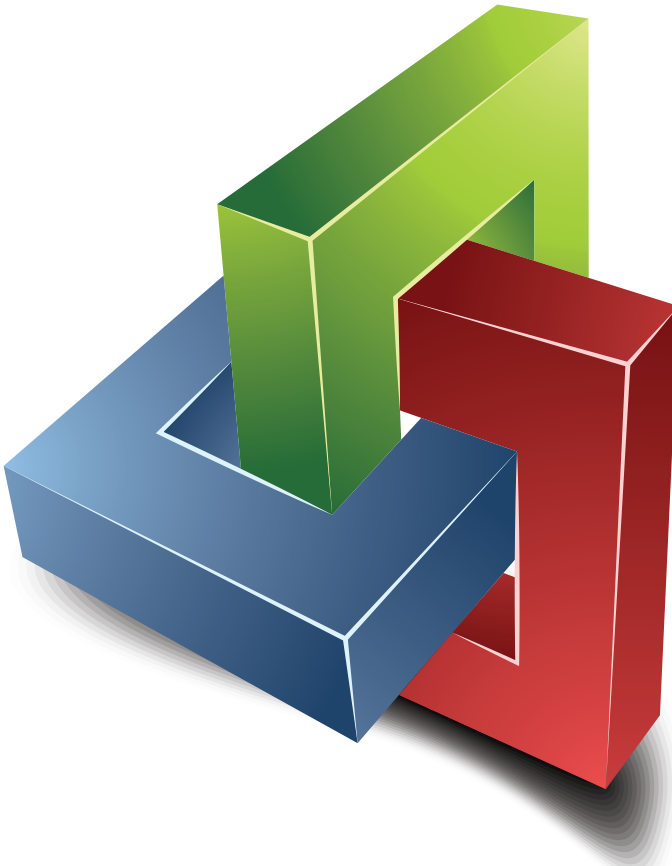




Skill shortages and gaps in European enterprises



STRIKING A BALANCE BETWEEN
VOCATIONAL EDUCATION AND TRAINING
AND THE LABOUR MARKET

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Foreword

As Europe struggles to exit from a protracted and costly economic crisis, four in 10 businesses in the European Union (EU) report difficulties finding staff with the right skills. To the extent that such vacancies reflect skill shortages, which have adverse consequences for the productivity and competitiveness of European enterprises, it is important for EU vocational education and training (VET) policies to address the source. But why are employers faced with significant difficulties in recruitment at a time when the European workforce is the most highly qualified in its history and is characterised by high un(der)employment? This report tries to provide an answer to this topical question.

By exploring a wealth of available European data sources (European company surveys, Eurobarometer surveys, OECD/PIAAC survey of adult skills, Cedefop's pilot skills obsolescence survey), the report attempts to single out the extent to which employers' general difficulties in recruitment can be truly attributed to skill shortages, as opposed to other possible factors. It also traces the evolution of skill shortages in EU Member States over time. Finally, it scrutinises the critical role that organisations have in addressing not only the skill gaps of their present workforce but also those that may arise in the future due to skills obsolescence.

The coexistence of high unemployment and unfilled vacancies in the post-crisis era is indicative of declining matching efficiencies in EU labour markets (European Commission, 2014d). Many observers have attributed such inefficiencies to skill mismatches, which arise primarily for lack of work experience and of appropriate work-related skills (or employability) of (younger) individuals. To tackle skill mismatches, the European Commission, with the support of Cedefop, has strongly promoted the further development of work-based learning (e.g. apprenticeships) and the strengthening of Member State VET systems. This has been targeted via a series of policy initiatives, including the alliance for apprenticeships, the quality framework for traineeships and the youth employment initiative. Mobility schemes, including 'Your first EURES job', have also sought to ease access of young people to jobs in sectors experiencing recruitment difficulties, such as ICT.

This report provides evidence that closer stakeholder collaboration between the worlds of education and of work is a recipe for success, potentially leading to greater employer satisfaction with the skills of new recruits. However, while the identified policy tools may go a long way towards mitigating the initial skill gaps that young workers inevitably experience during their school-to-work transition, they are only likely to be part of the solution. The inability of firms to attract the 'right' workers and fill their vacancies may arise for many reasons other than genuine shortages of skill: unattractive wages, poor and precarious working conditions, lack of career prospects, geographic and other administrative barriers, such as lack of international recognition of qualifications.

The key lesson to be drawn from this report is that many dynamic, internationally oriented EU companies, in specific economic sectors and in some Member States, face a genuine shortage of applicants with the right skills. This is concerning, given the evidence of lagging productivity and innovation in the EU relative to its major competitors in the global market. However, the share of EU firms faced with genuine skill shortages is smaller than one would believe solely on the basis of employer surveys. The evidence clearly shows that many EU firms face recruitment difficulties for reasons other than a generalised lack of skills in the European labour force. This implies that tackling skill shortages cannot be a one-sided endeavour and that the much-needed efforts to reform VET systems, as part of the ongoing Copenhagen process, may run out of steam unless enterprises fully engage in the skill formation process.

To encounter fewer difficulties in finding and retaining a skilled workforce, European companies must commit to offering high-quality apprenticeship places and good quality jobs, and take a long-term perspective to hiring and managing talent. This talent-management approach is dependent on widening the potential applicant pool (in particular females, older individuals and migrants) and on strengthening the internal talent pipeline. It requires reform of human resource management practices to create better workplaces, characterised by non-precarious work, ample learning opportunities, and challenging and motivating jobs that can effectively develop and use the skills of individuals.

However, European policy-makers also have a crucial role to play by encouraging a process of social dialogue between education and training providers and labour market actors. They must create the right incentives and institutional frameworks so that our European tools for education and training,

including national qualification and quality assurance frameworks, as well as instruments for the better validation and recognition of skills, are also embraced and owned by employers.

This report is part of Cedefop's continuous efforts to provide solid and reliable evidence to policy-makers who wish to develop and refine European VET and employment policy, in accordance with the recommendations of the flagship initiative of the Europe 2020 strategy, an agenda for new skills and jobs. I am convinced that the report will inform and enrich the policy debate on striking the right balance of skills and employment policies that can mitigate the mismatch of skills and jobs in European labour markets.

Joachim James Calleja
Director

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This report is the outcome of team effort and of own empirical analysis by Cedefop experts. Konstantinos Pouliakas, Cedefop expert, was the lead project manager and edited the report. Together with Giovanni Russo, Cedefop expert, they analysed the datasets and were the main authors. Daniel Scheuregger, Cedefop expert, also contributed part of the content.

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Executive summary

Empirical findings of report

Between a half and two thirds of EU firms with difficulties finding skilled workers face the problem for reasons other than lack of skills: unattractive job offers (unwillingness or inability to offer a competitive market wage; bad job quality; precarious contracts); and lack of employer commitment to talent management. The remaining firms meet genuine skill shortages: inability to find job applicants with the right skills, despite their willingness to pay the price for the skills sought. Genuine skill shortages are a marker of growing, dynamic, international enterprises and are more likely to prevail in specific economic sectors such as health and social care, ICT, and manufacturing.

Hiring difficulties, particularly when related to shortages of staff in high-skill jobs, are a constraint on firm productivity and the adoption of innovative technologies and forms of work. But other obstacles, such as the high cost of labour and lack of access to credit, also affect organisational performance.

For organisations with business strategies reliant on a skilled workforce, with focus on quality improvements and product differentiation, skill shortages can be an indicator of positive business outcomes (such as increasing financial turnover and employment). The reverse is true for organisations adopting business strategies based on cost reduction and volume-based production.

Skill gaps, a misalignment between the skills required to do the job in the best possible way and the skills of workers, are common in some European countries. According to a pilot survey carried out by Cedefop in four Member States (Germany, Hungary, the Netherlands and Finland) in 2011, about a quarter of all workers reported a significant skill gap.

Skill gaps are linked to job complexity; organisations that design their jobs so that skills of different breadth and depth are required by the staff to carry out their duties are characterised by larger skill gaps. The reason is that complex jobs are associated with a higher level of skill demand, which demands greater expertise of employees so that they are fully proficient in their jobs. But such high-performing organisations also tend to invest more in employee skill development to tackle emerging skill gaps, rendering the cost of skill mismatch smaller and the productivity gains for the firm larger.

Keeping up with high skill requirements to carry out one's job tasks is dependent on learning (non-formal and informal) taking place in enterprises. While part of workers' learning depends on individual attitudes, much is embedded in job design and in the wider organisational context supportive of the learning process (such as intercollegiate learning and supervisory support).

Employees with longer job tenure and those on permanent contracts also tend to report smaller skill gaps and so have the skills required for maximising the productivity potential of their jobs. The added flexibility for employers and any immediate cost-related gains from the offer of precarious contracts, therefore, need to be carefully weighed against the opportunity cost of lost productivity arising due to greater skill gaps in personnel.

By contrast, organisations that invest in informal learning for their workforce, integrated within the overall work context, are less likely to experience skills obsolescence among their staff.

Employers that are inclined to break down jobs into simple tasks, requiring only a limited set of skills for the sake of cost competitiveness, may benefit from the existence of smaller skill gaps in their existing workforce. In the long term this will come at the cost of lower skill content and productivity of jobs; employees may struggle to adapt to changing circumstances, with a greater propensity towards skills obsolescence.

