD, constant prices, 2010 PPPs. Data refer to the year 2013.
Source: OECD Skills for Jobs database (2018) and OECD.stat.

5. What skills, knowledge and abilities are in shortage and surplus?

The OECD Skills for Jobs Database provides country-level (as well as subnational) information on shortages and surpluses in a wide range of skill dimensions, including cognitive, social and physical skills. The information can be disaggregated into approximately 150 dimensions across i) Knowledge areas, ii) Skills and iii) Abilities is available for 40 countries across OECD and emerging economies.

Box 5.1. Key definitions

Knowledge areas refer to the body of information that makes adequate performance of the job possible (e.g. knowledge of plumbing for a plumber; knowledge of mathematics for an economist).

Skills refer to the proficient manual, verbal or mental manipulation of data or things (e.g. complex problem solving; social skills)

Abilities refer to the competence to perform an observable activity (e.g. ability to plan and organise work; attentiveness; endurance).

It is important to notice the aggregate shortage of a certain skill dimension represents the average of shortages of very different occupations that are demanded with varying intensities in the each labour market and that use competencies with different intensities. Hence, the reader should notice that a surplus in the Knowledge area of "Sociology" does not mean that "sociologists" are in shortage. Even if professionals like "sociologists" were to be in shortage in a country, the 'Knowledge of Sociology' may still be in surplus in the aggregate national labour market if other occupations (say anthropologists) that use that knowledge intensively were to be in a relatively stronger surplus.

5.1. Knowledge, Skills and Abilities: where are the shortages and the surpluses?

In recent years rapid technological change, the penetration of new digital innovations into production and the increasing digitalisation of manufacturing and service sectors has certainly contributed to put pressure on firms to attract talented workers with digital skills and ICT knowledge. Similarly, many observers argue that recent technology trends are going to require, at an increasing pace, workers with high-level cognitive and non-routine skills, able to cope with unpredictable and non-codifiable tasks while, at the same time, being able to clearly communicate and understand new ideas and concepts.

Results from the OECD Skills for Jobs database (**Figure 5.1**) confirm the emergence of the above-mentioned trends. On average across OECD and EU countries alike, shortages are the strongest in the knowledge of Computers and Electronics (i.e. the knowledge of computer hardware and software, programming and applications) followed closely by substantial demand for Judgment and Decision Making Skills and Verbal Abilities.

5.2. High-level cognitive skills and the intersection between technology and humanities

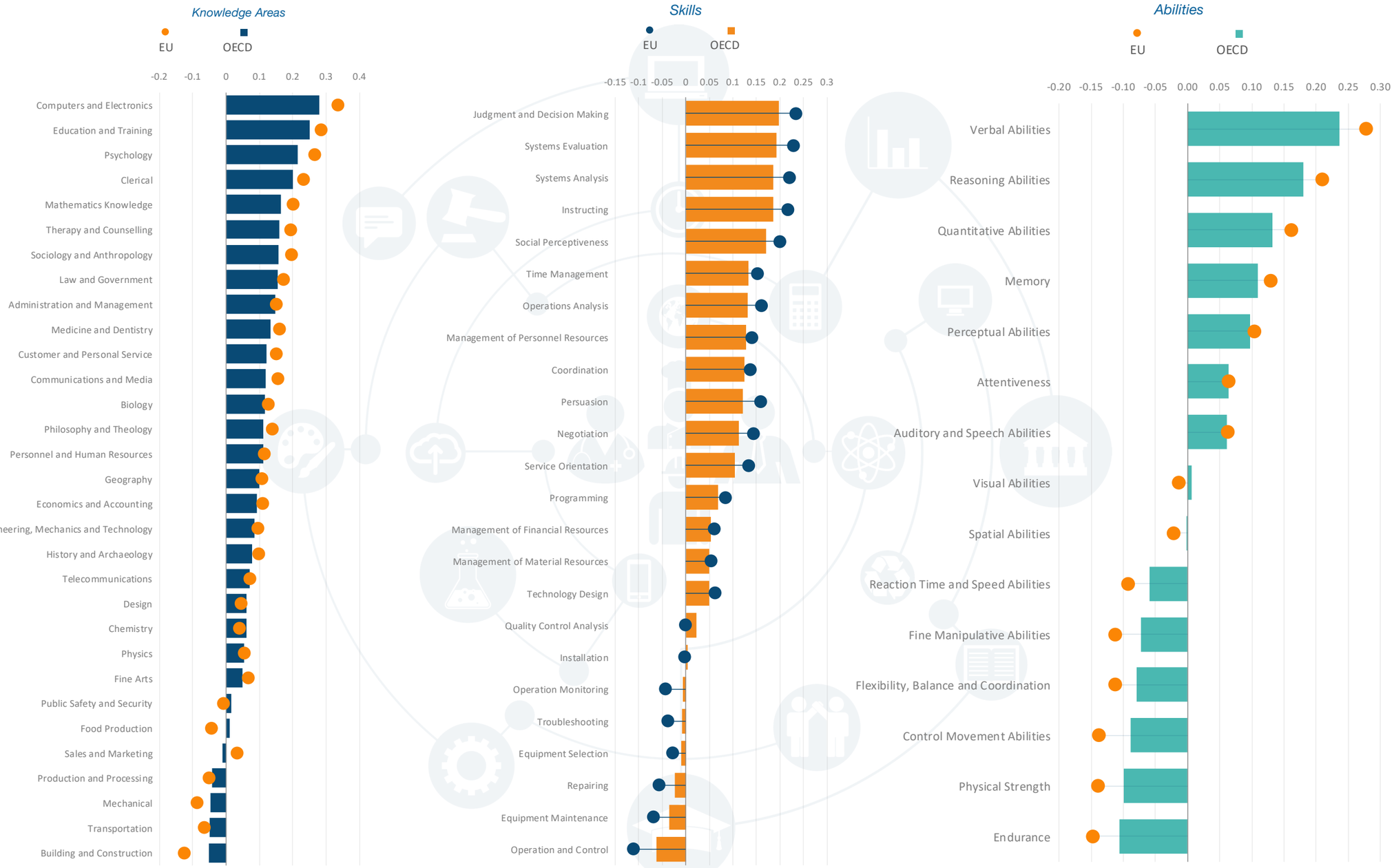
While the intense demand for several high-level cognitive skills may not be surprising, the observed shortages in some humanities-related knowledge areas such as Psychology or Therapy and Counselling can be. The intense demand in these knowledge areas, however, can be traced back to at least two potential explanations.

On the one hand, across OECD and EU countries alike, teaching and health-care professionals have seen a dramatic surge in demand and this translates into shortages in related knowledge areas.

On the other hand, the penetration of new technologies and of digital products is, today more than ever, intertwined with the need to understand users' preferences, wishes and habits and their "human" response to their use. These are all aspects that require well-developed knowledge of how society works and of human social behaviour. Interestingly, the ability to interpret social pattern and design products and services to satisfy customer demands is going to become increasingly important as big-data become increasingly available (Lazer and Radford, 2017). A famous quote by Steve Jobs exemplifies the substantial links that are emerging between technology developments and knowledge in the fields of humanities *as "it's in Apple's DNA that technology alone is not enough. That it's technology married with liberal arts, married with the humanities, that yields us the result that makes our hearts sing"*[2]

2 Other renowned entrepreneurs are claiming how people with backgrounds in the arts and humanities can bring creativity and insight to technical workplaces. See for instance, Eric Berridge (2017) https://www.ted.com/talks/eric_berridge_why_tech_needs_the_humanities

Figure 5.1. Knowledge, Skills and Abilities shortages and surpluses across OECD and EU countries



Note: Positive values represent shortages (e.g. unsatisfied demand in the labour market for the analysed dimension). Negative values represent surpluses (supply exceeds demand in the labour market for the analysed dimension). Results are presented on a scale that ranges from -1 to +1. The maximum value represents the strongest shortage observed across OECD (31) countries and skill areas.
Source: OECD Skills for Jobs database (2018).

6. What are the skills in-demand across sectors?

Results from the OECD Skills for Jobs database provide a detailed picture of occupational and skill imbalances at the sector level. The distribution of workers in shortage or surplus in each sector can be mapped into sectoral skill demands. It is worth noting that the output produced by each sector combines skill-inputs from workers employed in different occupations with different skill requirements.

The Information and Communication sector, for instance, employs a large share of ICT engineers but also Science and Technology professionals. The Building and Construction sector is composed of a large number of Builders and related Trade workers but also Carpenters and Plumbers. At the aggregate level, sectoral skill demands, therefore, can vary substantially from one sector to the other as they depend on the specific combinations of different workers (with different skills) employed in each one of them which, eventually, translate into sector specific skill demand

Figure 6.1 reveals that, on average across OECD and EU countries, occupational shortages are the strongest in the Education as well as in the Information and Communication sectors – meaning that a large share of workers in those sectors is employed in occupations that are in shortage. Conversely, occupational surpluses are found in the Wholesale and Retail Trade as well as in the Construction sector where a large share of those sectors' employment is in occupations in surplus or that face weak demand.

Figure 6.2 exemplifies the stark difference in skill demands between the Education sector and the Information and Communication sector respectively. *'Learning Strategies' Skills* (i.e. selecting and using appropriate teaching and learning methods) is in strong shortage in the Education sector. This is primarily due to the shortage of teaching professionals. This skill, however, is considerably less in shortage in the Information and Communication sector where, instead, Reading Comprehension and Critical Thinking skills are in shortage.

6.1. Transversal skill demands and 'resilient' skills

Labour markets are changing at a fast pace and workers need to be ready to change career or even sector of activity as innovations are likely to affect skill demands and, as such, the demand for workers. Therefore, developing skills that facilitate labour market transitions is becoming of paramount importance.

While some skills can be very versatile and transversal (i.e. applicable with similar intensity to very different working contexts, jobs and sectors), others may be of real use only in certain specific occupations or industries. For instance, Complex Problem Solving is usually referred to as a 'transversal skill' as it is in high-demand across a broad range of occupations, regardless of the specific tasks of the job, industry or sector.

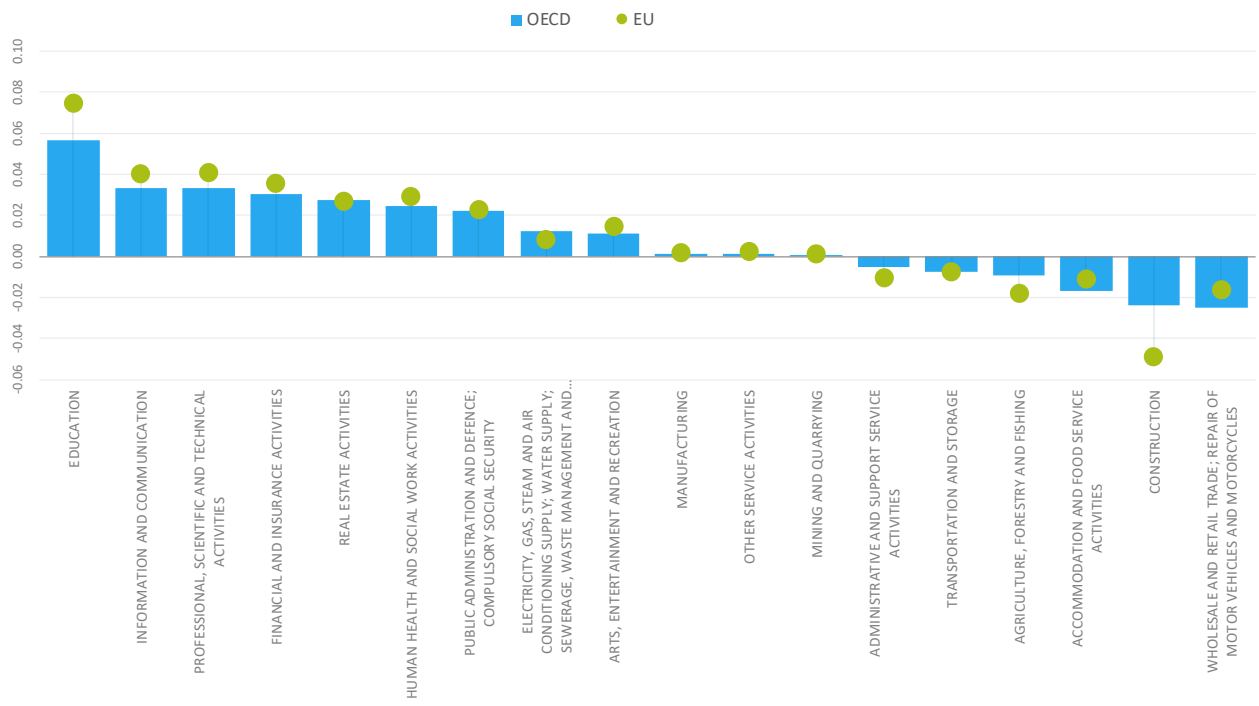
Other skills, however, are much more specific when it comes to their applicability and usefulness across different occupations or industries. Skills such as Programming (i.e. writing computer programs for various purposes) or Trouble Shooting (i.e. determining causes of operating errors and deciding what to do about it) are much narrower in scope and less likely to be in high-demand everywhere in the labour market.