Policy implications

Skill shortages

The difficulties in recruitment faced by employers could be tackled better if firms adopt an alternative mix of human resource policies. Such a strategy should rely on:

- (a) the offer of better and more stable jobs to skilled applicants, including the offer of high quality apprenticeship places;
- (b) investment in strengthening the talent pipeline, both from outside (via greater cooperation with local employer associations and with education and training institutions) and inside the firm (provision of vocational training to staff in lower-skilled posts and on temporary contracts; clearly defined career progression paths);
- (c) hiring on the basis of the potential of job applicants rather than on accumulated prior work experience;
- (d) greater reliance on sourcing relatively unexploited talent (female and older workers);

(e) superior design of learning-intensive jobs and workplace practices.

However, policy-makers also have a crucial role to play in creating the right incentives and institutional frameworks to strengthen the involvement of employers in developing and implementing VET policies. The provision of financing and of public consultancy support (such as exchange of best practices in workplace reorganisation), as well as policies to combat monopsonistic practices, can be particularly beneficial for smaller-sized, domestic or remote firms, which tend to have greater difficulty attracting skilled workers.

Skill gaps

To tackle current and dynamic skill gaps in European enterprises, the incentives of both individuals and organisations in the process of skill development and skills matching need to be closely aligned. Individuals need to have a positive attitude to learning and possess an appropriate set of core competences and motivations that will enable them to be flexible and adaptable in response to economic and organisational shocks. But organisations also have a critical role to play in avoiding the cost of skill gaps. This can be achieved by:

- (a) reflecting on the organisation's business strategy: innovative business and product market strategies may be positively associated with skill shortages and skill gaps due to the higher level of skill demanded in jobs, but ultimately such practices are linked to better organisational performance outcomes and lower levels of skills obsolescence;
- (b) fostering a learning climate in the workplace, with emphasis on management provision of support for employee learning opportunities and via intercollegiate learning;
- (c) supporting work complexity, including the ability of workers to use skills of wider breadth and depth in their daily work routines and to have a degree of control when engaging in abstract tasks;
- (d) enabling better balance between work and life responsibilities, given that skill development is an investment that requires time and since work-life conflicts may lead to larger skill gaps;
- (e) cooperating with education and training institutions and participating in curriculum design (particularly in relation to state-of-the-art sector skill needed in the relevant industry), which mitigate asymmetries in information on the skills of new recruits.

The returns on training for organisations are heterogeneous (Cedefop, 2013; European Commission, 2014d) and the effectiveness of training subsidies to firms depends on their overall business strategy and commitment to a high quality workforce. Firms that treat their human resources as an intangible asset are more likely to reap substantial benefit from training activities. By contrast, organisations that regard labour as a cost to the firm are likely to enjoy fewer benefits, or even a zero or negative return from their investment in training.

A complex shift in organisational paradigm and architecture has to be engineered to change non-training organisations into training organisations. Organisations need to regard their workforce as an intangible asset, jobs must be designed to enable on-the-job learning, and skill needs to be effectively deployed as part of workers' everyday job tasks. Organisations must support the continuing learning efforts of their workers. This can be achieved not only via the offer of additional non-formal training courses but, critically, by fostering high levels of informal learning as part of the work setting and by wider organisational support for the learning process. A long-term perspective must be put in place to avoid rising levels of skills obsolescence among ageing workers.

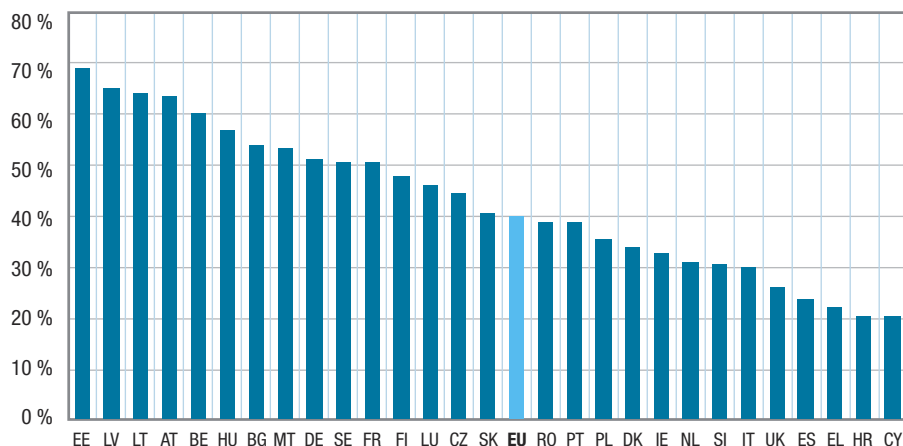
To survive in the global economy, the business strategy of European firms will increasingly have to make higher demand for skills that hold the key to greater competitiveness. Necessary prerequisites to this are European VET policies aimed at developing creativity and entrepreneurial capacity, accompanied by the offer of consultancy services to SMEs on organisational change and market positioning, and strategic investment funds and financing tools supporting the reengineering of European business and product market strategies.

Tales and myths of skill shortages in Europe

1.1. Introduction: claims of skill shortages in the EU

The global financial and economic crisis has increased unemployment in the European Union (EU) to unprecedented levels, yet a range of global manpower and consulting surveys frequently indicate that a significant share of employers have difficulties finding job candidates to fill their vacancies. The latest European company survey in spring 2013 (ECS-2013), found that four out of 10 (39%) firms in the EU had difficulties finding staff with the right skills. Figure 1 shows these skill shortages vary markedly across Member States; 'over 60% of establishments in Austria and the Baltic states have difficulties finding suitably skilled employees, this is substantially more than in Croatia, Cyprus, Greece and Spain (less than 25% each) (Eurofound, 2013, p. 7).

Figure 1. **Difficulties finding staff with required skills in EU firms, 2013, EU-28**

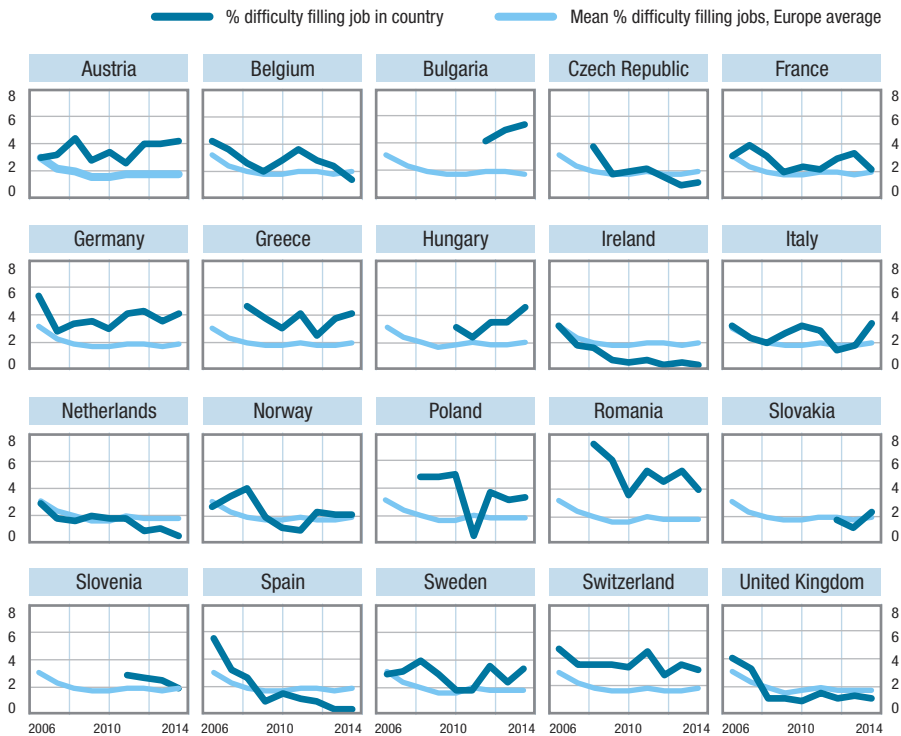


NB: Proportion of establishments replying affirmatively to the question 'Did your establishment encounter difficulties in finding staff with the required skills?'

Source: Eurofound, ECS-2013.

Claims of skill shortages are also widespread in the public media and in policy discourse. For example, the annual talent shortage surveys ⁽¹⁾, undertaken by ManpowerGroup using a sample of over 37 000 employers from 42 countries, regularly report that more than a third of employers experience difficulties to fill their jobs (ManpowerGroup, 2014). Employers in some European countries, most notably Austria, Bulgaria, Germany, Greece, Hungary Romania and Switzerland, have generally been more susceptible to talent shortages over the past eight years (2006-14) (Figure 2).

Figure 2. Difficulties filling jobs in European countries, 2006-14



NB: The mean EU difficulty filling jobs is based on the means of 12 European countries (Austria, Belgium, France, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the UK) with valid information across all years (2006-14). The EU average is weighted according to each country's share in total EU employment.

Source: ManpowerGroup, talent shortage surveys, 2006-14.

⁽¹⁾ ManpowerGroup's ninth annual 2014 talent shortage survey. <http://www.manpowergroup.com/wps/wcm/connect/ec2b6e68-bc26-4e5a-8493-78a9b53c5ab8/2014+Talent+Shortage+Infographic-Final.pdf?MOD=AJPERES> [accessed: 26.3.2015].

Concerns about the existence of skill shortages and skill gaps in an economy are important, given that they can potentially lead to a loss of competitiveness, as wage rates are bid up, and to lower productivity in industries where such skill-related problems exist (Haskel and Martin, 1996; Bennett and McGuinness, 2009; Healy et al., 2015; UKCES, 2011; ManpowerGroup, 2014) ⁽²⁾. They are crucial to shaping appropriate skills and employment policy responses to the extent that skill mismatches are considered to be a significant component of high and persistent structural unemployment rates in Member States (Box 1).