The sectoral results of the OECD Skills for Jobs database allow shedding light on what knowledge, skills or abilities workers should develop to ensure a smooth transition from one sector to the other. **Figure 6.3** presents the intensity of transversal labour market shortage across sectors by highlighting what skills are consistently in high (low) demand across all sectors on average in the OECD.

Computer and Electronics is the knowledge that is most widely in shortage across all economic sectors. To put it in other words, having some command of this knowledge can help smooth career transitions from one sector to the other as this is in shortage in all sectors. Similarly, the knowledge of Clerical

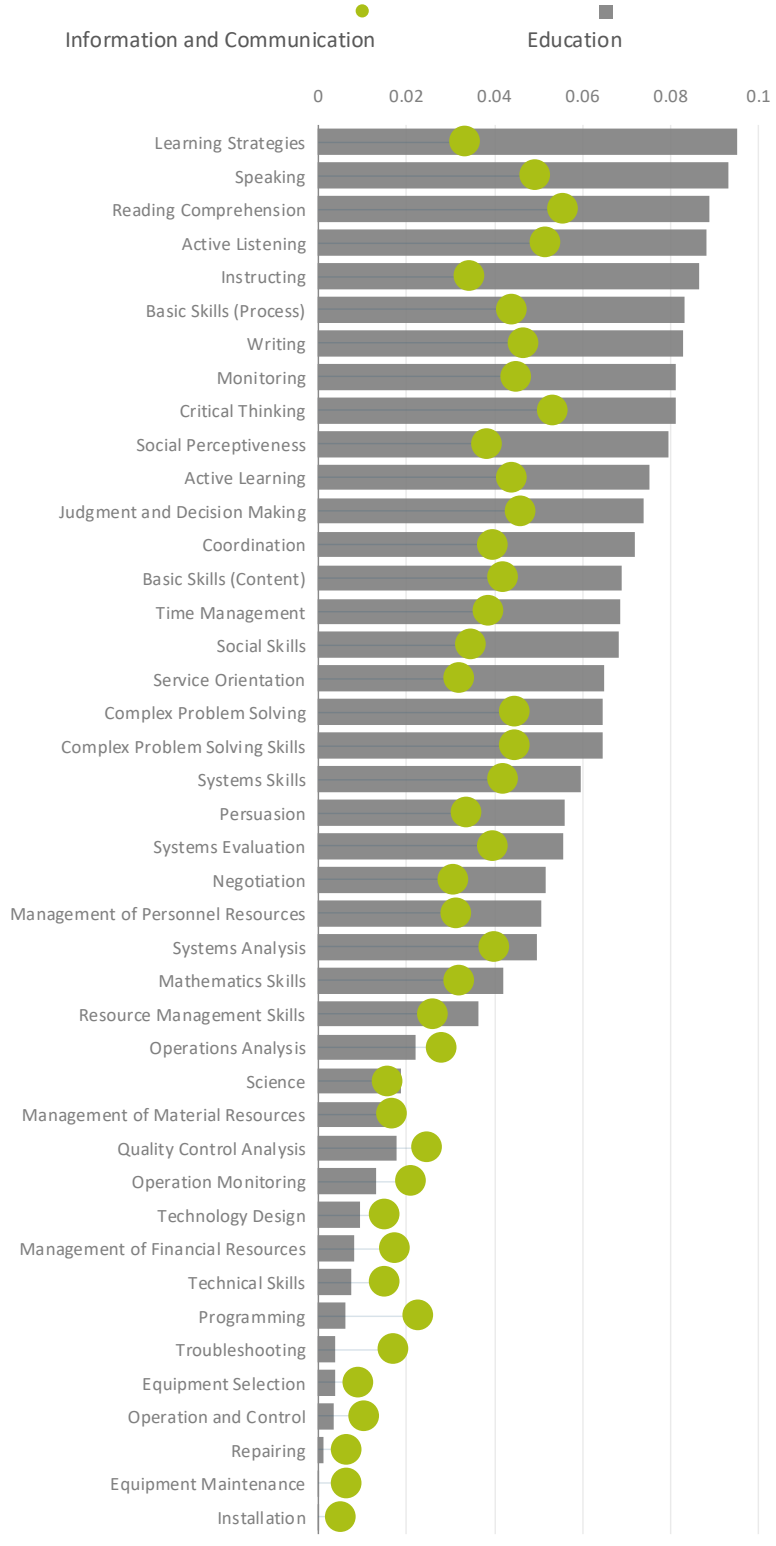
and Administrative procedures (Clerical) and that of Education are not necessarily those where strongest overall shortages are observed but they are, on average, generally in great demand across most sectors, potentially allowing workers with this knowledge to move to a broad variety of sectors. Other cognitive skills and abilities such as Reading Comprehension, Writing and Speaking but also Critical Thinking or Active Listening and Learning are in high-demand across most economic sectors. Put differently, not only do most of these skills make finding a job easier (as they are in overall shortage) but they also smoothen the transition from one sector to the other. At the other end of the spectrum, the demand for skills such as Operation Control, Equipment Maintenance or physical abilities such as Static Strength or Manual Dexterity is relatively weak across all sectors.

Figure 6.1. Occupational shortage indicator- sector aggregation



Source: OECD Skills for Jobs database (2018).

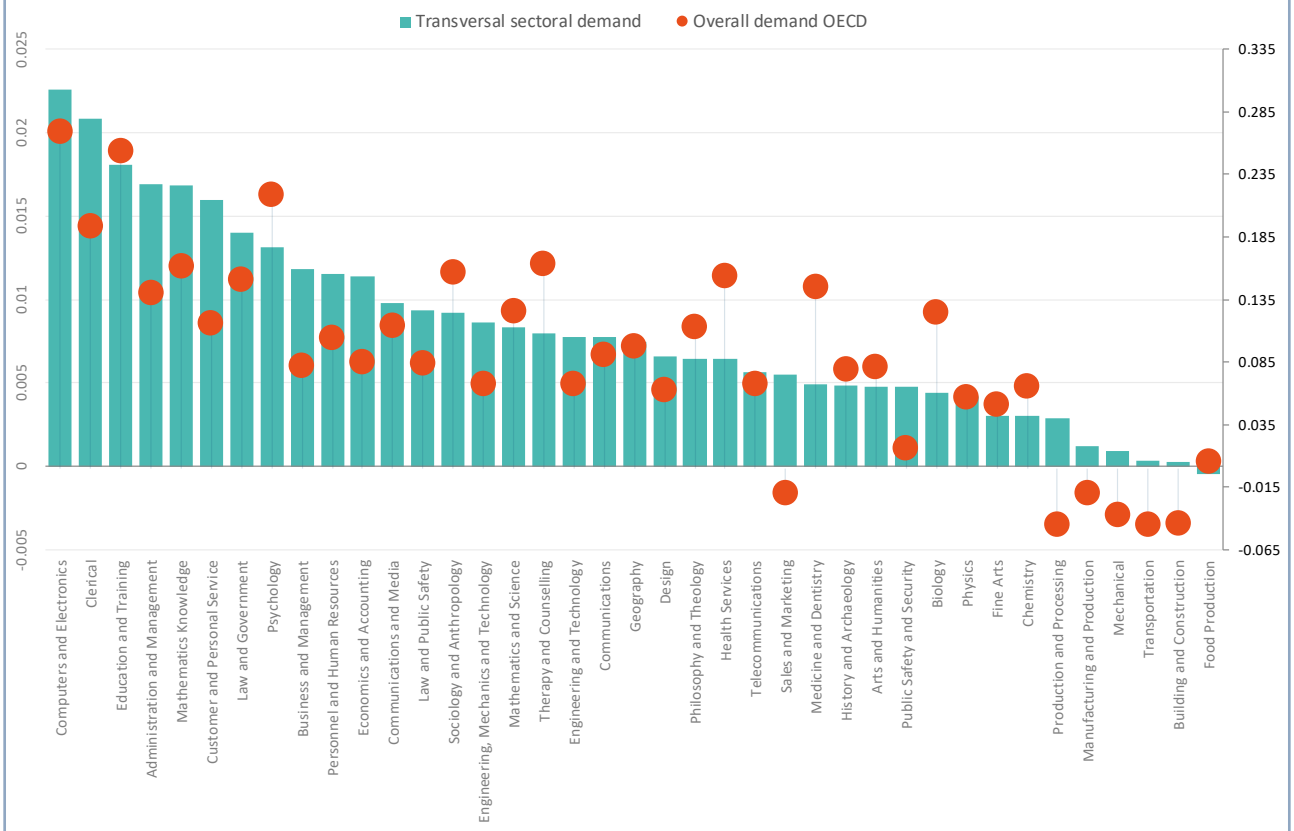
Figure 6.2. Skills shortages in the Education and Information and Communication sectors



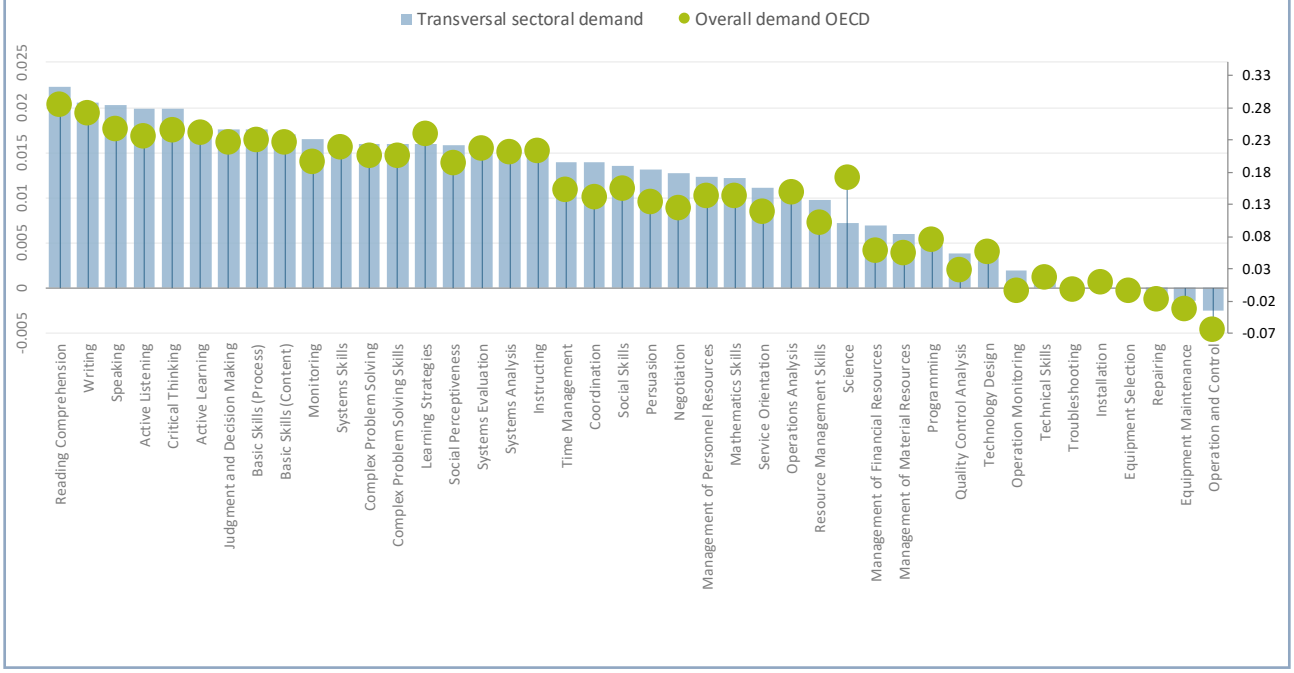
Source: OECD Skills for Jobs database (2018).