Box 1. European policies to tackle skill mismatch

Given the historically high (youth) unemployment rates in the EU economy as a result of the great recession of 2008, striving for a closer integration between the worlds of education and of the labour market has been high on the European policy agenda. In response to evidence of widespread skill imbalances in EU economies, the EU communications *New skills for new jobs* and *Rethinking education*, as well as the Europe 2020 flagship initiative *Agenda for new skills and jobs* (European Commission, 2008; 2010a; 2012a), have emphasised the need to tackle skill mismatch by anticipating and matching skills in closer alignment with labour market needs. To assist, the European Commission has developed a range of labour market and skills intelligence tools in recent years, such as Cedefop's European skills forecasting model, the EU skills panorama and the European skills and competences for occupations tool (ESCO). Recent EU policy initiatives for combating youth unemployment, including the 'youth guarantee' and the 'alliance for apprenticeships', have also been built under the premise that updating the skills of job seekers via work-based learning and practical experience can be beneficial for simultaneously mitigating skill shortages of firms while tackling high rates of unemployment.

In a 2014 study, Cedefop collected an inventory of the most recent (post-2007) innovative policies that EU Member States have adopted to combat skill mismatch



⁽²⁾ More than half of the global employers surveyed as part of the talent shortage surveys in 2014 stated that talent shortages significantly impact their ability to meet client needs; 40% of employers said that shortages reduce their competitiveness and productivity (ManpowerGroup, 2014). Haskel and Martin (1996) have estimated that skill shortages reduced annual productivity growth in the UK by 0.4 percentage points over the period 1983-99; Bennett and McGuinness (2009) reported that output per worker was lower in high-tech Irish firms with hard-to-fill vacancies.

(Cedefop, forthcoming). The study has revealed that governments have invested considerably in improving the institutional framework that governs the relationship between the worlds of education and of work, including the development of sectoral or local skills councils, national qualification frameworks, skills forecasting systems and electronic platforms that enable skills profiling of job applicants and job vacancies by public employment services. Public training courses have also been redesigned to consider the needs of particular sectors and/or occupational groups that are critical for national economic development.

Although many sources have provided ample evidence that European enterprises face significant difficulties in finding talent, the causes of such recruitment difficulties are more contentious. Some commentators have argued that employers' difficulties in filling their vacancies are related to the fact that young graduates and individuals are ill-prepared for the skills demanded by modern enterprises. Skill mismatch in labour markets is therefore believed to be caused by structural shifts that have rendered the skills of individuals insufficient or irrelevant in relation to the rising demand for high-level skills in advanced economies (MGI 2012a; 2012b; also see quotations in Box 2). Others reject the proposition that there are skill deficits in the EU labour force and argue that the true reasons for firms' hiring challenges include the offer of low quality jobs, inadequate investment in employer-provided training or other inefficient human resource management (HRM) practices (Cappelli, 2012).

Despite these rebuttals, or the fact that skill shortages generally remain poorly defined and measured, and even though what constitutes appropriate government intervention is often an open question (Trendle, 2008), the thesis that persistent skill shortages are constraining the ability of European enterprises to remain competitive in the global competitive economy remains strong.

Box 2. Skill shortages in the 21st century workforce

Skill mismatch is 'symptomatic of structural changes that are altering the nature of work and shaping employment opportunities in advanced economies. Put simply, labour market institutions and policies have not kept up with the changes in business



practices and technology that are defining what kinds of jobs will be created and where they will be located. As a result, simply restoring robust aggregate demand may not be enough to bring back pre-recession employment levels and will not prepare the workforce for the new jobs of the next two decades' (MGI, 2012a, in Preface).

'Based on current trends, there are potentially serious gaps in the supply of workers with the skills that will be needed to drive 21st century economies, and a growing surplus of workers with more limited skills. Avoiding these imbalances (in both advanced and developing economies) and their consequences will require an unprecedented commitment to education and training' (MGI, 2012b, in Preface).

1.2. Defining skill shortages

Skill shortages are usually defined as instances when the demand for a particular skill exceeds the supply of available people with that skill at market-clearing wage rates (Veneri, 1999; Shah and Burke, 2003; Cedefop, 2010; also see Box 3 for further definitions).

Skill shortages may arise because of the differential dynamics between skill demand and skill supply in an economy, particularly when the latter may not respond (or respond with a significant lag) to changing market signals, notably the wage rate. A shortage of skill may be apparent in knowledge-intensive sectors and/or occupations, given that the demand for new skills may outpace existing supply for a given period of time. Further, demographic change is also often a cause of (current and anticipated) skill shortages. For example, the demographic crunch in the European population (Peschner and Fotakis, 2013, Cedefop, 2014a) is likely to exert considerable strain on the age dependency ratio and to result in high demand for particular professionals, such as in the health care sector. Unless appropriate market and policy responses are undertaken to anticipate such trends, skill shortages may materialise.

Recurrent shortages of STEM ⁽³⁾ skills in the European economy are also often reported; these are believed to have arisen because of the low

⁽³⁾ Science, technology, engineering and maths.

attractiveness of jobs in the manufacturing sector. Sectoral restructuring, accentuated by the economic crisis, may also lead to simultaneous existence of unemployment and skill shortages for specific skills in an economy (e.g. a collapse in shipbuilding at the same time that there is a high demand for welders in wind turbine farms). Finally, business cycle movements, geographic barriers, information gaps (about available job vacancies, the skills of job applicants, the wider employment and career prospects of alternative occupations) and institutional constraints (such as wage inflexibility, stringent employment protection legislation, occupational licensing and regulations) that prevent the market from clearing, may also lead to skill shortages that last a considerable time.

The duration of a shortage will be longer the more complex and skill-intensive the vacancy, so it could vary across sectors and occupations (Richardson, 2007). The duration will ultimately depend on the time elapsing before it is communicated through the market mechanism or wages adjust to clear the disequilibrium. Nonetheless, there are several frictions that may impede the fast response of the wage mechanism in the presence of skill shortages. Apart from the challenges of collective wage bargaining, firms may be wary of wage inflation or of rising staffing costs across the board, or there may be significant time lags and 'menu costs' related to the ability of human resource departments to detect and adjust salaries quickly to meet recruitment difficulty (Arrow and Capron, 1959). For these reasons, wage adjustments are also only one possible means of adjustment; non-wage adjustments or alternative strategies appear to be more commonly used by companies to address the problem (Haskel and Holt, 1999; UKCES, 2012). Common examples are the provision of additional training to existing staff, reducing output, adjusting inventories, increasing overtime, or using more vigorous recruitment methods. In the face of genuine skill shortages, when required technical skills are not available in the labour market, employers may also be forced ultimately to adjust their skill demand by hiring less qualified workers for the specified tasks and seeking to upgrade their skills through training. In the long term, employers may also invest in a different mix of technology, capital and labour, to overcome skill deficiencies; this embodies the skills in the capital equipment rather than in people.

Box 3. Definitions of skill shortages

The term 'skill shortages' typically refers to a skills-related labour market shortage, i.e. when there are not enough individuals with the required skills within the economy to fill existing vacancies at market-clearing wages. This is the most conventional definition. However, in the context of the continuing adverse demographic evolution in most advanced economies, many also refer to the anticipated quantitative shortfall of workers in the economy as a 'skill shortage'. Others have used the concept to describe circumstances of aggregate mismatch between the available skills and jobs in labour markets (Shah and Burke, 2003). Measurement issues are important (as in Green et al., 1998) and some recent attempts have been made to move towards a more refined definition that incorporates training lead times and other important considerations.

Richardson (2007, p. 7) has proposed the following system for defining skill shortages:

- level 1 shortage: there is a shortage of individuals with the relevant technical skills who are not already using them and it takes a long training time to develop these skills;
- level 2 shortage: there are few people who have sufficient skills and are not already using them, but such skills can be developed relatively quickly.

The Australian government also emphasises the importance of job conditions and location by defining skill shortages as situations '... when employers are unable to fill or have considerable difficulty in filling vacancies for an occupation, at current levels of remuneration and conditions of employment and reasonably accessible location' (Australian government, 2014).

However, other authors have given emphasis to the dynamic element of skill shortages, clarifying that they only arise when '...the number of workers available (the supply) increases less rapidly than the number demanded at the salaries paid in the recent past' (Blank and Stigler, 1957, p. 24). In this context, the extent and duration of a skill shortage ultimately depends on the relative pace of change between demand and supply and on the effective responsiveness of market and policy actions (e.g. adjustment of wages, provision of appropriate public vocational training programmes).

For some policy-makers the notion of skill shortages is tantamount to a social planner problem (Arrow and Capron, 1959), whereby the market equilibrium in terms of skills is suboptimal relative to the socially desired outcome. For example, the existing numbers of engineering professionals in an economy may be considered to endanger strategic national or European objectives such as the shift of the economy from being resource-intensive to the development of sustainable green technologies. As the sole



reliance on market adjustments may be too risky for the attainment of national skill strategies, some policy-makers would argue that policy intervention is warranted to prevent bottlenecks from constraining long-term growth possibilities.

To avoid confusion in the context of this report, the following terms and definitions are used (Cedefop, 2010; Lazear and Spetizer, 2012; European Commission, 2014b):

Skill mismatch	A situation where there is a (qualitative) discrepancy between the qualifications and skills that individuals possess and those that are needed by the labour market.
Mismatch	A situation where industries, occupations, locations or groups with different levels of education/skill diverge over time in the unemployment-to-vacancies ratio.
Skill imbalance	A difference between the aggregate quantities of demand and supply of individuals with different levels of skill in an economy.
Recruitment/vacancy bottleneck	A situation where a given vacancy (posted in a recent time period) is hard to fill by employers
Skill shortage (or talent shortage)	A situation where the demand for a particular type of skill exceeds the available supply of that skill at the market-clearing rate of pay.
(Internal) skill gap	A situation where the level of skills of the existing workforce in a firm is less than required to perform a job adequately or to match the requirements of a job.
(Economic) skills obsolescence	A situation where skills previously used in a job are no longer required or have diminished in importance.