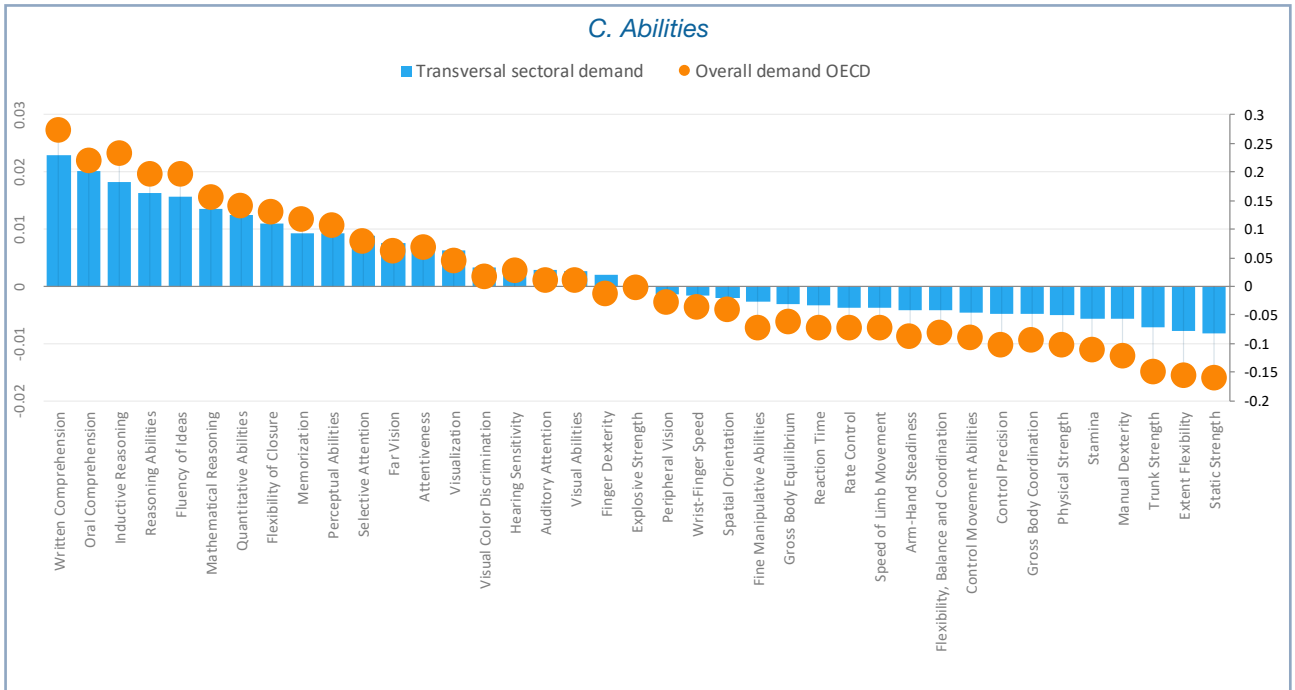
Figure 6.3. Transversal sectoral knowledge shortages-OECD average

A. Knowledge areas



B. Skills





Note: Transversal sectoral demands are computed as the average shortage for each knowledge dimension across all sectors. Higher values mean that the knowledge is in shortage across most sectors. Overall shortage is the aggregate OECD-wide shortage.
Source: OECD Skills for Jobs database (2018)

7. How are skill demands changing over time? What can the past teach us about the future?

If predicting what skills will be demanded in the future is an extremely difficult task, the analysis of recent trends may help understand the direction that labour market demands are taking and help prepare for further changes as new technologies are invented and organisational and productive processes adjust to reap their returns.

7.1 Skill demands are moving towards stronger demands for high-level cognitive skills

The OECD Skills for Jobs Database shows that, on average across OECD countries and during the period between 2004 and 2014, the demand for high-level cognitive skills has increased, while the demand for physical abilities and routine skills has decreased (**Figure 7.1**).

Interestingly, the largest increases in shortages emerged in skill dimensions that were already in shortage in the initial year of analysis. Cognitive abilities related to reading, understanding and processing information and ideas (e.g. written comprehension or expression) or others related to the ability of applying general rules to specific problems (e.g. deductive reasoning) were among the several cognitive dimensions in high-demand in the initial year of analysis across OECD countries and shortages of these abilities had increased by 2014.

In a specular but opposite way, negative trends have been recorded for most skill-dimensions that were already in surplus in the initial year. Physical abilities such as Trunk Strength (i.e. the use of muscles and of one's body attributes for long periods of time) or others such as Stamina or Arm-hand steadiness (typically used in many occupations that

are nowadays at risk of being automated by more precise machines) have seen the sharpest declines in demand in the last decade.

Despite the uncertainty that is inherent in any attempt to predict future skill needs, the analysis of past trends in skill imbalances suggests an increasing demand for high-cognitive skills and a decrease in the demand for routine or physical abilities being these latter found progressively more in surplus across labour markets.

7.2. What do experts say about future skill demands?

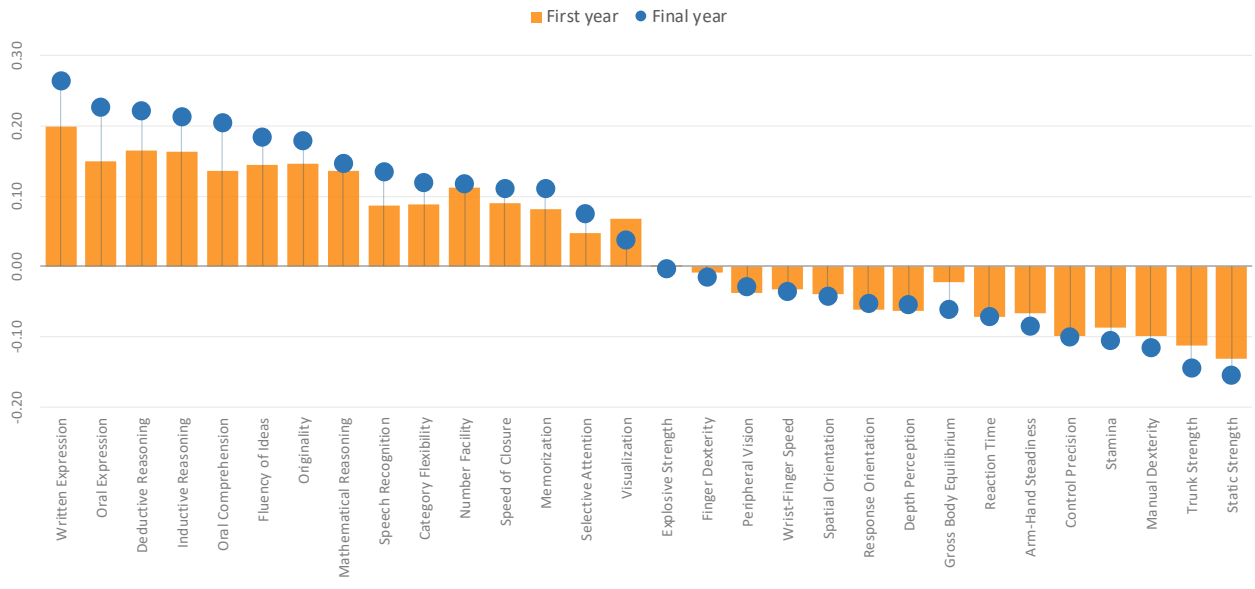
A recent study by (Benedikt Frey et al., 2013) has brought worldwide attention to the challenges related to the automation of tasks and to the potential losses in terms of employment that automation is likely to cause in the future as the tasks carried out by some workers may be partially or completely replaced by machines. Initial alarmist predictions, however, have been confronted with new empirical evidence suggesting that only 14% of jobs face a high-risk of automation (Nedelkoska and Quintini, 2018) but that 32% will undergo significant changes.