Skill mismatch, a particular form of labour market mismatch, refers not only to skill shortages or gaps, but also to qualifications, knowledge and skills exceeding job requirements. Depending on the extent of substitutability between labour of different skill levels, skill imbalances may not necessarily be equivalent to skill shortages, for instance when shortages for medium-qualified workers are easily filled with higher-educated individuals (which, nevertheless, may result in rising qualification mismatches in the form of higher overqualification rates). Skill shortages usually refer to recruitment difficulties when firms struggle to hire suitably skilled workers in the external labour market (outside the firm). By contrast, internal skill gaps and skills obsolescence are phenomena that concern the currently employed.

1.3. Recent evidence of skill shortages and mismatch

Skill shortages tend to manifest in difficulties by firms to fill their available vacancies in a reasonable period of time at current pay and working conditions in the industry, because of an inability to find workers with the desirable skill set.

Since the 2008 recession and up until the third quarter of 2011 the EU Beveridge curve shifted outwards towards a higher unemployment rate for a given vacancy (or labour shortage) rate, which is suggestive of impaired matching efficiency in the EU labour market (European Commission, 2014d) ⁽⁴⁾. This has led to concerns that the vacancies created in the aftermath of the economic crisis, primarily in services and among high-skilled occupational groups ⁽⁵⁾, require different skills from those that (long-term) unemployed workers possess, the latter released from sectors or occupations with a diminishing relative share in total employment (such as construction). Analyses by the ECB (2012) and the European Commission (2013) have further confirmed that the shift in the EU Beveridge curve is likely to reflect structural changes that took place during the crisis. The most significant of these changes included the shift in the aggregate balance of demand for skills (i.e. a fall in demand for lower-educated individuals) as opposed to rising dispersion in the sectoral or regional distribution of job vacancies in relation to the available stock of unemployed persons ⁽⁶⁾.

While the shift in the Beveridge curve points to structural difficulties in filling vacancies with the available labour force, it has nothing to say about the quality of the available jobs or the underlying causes of such difficulties. Researchers have typically tried to measure skill shortages at the microeconomic firm-level, as hard-to-fill vacancies that arise because of shortages of suitably skilled candidates (UKCES, 2014). For instance,

⁽⁴⁾ The Beveridge curve depicts a downward sloping convex relationship between the unemployment rate and the job vacancy (or labour shortage) rate. Empirically, a shift in the Beveridge curve (e.g. a higher number or duration of vacancies at the same level of unemployment) is likely to indicate an increase in the level of mismatch in a labour market, while a movement along the curve is indicative of cyclical fluctuations (e.g. a decrease or increase in job vacancies taking place simultaneously with an increase or decrease in unemployment).

⁽⁵⁾ For example, 18 of the top 25 growth occupations in the EU job market in terms of employment between 2011 and 2012 required high levels of skills; 11 were in the 'professionals' group (European Commission, 2014b).

⁽⁶⁾ Although in Greece, Spain, and Portugal, industry mismatch appears to have played a role in the drop in the efficiency of the matching process in the labour market during the crisis (European Commission, 2013).

evidence collected as part of the UK's employer skills survey illustrates that such skill shortages affect a small share of establishments and of total employment (typically 2-3%); but they can be persistent and account for most vacancies that are hard to fill. In 2013, even though about 15% of British establishments had unfilled vacancies, only about three in 10 of these were hard-to-fill vacancies. Skill-shortage vacancies, namely hard-to-fill vacancies specifically for lack of skills, qualifications and/or work experience on behalf of job applicants, represented a fifth (22%) of all vacancies. However, such skill shortages are the main reason for hard-to-fill vacancies and their contribution has risen since 2011 in the UK by 4% (up from 16% three years ago). Also, almost two-thirds of all skill-shortage vacancies in 2013 were linked to 'lack of technical, practical or job-specific skills' and most such vacancies are typically reported for skilled trades workers and machine operatives but also among managerial and professional occupational groups. Generic or 'softer' skills such as planning and organisation, customer handling, problem solving and team working were each cited in connection with between one-third and two-fifths of skill-shortage vacancies.

Talent shortages are often a concern for particular economic sectors. The shift to greener technologies in manufacturing poses significant challenges with respect to the need for specific engineering skills (electric engineering of hybrid cars, manipulation of light materials, product design) or of specific occupations (energy auditors, photovoltaic installers, insulation workers, environmental engineers, sheet metal workers) (Cedefop, 2011). In a recent survey of manufacturing establishments in the US, more than 75% of manufacturers reported a moderate or severe shortage in highly skilled manufacturing resources (Accenture, 2014). The ICT sector also seems to be confronted by lack of professionals with highly technical skills in areas such as ICT security and cloud computing (European Commission, 2012b). A growing shortage of ICT professionals and experts in Europe has been predicted, with an estimated shortfall of as many as 900 000 professionals by 2020, which has prompted the institution by the European Commission of the so-called Grand coalition for digital jobs (7).

The European recruitment and vacancy report (European Commission, 2014b) in recent years has employed several indicators of recruitment difficulties, such as the ratio of vacancies or of new hirings to unemployment, to identify sectors and occupations susceptible to labour market bottlenecks.

(7) European Commission. *Digital agenda for Europe: skills and jobs: Grand coalition*. <https://ec.europa.eu/digital-agenda/en/grand-coalition-digital-jobs> [accessed: 26.3.2015].

The level of recruitment difficulty typically varies by sector. For instance, hiring problems are widely reported by employers in manufacturing while they are least common in financial services. Several occupations that experienced consistent employment growth throughout the years of the economic downturn are also identified. Demand has tended to be generally strong for high-skilled vocational professionals, mainly in ICT (software and applications developers), health (personal care workers in health services, nursing and midwifery professionals, medical doctors), engineering (mining, manufacturing and construction supervisors, process control technicians) and teaching (university and higher education teachers).

In a recent overview of bottleneck occupations across all Member States, the European Commission has found that these vacancies do not only occur in high-skill occupations, such as health, IT, scientific and engineering professionals, but are also found in skilled and low-skill manual occupations, in manufacturing, construction or tourism (European Commission, 2014a). The study has highlighted that most bottlenecks identified are structural and persistent. The most common reasons for them are mismatch in educational choices at high-skill level, and poor wage or working conditions leading to high turnover and difficulties in replacing ageing workers at lower skill levels. From this information, the study notes that education and training systems need to be aligned better and more swiftly to labour market needs, also with the help of better labour market intelligence tools, and that EU governments need to design initiatives that address shortages in a coordinated manner.

1.4. Challenging the evidence on skill shortages

1.4.1. Measurement problems

Most of the evidence reported in the previous section relies on subjective reports by employers and/or other field specialists, such as labour market experts and consultancy companies, about difficulties filling vacancies in the labour market ⁽⁸⁾. But, as argued by Cappelli (2015), there are many problems in assessing these reports, beginning with basic concerns about the quality

⁽⁸⁾ On some occasions commentators also argue that the presence of vacancies in an economy with high unemployment is a sign of skill mismatches. But although vacancies are an important sign of 'unrealised' labour demand, at the same time they are the natural outcomes of the functioning of the labour market. At any particular point in time, vacancies will exist in a cross-section of firms or of a market economy, sometimes only reflecting natural labour market turnover as opposed to skill shortages.

and nature of the data: how was the sampling frame created (including whether the sample is representative of all employers in the economy)? What was the response rate (are there biases in the responses)? What does it mean to have difficulty in hiring? Respondents are rarely presented with any objective criteria, rendering their assessments susceptible to their own prior expectations.

Green et al. (1998) have highlighted further that the terms ‘skill shortage’ and ‘hard-to-fill vacancy’ are understood as different concepts by different employers. It is therefore important that measures of skill shortages based on establishment surveys first gain clarification (either directly or indirectly) over employers’ preconceptions of what constitutes a ‘hard-to-fill vacancy’ or a ‘skill shortage’.

Skill shortages are also hard to diagnose from subjective accounts of recruitment bottlenecks, because other situations may give rise to the same symptom. Examples of factors that may account for the difficulties of employers in hiring, other than skills, include:

- (a) information friction: employers may have difficulty locating the right skills in the labour market when there is asymmetric information about the availability of job vacancies, competing job conditions in the industry, the typical duration of vacancy filling (particularly among firms that hire infrequently) or when firms cannot suitably filter job candidates with the right skills (even though skilled workers are readily available in the job market);
- (b) geographic barriers: even though there can be an overall balance in skilled workers needed and available in the national economy, skill shortages may ensue at regional or local level if there is an unbalanced concentration of jobs and skills in the economy (so-called agglomeration or clustering effects; UKCES, 2010);
- (c) poor or inefficient recruitment intensity in firms: according to Cappelli (2012), many companies suffer from a dysfunctional hiring process that is caused by an over-reliance on software-based hiring systems. Such systems employ strict automated keyword searches of *résumés* and may reject suitably skilled job candidates who are not precise matches with the automated job criteria. He also notes that many companies are constrained in their ability to counteract such hiring errors, as there has been a dramatic downsizing in human resources departments in recent years. Therefore, ‘part of the problem is that employers are indeed searching for unicorns: “perfect” fits for what are often imperfectly described and listed jobs’ (Cappelli, 2012). Davis et al. (2012) also offer

evidence in support of this argument, as they show that the recruiting intensity per vacancy of US firms declined steadily during and after the years of the recent recession. Few companies tend to widen their recruitment pool to include possible sources of unexploited talent (females, older workers, migrants) (ManpowerGroup, 2014);

- (d) uncompetitive or unattractive job offers (poor wages, bad working conditions): although firms may believe that they are faced with a skill shortage, the underlying reason for their inability to attract a suitably skilled workforce may be that the job offer, in terms of compensation and working conditions, is unattractive.

What these alternatives imply is that without additional information on the skill requirements of jobs, firms' recruitment efforts, wages and working conditions offered, or the typical time to fill a vacancy, it is very difficult to say whether the reported difficulties in hiring applicants with the desired skills are a sign of genuine skill shortages.

1.4.2. Problems of time inconsistency

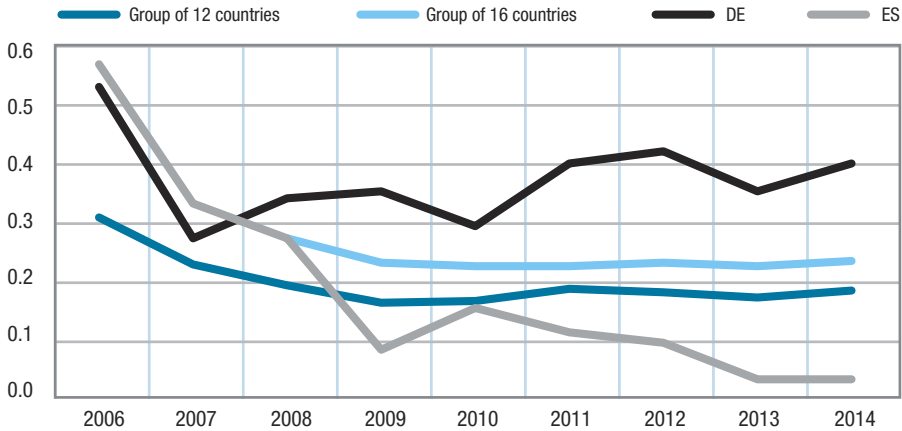
The magnitude and persistence of skill shortages, as reported by employers, also defies prevailing (economic) logic, considering the falling or subdued average wage growth in most European countries in the post-crisis era and the fact that the pool of available labour (including the unemployed or inactive) was amplified as a result of the 2008 recession ⁽⁹⁾. Figure 3 displays the average trend of talent shortages across selected European countries in the past nine years, based on the annual ManpowerGroup talent shortage surveys. The scale of talent shortages generally declined in Europe during the period of the economic crisis, particularly evident in some Member States (the Czech Republic, Ireland, Spain, the Netherlands and the UK; see Figure 2).

The fact that the reported skill bottlenecks in EU firms fell as a response to rising unemployment rates created by the recession is also confirmed by a longitudinal statistical analysis of two separate surveys of business executives and managers (see Annex 2 for a methodological guide). Table 1 shows that the variation in employers' perceptions of skill bottlenecks both across, but also within, countries can be significantly explained by differences in the unemployment rate. After considering other important factors that vary

⁽⁹⁾ Krugman (2012) has also drawn attention to the fact that concerns about endemic skill deficits were also prominent in the policy discourse during previous economic recessionary periods (e.g. the 1930s and 1980s). Such concerns were swiftly alleviated when positive macroeconomic swings ensued in the booming years of the 1940s and 1990s.

between the countries (such as levels of national income, regulatory environment, employer commitment to good work), higher unemployment rates are found to be associated with a significantly lower hiring difficulty by employers. For every 1% increase in the rate of unemployment since 2006, there was a 0.8-1.3% decline in the average recruitment bottleneck of firms.

Figure 3. **Share of European employers with difficulty filling jobs, 2006-14**



NB: The average EU difficulty per year is based on the means of either 12 (2006-14) or 16 (2008-14) European countries for which valid information is available. The group of 12 countries includes: Austria, Belgium, France, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the UK. The group of 16 also include: the Czech Republic, Greece, Poland and Romania. EU average weighted according to the share of each country in total employment.

Source: ManpowerGroup, talent shortage surveys, 2006-14.

Table 1. Determinants of difficulties filling jobs/finding skills by employers, 2000-13

	Difficulty filling jobs		Skills not readily available in economy ⁽ⁱ⁾			
	Global re	Europe fe	Global re	Global fe	Europe re	Europe fe
Unemployment rate	-1.26*** (0.338)	-0.80** (0.392)	-11.42*** (1.333)	-12.48*** (1.417)	-10.11*** (1.952)	-7.61*** (2.350)
Skills not readily available in economy (i)	0.02** (0.009)	0.04*** (0.010)				
Firms' commitment to good work (i)	-0.01 (0.011)	-0.01 (0.012)	-0.37*** (0.038)	-0.31*** (0.042)	-0.31*** (0.057)	-0.24*** (0.068)
Leniency of regulations (i)	0.02 (0.013)	0.02 (0.013)	-0.32*** (0.045)	-0.33*** (0.046)	-0.32*** (0.065)	-0.36*** (0.069)
GDP per capita	0.00 (0.001)	-0.00 (0.001)	-0.01*** (0.004)	-0.00 (0.005)	-0.01* (0.006)	-0.01* (0.007)
Share of industry in employment	0.11 (0.332)	-0.26 (0.474)	3.96*** (1.261)	4.37** (1.752)	10.35*** (2.659)	16.21*** (4.515)
Time dummies	√ (2006-13)		√ (2000-13)			
Constant	0.49*** (0.108)	0.58*** (0.171)	0.28 (0.421)	-0.06 (0.531)	-1.89** (0.905)	-3.69*** (1.354)
N	239	132	710	710	358	358
R-squared	0.21 (overall)	0.24 (within)	0.47 (overall)	0.45 (within)	0.52 (overall)	0.47 (within)
Wald chi2	64.79***	4.69***	547.11***	28.56***	311.65***	15.0***
Corr(ui, X)	0	-0.26	0	0.17	0	-0.29
No of countries	38	21	58	58	28	28

NB: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; re = random effects estimates; fe = fixed effects estimates; (i) = principal components index (see Annex 2 for methodology).

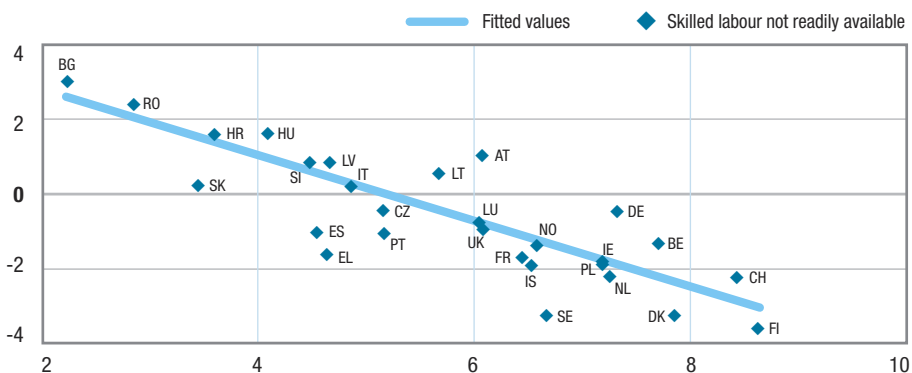
Source: ManpowerGroup, talent shortage surveys (difficulty filling jobs); IMD world competitiveness yearbook (WCY) (skills not readily available).

The empirical evidence, therefore, confirms that during the economic turmoil, talent shortages in the European (and global) economy became less pronounced, given that employers were confronted with a significantly larger supply of available skilled labour per job vacancy.

1.4.3. Erroneous perceptions of failing education systems

The contemporary policy debate has also highlighted the critical role of an effective and responsive education and training system in mitigating the difficulties firms face in finding skilled labour. As depicted in Figure 4, there is a close negative correlation between the perceived economic relevance of education and training and managers' beliefs about the absence of a readily skilled workforce in the economy. In countries in which business executives believe that the education system meets the needs of a competitive economy (Denmark, Finland, Switzerland), there is a simultaneous lower incidence of stated skill shortages. The reverse is true for countries where the education and training system is believed to be non-responsive to economic needs (Bulgaria, Croatia, Hungary, Romania). Therefore, various commentators frequently place the blame for skill mismatch on the inertia and inflexibility of education and training systems, which cannot keep up with the dynamic demands of competitive markets. It is often asserted that education systems have a tendency to educate the graduates of tomorrow in the skills needed by industry yesterday. Current education structures and curricula have also been characterised as relics of a past industrial era (Robinson, 2011), which consistently fail to endow students with the much needed 21st century skills of the modern economy, such as learning, creativity and innovation, digital literacy, and life and career management skills (Trilling and Fadel, 2009).

Figure 4. **Education system meeting needs of a competitive economy versus skilled labour not readily available, 2013**



NB: Based on perceptions of business executives; the vertical axis is a principal components factor summarising the lack of availability of skilled labour in the economy; the horizontal axis is measured on a 0-10 scale, where 0 is the lowest possible level of agreement to the statement and 10 the highest.

Source: IMD, WCY 2013.

But new labour market entrants are just a small share of the overall labour supply of countries per year. Therefore, potential skill deficits in recent graduates cannot account for the aggregate skill shortages reported by employers. Further, claims that skills are in short supply are also in contrast with the fact that recent cohorts of young European men and women have acquired unprecedented levels of human capital. In addition to rising educational attainment rates (European Commission, 2014c), the OECD also conducts a triennial international assessment of young individuals' cognitive skills as part of the PISA (and more recently the PIAAC) surveys. No strong evidence has been found to suggest that the skills of young students have declined over the past decade or that younger individuals are less skilled relative to older cohorts of individuals.