In a companion study, NESTA and the Oxford Martin School exploited a similar methodology drawing a ranking of skills that are expected to be in high/low demand in the future. The ranking of skill demands carried out by the authors is based on the both the informed judgment of labour market experts and on machine learning algorithms used to predict future demands (Bakhshi et al., 2017)[3].

Despite the differences in the underlying methodologies between the OECD Skills for Jobs database and Bakhshi et al., (2017), results in **Figure 7.2** seem to suggest that skill shortages as measured by the OECD Skills for Jobs database

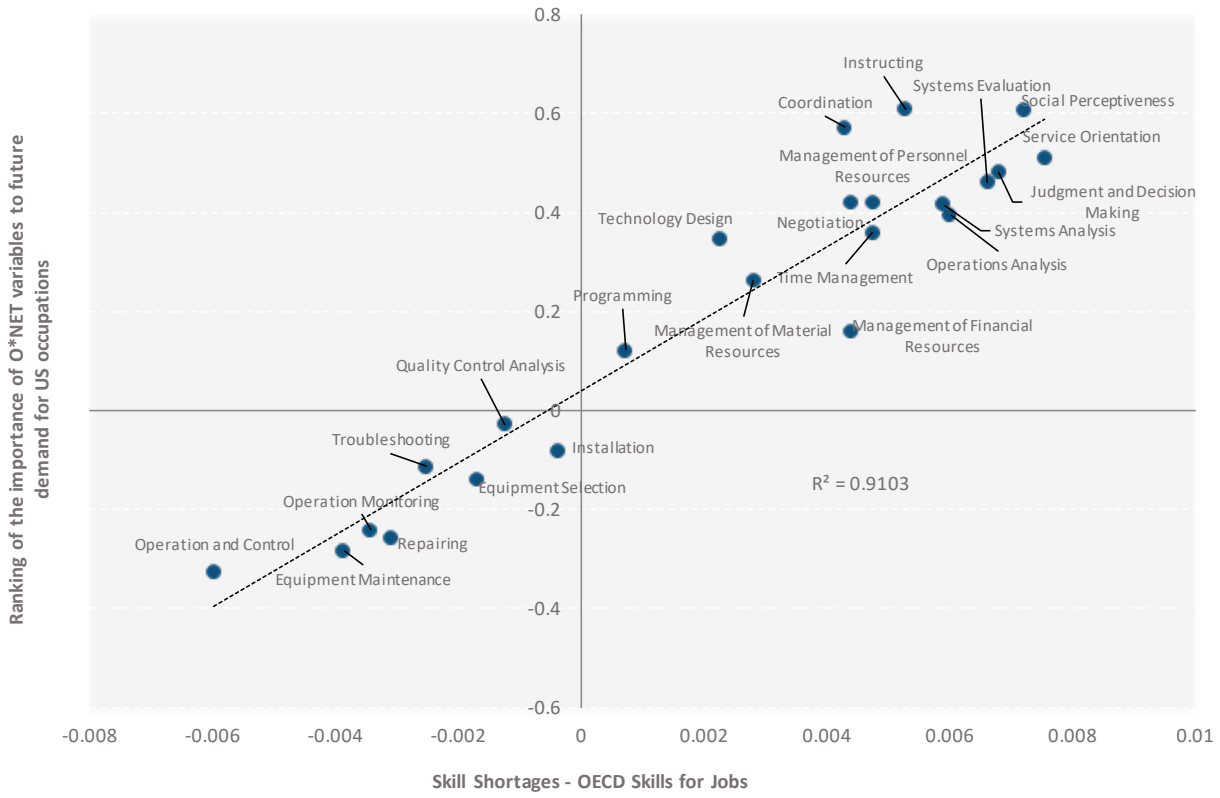
3 As mentioned by (Bakhshi et al., 2017), the analysis is "grounded in an explicit consideration of the diverse and interacting sources of structural change — non-technological as well as technological — all of which are expected to have major impacts on future skills needs".

Figure 7.1. Time evolution of skill imbalances



Note: Data refer to the years 2004 and 2014 for all OECD countries for which information was available. Skills are ordered by the intensity of shortages in the last year.
Source: OECD Skills for Jobs database (2018).

7.2 NESTA Machine learning foresight and OECD Skills for Jobs skill demands



Source: OECD Skills for Jobs database and (Bakhsi et al., 2017).

are aligned to the predicted changes in future skill demands derived by labour market experts. This suggests that the observed strong demand for high-level cognitive skills will likely continue in the near future and that routine and physical skills will instead increasingly be less demanded, posing important policy challenges as to how to equip all workers with the skills needed to be successful in the future.

7.3 How do labour markets demands adjust to future automation?

Recent developments in Machine Learning, in the use of Artificial Intelligence and in the penetration of robotics in production are all likely to contribute to the automation of several tasks that, in the past, have been carried out by humans. As a result, workers across most countries are now facing substantial changes in the way their work is organised and in the complexity and nature of the tasks that they are required to perform at work.

While future technological innovations are difficult to predict along with the changes that are about to come, results from the OECD Skills for Jobs database suggest the existence of a negative relationship between the risk of automation and labour market shortages. Jobs facing a high risk of automation are, on average, in surplus across the countries covered by the OECD Skills for Jobs database. Vice versa, occupations in critical shortage are also those facing the lowest risk of being automated.