According to the flash Eurobarometer survey 304 (European Commission, 2010b), about 89% of European employers who recruited higher education graduates in the past five years were also satisfied with the skills of their new recruits: they agreed that these graduates had the skills required to work in their company. These employers were mostly dissatisfied with the foreign language skills as well as the 'soft skills' (problem solving, planning/organisation skills, interpersonal skills, team working) of the graduates hired. Concerns are often expressed in employer surveys about the inability of businesses to find workers with the right set of soft skills. But most surveys do not account for the fact that employers complain about the absence of such skills under the condition that workers already possess the necessary technical competences (hard skills) at the time of hiring (Humburg and van der Velden, 2014).

According to the talent shortage surveys, the reason most commonly cited by employers for struggling to fill their jobs is lack of technical competences (hard skills). The lack of available candidates, lack of work experience and soft skills follow in importance. Skilled trades positions tend to be the most difficult jobs to fill, followed by engineers and technicians, which emphasises that recurrent skill shortages reported by employers are often a reflection of deficits in vocational skills (ManpowerGroup, 2014) ⁽¹⁰⁾.

Too often employers also confuse skill shortage with a general lack of work experience or of work readiness on the part of young labour market entrants. Work readiness covers the set of desirable attitudes and behaviours for the workplace (Hettich and Landrum, 2014) but such skills are often better

⁽¹⁰⁾ Sales managers and representatives, accounting and finance staff, managerial and executive posts, IT staff, office support staff and drivers also feature in the top 10 list of bottlenecks.

acquired in work-based learning (such as apprenticeships), rather than in a school-based environment (Handel, 2005).

1.4.4. The role of the firm

Recent EU policies have emphasised the importance of work-based learning and of continued investment by firms in skill formation. To be effective, it is often argued, channels of communication between employers and education and training institutions need to be strengthened. However, in the flash Eurobarometer survey 304 (European Commission, 2010b) few companies were found to cooperate frequently with higher education institutions in designing their curricula and study programmes or in recruiting their graduates: more than 40% of graduate employers reported in the survey that they had never done so. Companies that fail to cooperate with higher education institutions tend to be smaller-sized and to operate mainly in a domestic market. They also tend to rely on employing a lower-skilled workforce (have lower skill needs) and fail to engage in employer-provided training. As shown in Table 2, employers who rarely cooperate with higher education institutions to discuss curriculum design and study programmes are significantly more likely to be dissatisfied with the skills of their new recruits, in particular their sector-specific skills ⁽¹¹⁾. Ensuring wider participation of employers in study programmes that involve sector-specific work placements or the acquisition of practical experience by individuals could result in a lower incidence of reported skill shortages and skill gaps by employers.

There is also significant variation in the commitment of European firms to skill formation and the offer of good quality working conditions, which is ultimately associated with significantly fewer skill bottlenecks. As implied by the empirical estimates in Table 1 (also see Figure 5), the (perceived) intensity of skill shortages is smaller in countries where organisations give higher priority to the process of talent management (employee training, attracting and retaining talent) and to the offer of a good working environment. Businesses in the north European cluster of countries (including Denmark, Finland, Ireland, the Netherlands, Norway, Sweden and Switzerland), which tend to exhibit a stronger orientation towards such talent management practices relative to their counterparts in central and eastern Europe (Bulgaria, Croatia, Hungary and Romania), experience significantly smaller skill

⁽¹¹⁾ These findings are based on an empirical analysis of microdata from the flash Eurobarometer survey 304, *Employers' perceptions of graduate employability*, carried out in 2010 (European Commission, 2010b). The full regression output is available from the authors upon request. More information on the survey is available in Annex A1.2.

Table 2. Employers' dissatisfaction with skills of graduates recruited in past three to five years and frequency of cooperation with higher education institutions, EU+, 2010

Frequency of cooperating with higher education institutions	All skills	Basic skills	Sector-specific skills	Generic skills
Rather frequently	-0.095 (0.174)	0.122 (0.217)	0.127 (0.267)	0.096 (0.188)
Sometimes	-0.074 (0.174)	0.278 (0.221)	0.479* (0.266)	0.265 (0.210)
Never (base: very frequently)	-0.115 (0.185)	0.324 (0.211)	0.503** (0.253)	0.367* (0.211)
Other control variables (see footnote)	√	√	√	√
Country dummies	√	√	√	√
Observations	5 307	5 263	5 164	5 263

NB: Ordered logit estimates; robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; applicable only for a sample of firms that have recruited higher education graduates in past five years; other control variables include: firm plans to recruit more graduates, firm size, private sector, economic sector, international orientation, share of higher education graduates in firm, level of graduate best fitting skill requirements, most common field of study of recruits, recruitment of graduates from abroad, provision of training in past two years; the dependent variables are Cronbach alpha summary scales of the following items: basic skills = numbers, reading/writing skills, foreign language skills, computer skills; generic skills = analytical and problem solving, ability to adapt to and act in new situations, decision-making, team-working, organisation and planning skills

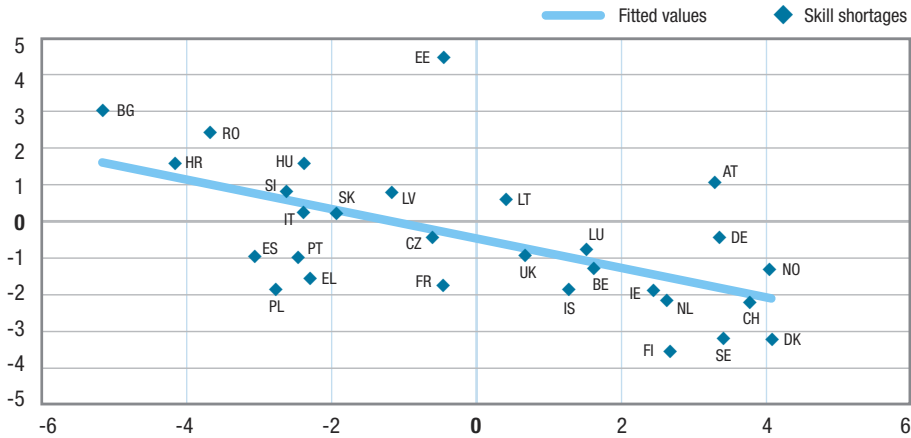
Source: Microdata based on flash Eurobarometer survey 304 (European Commission, 2010b); Cedefop estimation.

shortages. Another subset of countries (Greece, Spain, Poland and Portugal) is exceptional as they experience below-average skill shortages despite the low commitment of firms to the HRM process.

The commitment of employers to human resources through the offer of good working conditions is generally dependent on how production is organised (Bresnahan et al., 2002) ⁽¹²⁾. Some organisations bundle a variety of skills into complex jobs while others break down production into precisely described and rather narrowly defined tasks. These jobs require workers to use only a limited set of skills. The two options – complex jobs versus narrowly

⁽¹²⁾ The way production is organised is influenced by the industry in which the organisation operates and by its size. However, there remains substantial variability in the way organisations design their jobs (simple versus complex set-ups) even within industry and size class.

Figure 5. **Skill shortages and commitment of firms to talent management and quality of working conditions, EU+, 2013**



NB: The horizontal and vertical scales have been derived on the basis of a principal components analysis of correlated statements in the IMD, WCY (see Annex A 2.1 for details).

Source: IMD, WCY 2013; Cedefop analysis.

defined jobs – only represent the extremes on a wide scale of job complexity within a spectrum of all possible configurations that organisations can adopt to organise their production.

For complex jobs, organisations need workers with a wide variety of skills; they may organise their jobs in a manner that bundles different combinations of skills into a job (job title) (Lazear, 2009). The skill set required by a particular job title may also differ across organisations. As a consequence, finding workers with the right combinations of skills, particularly if organisations rely on external recruitment, can be challenging. Workers may have a hard time identifying the precise set of skills to invest in to find employment in a particular organisation and so instead choose the combination of skills which commands the largest currency across all possible organisations. In consequence, an organisation trying to recruit workers with the specific skillset that constitutes an exact match for its needs may experience a skill shortage. However, such a perceived shortage will result from the firm searching for a ‘perfect match’, having applied narrowly defined recruitment criteria and ignoring the existence of generic skills in the pool of available job candidates.

1.5. Aim and structure of report

The aim of this report is to examine and evaluate the extent to which self-reported hiring bottlenecks in European establishments reflect genuine skill gaps in the EU workforce. It focuses on the critical role that firms can play in addressing both the skill challenges faced when attempting to recruit individuals from the external labour market and also in mitigating internal skill gaps within their existing workforce.

Using several European data sources (including the European company survey, Eurobarometers, OECD/PIAAC survey of adult skills, Cedefop's pilot skills obsolescence survey), the analysis carried out in the remainder of this report investigates the causes and characteristics of the difficulties that employers face in filling their vacancies. The evidence casts some doubt on the argument that there are prolific shortages of skill in the EU workforce. Although it is shown that skill shortages may arise because of a dynamic attitude to sourcing skills and the adoption of innovative product market/business strategies by (a subset of) employers, a significant part of firms' recruitment difficulties can be attributed to unattractive job offers (in terms of pay, job insecurity and bad working conditions) and other inefficiencies in their talent management practices.

While evidence clearly highlights the benefits of VET reforms and establishing better feedback between EU education and training systems and enterprises, it also emphasizes that the difficulties in recruitment faced by employers could be tackled better by adoption of an alternative mix of HRM policies. Such a strategy should rely on the offer of better and more stable jobs to skilled applicants, investment in strengthening the talent pipeline both from outside (via greater cooperation with local employer associations and education and training providers) and inside the firm, hiring on the basis of the 'potential' of job applicants rather than on accumulated prior work experience. Greater reliance on sourcing relatively unexploited talent (including female, migrant and older workers) and better design of learning-intensive jobs and related workplace practices can also be of benefit.

The structure of the remainder of this report is as follows: Chapter 2 explores a representative survey of EU establishments, the so-called European company survey, to analyse the determinants of firms' difficulties in finding skills. Chapter 3 draws on two Eurobarometer surveys, which focused on a subset of European establishments (recruiters of higher education graduates; small and medium-sized enterprises), to explore the extent to which the stated recruitment difficulties of employers are genuine reflections

of skill deficits in the workforce. Chapter 4 investigates the impact of such skill shortages on several organisational performance outcomes such as labour productivity, innovation, and employment growth. Chapter 5 examines two recently available skills surveys, which contain previously unexplored information on the skills and jobs of European employees. This chapter focuses on the extent to which organisations can adopt appropriate HRM practices, including better job design and the provision of organisational support for learning in the workplace, to mitigate the incidence of skill gaps in their workforce. Details of the several data sets and empirical methodologies used for this report are provided in Annexes 1 and 2.

Determinants of firms' difficulties in recruitment

2.1. Introduction

In 2013, four out of 10 (39%) European establishments reported that they had difficulties in finding employees with the required skills, according to data from the third European company survey (ECS-2013) (Eurofound, 2013). Several factors can lie behind the inefficiency of the matching process between job seekers and available vacancies. This inefficiency can result in a situation where employers claim they face shortages of skill at the same time that there are high unemployment rates in the labour market. Long-term technological and demographic forces, information asymmetries about the qualities of jobs and/or job applicants, wage frictions or other institutional constraints (such as employment protection legislation), lack of mobility and geographic segmentation (including congestion effects) are some of the possible factors. Heterogeneity of individuals' job preferences and reservation wages, as well as in the human resource technologies used by firms, are also crucial to understanding the factors that underlie and foster skill shortages. Boswell et al. (2004) summarise such explanations for skill shortages under four broad groupings: qualitative mismatches (including genuine mismatches between the skill of individuals and the skills demanded by employers); regional mismatches; preference mismatches; and mismatches due to information deficits.

This chapter assesses further the determinants of the hiring difficulties faced by firms and attempts to understand better the extent to which such bottlenecks reflect the absence of desired skills in the job market, as opposed to the inability of firms to find and attract suitably skilled workers to the available vacancies. To do so, the analysis draws on microdata from the second and third waves of the European company surveys (ECS-2009 and ECS-2013) ⁽¹³⁾. The ECSs are representative of European establishments

⁽¹³⁾ Although the chapter draws on descriptive statistics of recruitment difficulties from the ECS-2013, provided to Cedefop by Eurofound under a confidentiality agreement, the multivariate empirical analysis of this chapter relies only on data from the ECS-2009. The analysis is thus restrained to include only the 27 countries that were members of the EU during that time period. The reason for restricting the analysis to the ECS-2009 is that microdata of the ECS-2013 were not available at the time of writing of this report. More information on the surveys is available in Annex 1.

carried out every four years by the European Foundation for the Improvement of Living and Working Conditions (Eurofound). They collect information on the difficulties encountered by European establishments in finding skilled workers as well as many other organisational characteristics, allowing exploration of the relationship between key workplace characteristics and recruitment bottlenecks.

2.2. Bottlenecks in the aftermath of the economic crisis

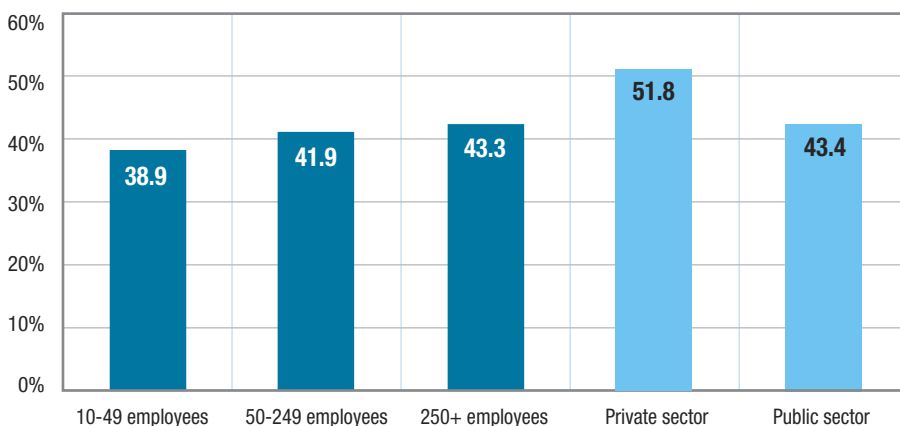
The ECS-2013 addressed a specific question to managers on whether their establishment encountered, at the time of the survey, difficulties in finding employees with the required skills⁽¹⁴⁾. Descriptive evidence from ECS-2013 reveals that recruitment problems are more prominent in larger-sized firms, even though a significant share (over a third) of small and medium-sized enterprises (SMEs) is also affected (Figure 6). The challenges in finding workers with the right skills are more severe in private sector firms and those that have been in operation for a longer period of time (Figure 7).

The difficulties in finding workers with the required skills are most widely reported by employers in manufacturing and least common in financial services (Figure 8). The contribution of different sectors to the overall incidence of bottlenecks varies considerably across the Member States, reflecting their diversity in terms of economic structure, education and training systems and the nature of shocks and imbalances in the years before and after the crisis (Figures 9 and 10). For example, in most Member States most establishments that face difficulties in finding workers with the right skills are found in the industrial sector, followed by wholesale and retail trades. In the Czech Republic, Italy, Poland and Slovenia, more than a half of all

⁽¹⁴⁾ The ECS question on skill bottlenecks suffers from a degree of ambiguity, given that it does not assess or clarify the degree and impact of the 'difficulties' faced by the firm. The survey also does not collect follow-up information on the reasons for such difficulties, so it is impossible to pinpoint directly the extent to which such difficulties arise because of skill deficiencies in the pool of applicants or because of other factors. The underlying expectations of employers in terms of what constitutes the 'right' staff for filling their jobs, in particular in relation to the skills required for such jobs, are also left unspecified. The positive response of some employers to a question on recruitment difficulties may therefore be a reflection of their relatively unrealistic expectations of the type of skills they can attract at a given level of wages and working conditions. Also, the actions taken by firms to mitigate any such difficulties are not available in the survey, so it is impossible to assess whether perceived recruitment difficulties are more prominent in firms that are less inclined to invest in the process of job search.

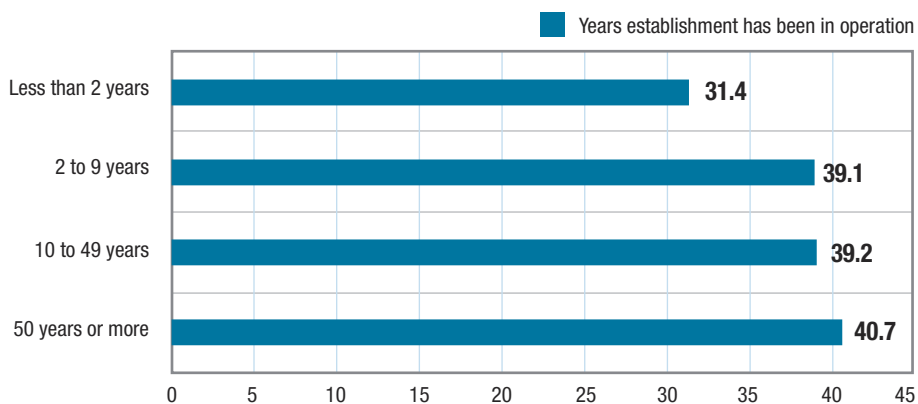
establishments with hiring difficulties are in industry. Croatia and Luxembourg have difficulties in construction, while Ireland, Greece and Cyprus experience a disproportionate share of perceived skill shortages (relative to other Member States) in wholesale and retail trades. Latvia and Lithuania have greater domestic bottlenecks in the transport sector.

Figure 6. **Recruitment bottlenecks in European firms by firm size and sector, 2013, EU-28**



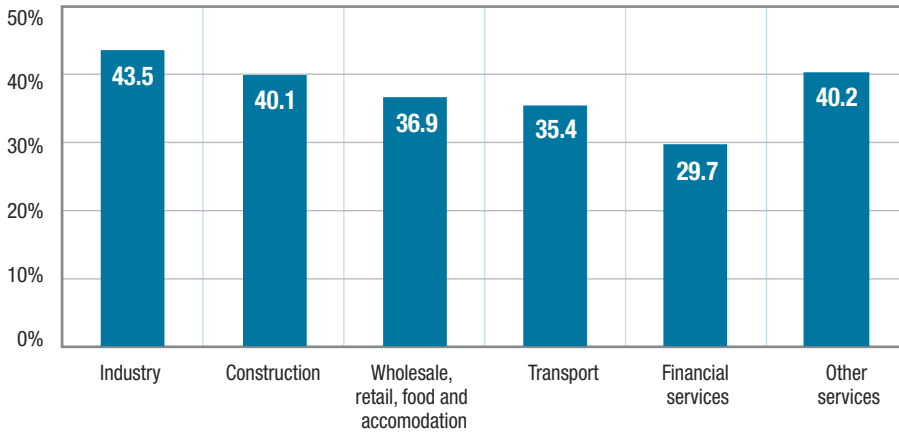
Source: Eurofound, ECS-2013.