The nature of the tasks carried out by workers in each occupation does help explain the relationship between the risk of automation and the observed

occupational shortages and surpluses across labour markets. Occupations that are in surplus in the labour market and face high-risk of automation are usually employing low skilled workers involved in routine tasks. Examples of these occupations are Food Preparation Assistants, Cleaners and Helpers or Stationary Plant and Machine Operators for which labour market demand has been worsening over time and whose tasks have already went through substantial change in the past few years with the advent of new and more efficient technologies such as robotics[4]. Occupations in shortage are, instead, characterised by high-level cognitive skill requirements and by core-tasks that are extremely difficult to automate. Business and Administration or ICT and Science professionals are among the occupations facing low risk of automation and strong shortage across OECD labour markets.

The challenges stemming from automation call for targeted policy action designed to equip low-skilled workers with the necessary tools to navigate the changing landscape and ensure that they are not displaced or excluded from the labour market in the near future.

4 If a fully articulated robotic kitchen with hands to reproduce the entire function of human dexterity speed, sensitivity and movement is about to come (see http://www.moley.com/), changes in the way well-known food chains organise work have been underway for a long time already, simplifying complex tasks and reducing the number of workers required to deliver the final product.

8. The misalignment of talent at work: Qualification and Field of Study mismatch

Along with the set of indicators on skill shortages and surpluses, the OECD Skills for Jobs database provides detailed information on the misalignment between the quantity and quality of education credentials of workers and those required by their job.

Indicators of qualification mismatch measure the alignment of a worker's qualification level to that required in her/his job. Over-qualified workers own higher qualifications than usually required in those jobs while under-qualified workers have lower qualifications than those usually held by workers in their jobs. On the other hand, indicators of field of study mismatch measure the alignment between a worker's specialisation (her/his field of study) and the field in which she/he is employed.
Empirical evidence shows that all these forms of mismatch can have substantial negative consequences for workers. Previous literature, for instance, highlights that, on average, over-qualified and field of study-mismatched workers suffer a wage penalty when compared to well-matched workers with the same qualifications (Quintini, 2011) and (Wolbers, 2003). Furthermore, field-of-study mismatch explains lower level of satisfaction at work (Béduwé and Giret, 2011) and it generates higher job-turnover as unsatisfied workers tend to move often in search for a better match.

Results from the OECD Skills for Jobs database in **Figure 8.1** rank countries by the degree of total qualification mismatch (i.e. the share of workers who are either over or under-qualified in their national labour market). On average across the OECD, approximately 35% of workers are mismatched by qualifications with shares of over and under-qualified workers being roughly the same on average (17 and 19% respectively). The prevalence of both types of mismatch speaks to both an insufficient supply of talent (causing under-qualification to emerge in

some parts of the labour market) as well as to weak skill demand (leading to the emergence of over-qualification).

The magnitude of qualification mismatch changes substantially from one country to the other. Approximately 1 in 2 workers in Mexico and Chile are mismatched by qualifications, with large shares of workers being over-qualified. Less than 2 in 10 workers are, instead, mismatched by qualifications in the Czech Republic and only 8% of these are over-qualified in their jobs.

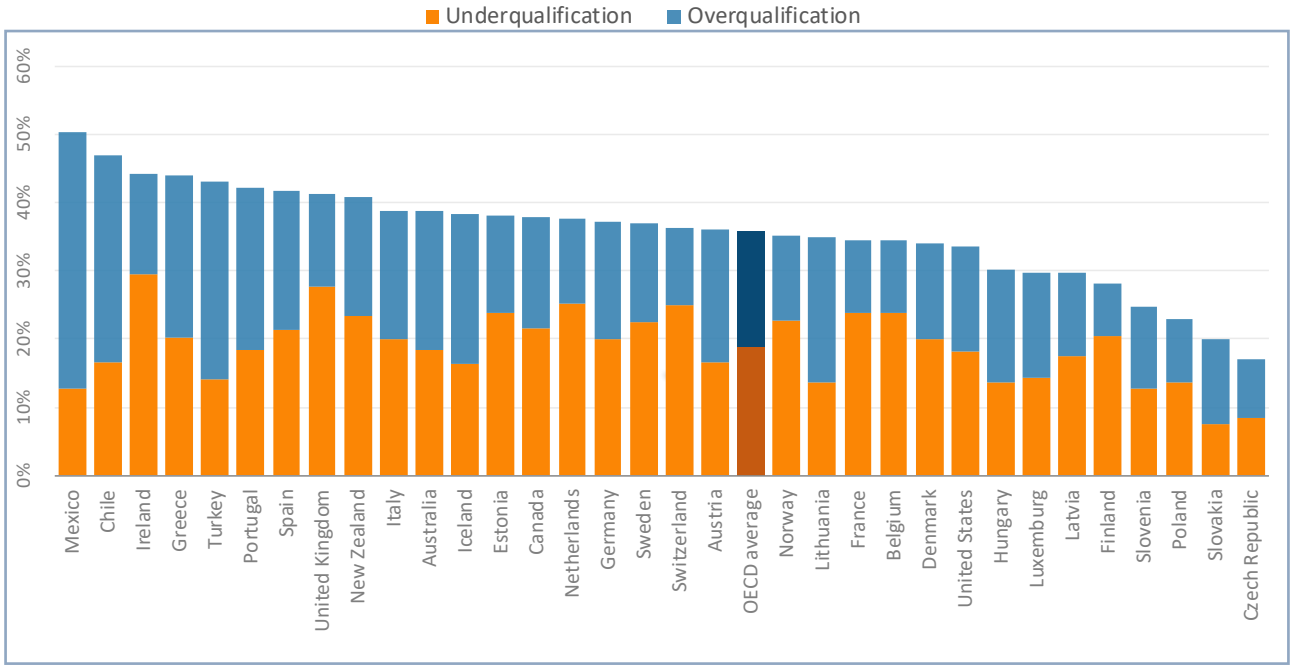
Figure 8.1 also shows heterogeneity in the extent of qualification mismatch across sectors. On average across the OECD, more than 4 out of 10 workers are mismatched by qualifications in the Agriculture, Forestry and Fishing sector but less than 20% are so in the Education sector highlighting how firms in different sectors may struggle more (or less) to adequately match their skill needs to the available talent in the labour market.

8.1. But how does the choice of a field of study affect a worker's matching in the labour market?

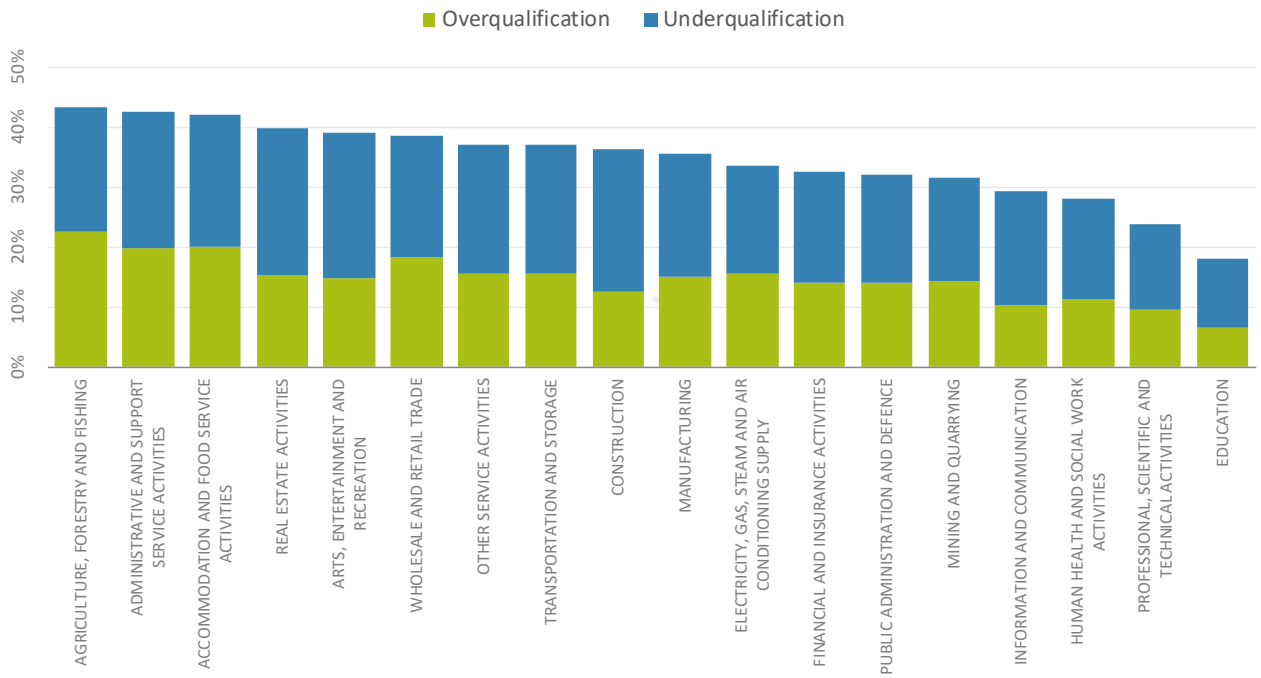
It is clear that not all qualifications face the same demand in the labour market and the choice of a specific field of study may end up affecting the match between a worker's education level and field of study to those of her/his job. **Figure 8.1** shows the extent of field of study mismatch across different fields. **On average across the OECD, more than 7 out of 10 graduates in the field of Humanities and Arts are employed in a job that is unrelated to their specialisation**. Similarly, a substantial share of graduates in Science and Agriculture fields also struggle to find employment in those fields (60 and 51% respectively). A relative good alignment exists, instead, in the field of Social Sciences, Business and Law as well as in Health and Welfare whose graduates are able to find a job matching their fields of specialisation more easily. Strengthening career guidance and building robust information systems for families and students may help reduce the extent of these mismatches, supporting individuals in their education choices.

Figure 8.1 Qualification and Field of Study mismatch across countries and sectors

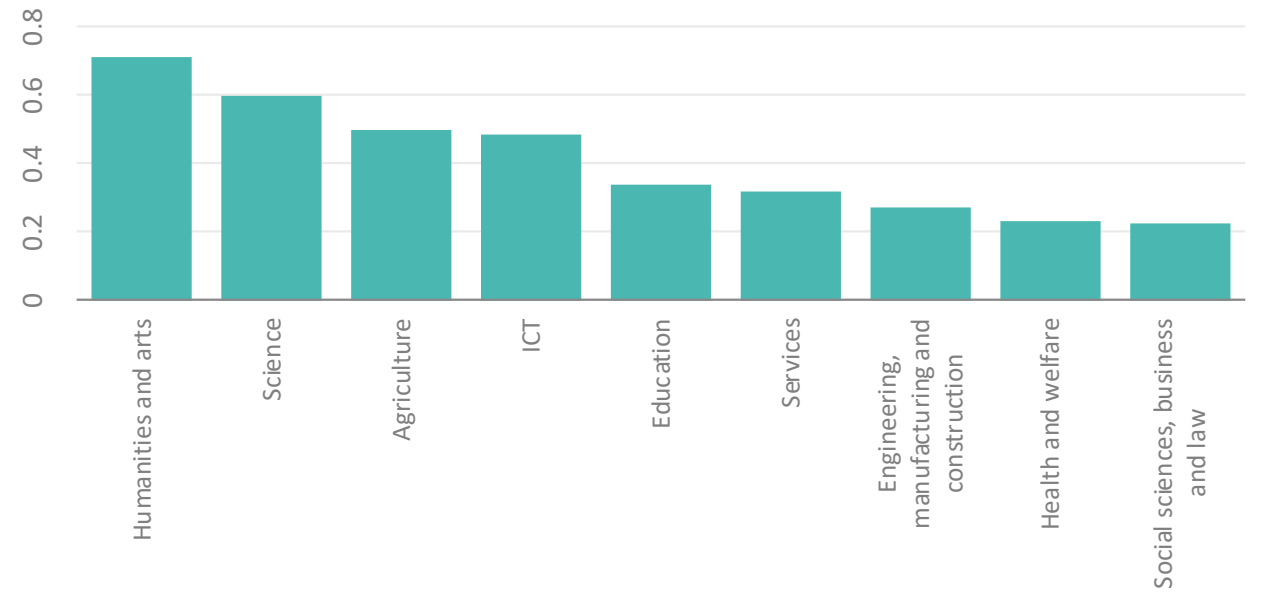
A. Qualification Mismatch



B. Over and under-qualification by sector -OECD average



C. Fild of study mismatch by field of study - OECD average



Source: OECD Skills for Jobs database (2018)

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