Figure 7. **Recruitment bottlenecks in European firms by age of establishment, 2013, EU-28**



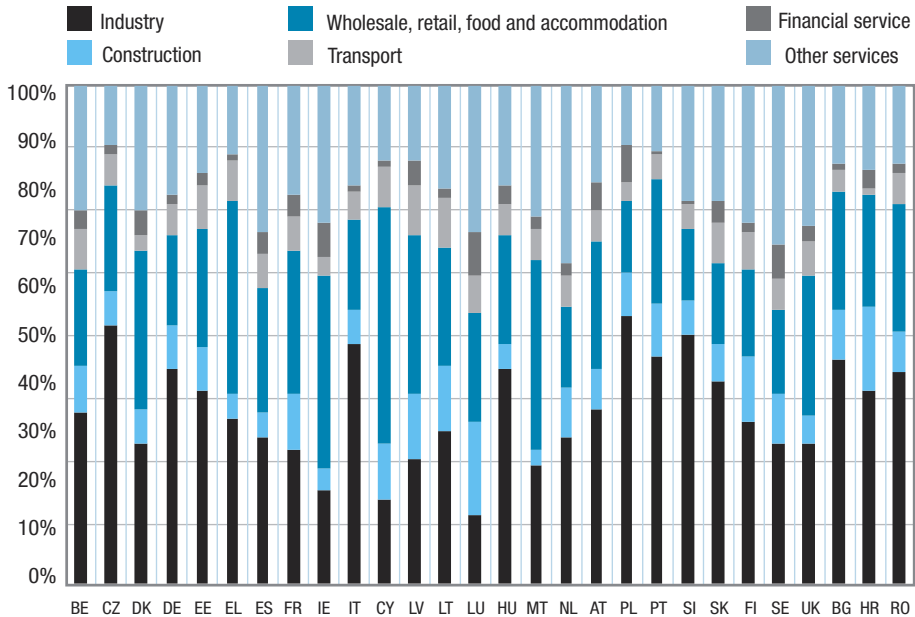
Source: Eurofound, ECS-2013.

Figure 8. Recruitment bottlenecks in European firms by broad industry, 2013, EU-28



Source: Eurofound, ECS-2013.

Figure 9. Within-country distribution of recruitment bottlenecks by broad economic sector, EU-28, 2013



Source: Eurofound, ECS-2013.

Figure 10. **National difficulties in finding workers with the required skills relative to EU average, broad economic sectors, EU-28, 2013**

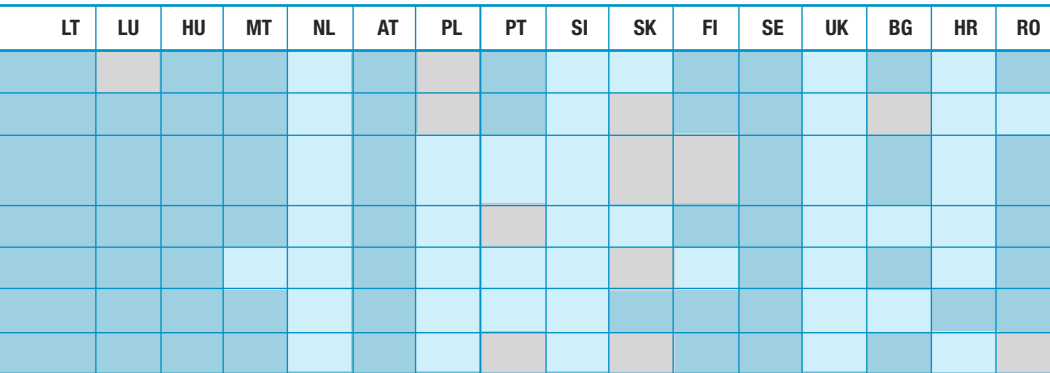
	BE	CZ	DK	DE	EE	EL	ES	FR	IE	IT	CY	LV
Industry	Dark Blue	Dark Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue
Construction	Dark Blue	Dark Blue	Gray	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Gray	Light Blue	Light Blue	Dark Blue
Wholesale, retail, food and accommodation	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue
Transport	Dark Blue	Dark Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue
Financial services	Dark Blue	Dark Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue
Other services	Dark Blue	Light Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue
Total	Dark Blue	Dark Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue

NB: Dark blue cells indicate that the respective country has a higher incidence of shortages in a given economic sector relative to the EU average; light blue cells indicate a lower incidence of shortages; gray cells indicate that the difference between the country and the EU average ranges between -1.5% and 1.5%.

Source: Eurofound, ECS-2013.

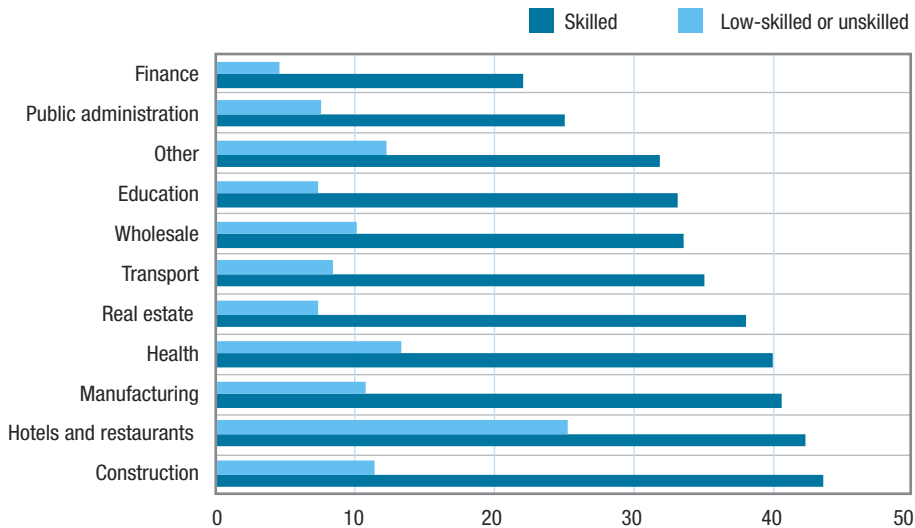
2.3. Bottlenecks at the start of the economic crisis

Because of a change in the phrasing of the main question on hiring difficulties between the ECS-2013 and previous rounds, it is not possible to assess directly the extent to which recruitment difficulties have changed across Member States and, in particular, the impact of the economic crisis. As opposed to the ECS-2013, where managers from a representative sample of enterprises were asked whether they had difficulties in finding workers with the right skills, in 2009 they were asked instead to respond to whether they faced difficulties in finding staff to fill their skilled jobs and/or their low-skill/unskilled jobs. In 2009, about 36% of firms in the EU-27 experienced difficulties in hiring staff for skilled jobs. This figure ranged from above 50% in Belgium, Bulgaria, Cyprus and Lithuania to below 20% in Ireland and the UK. 11% of enterprises faced difficulties in recruiting workers for low-skill or unskilled jobs (Cedefop, 2012b). As shown in Figure 11, in the midst of the financial crisis a significant share of European employers encountered difficulties in finding suitably skilled staff, mostly in construction, hotels and restaurants, manufacturing, and health care. Therefore, even though the cross-country pattern of shortages appears to have been affected during the period 2009-13, the sectoral distribution of shortages confirms that recruitment



difficulties faced by European firms have remained higher in the secondary sector of the economy, while they have been consistently much lower in finance and public administration.

Figure 11. Difficulties in finding staff by economic sector, 2009, EU-27



NB: Proportion of managers in establishments replying affirmatively to the question 'Did your establishment encounter any of the following problems related to personnel? (i) difficulties in finding staff for skilled jobs; (ii) difficulties in finding staff for low-skill or unskilled jobs'.

Source: Eurofound, ECS-2009.

2.4. Determinants of recruitment bottlenecks

Empirical analysis is needed to understand better which factors account for the difficulties that European employers face in finding skilled job applicants (Annex 2); this allows for investigation of the independent influence of several important firm characteristics. Using microdata from the ECS-2009, the analysis reveals that several important factors (described below) are positively related to the probability of firms encountering difficulties in finding suitably skilled staff to fill their vacancies (Table 3).

Table 3. Determinants of probability of establishments facing difficulties finding staff for skilled or low-skill/unskilled jobs, EU-27, 2009

	High-skill jobs	Low-skill/unskilled jobs
Casual or atypical workforce	0.029*** (0.005)	0.008*** (0.003)
Variable pay	0.010** (0.004)	-0.002 (0.003)
High performance work practices	0.016** (0.006)	0.001 (0.004)
Changes in establishment in past three years	0.022*** (0.005)	0.012*** (0.002)
Atypical hours	0.012*** (0.003)	0.013*** (0.003)
A single independent company or organisation	-0.005 (0.018)	0.014** (0.006)
Public sector	-0.070*** (0.021)	-0.024** (0.012)
Composition of workforce		
Proportion of female employees	-0.085*** (0.022)	0.035*** (0.013)
Proportion of employees who work in high-skill jobs	0.019 (0.019)	-0.095*** (0.018)
Proportion of employees working part-time	-0.040 (0.036)	0.039 (0.025)
Proportion of employees who worked overtime in past 12 months	0.080*** (0.020)	0.021** (0.010)
Proportion of employees covered by collective wage agreement	-0.007 (0.020)	-0.020*** (0.006)
Size of establishment		
20-49	-0.036*** (0.011)	-0.010 (0.006)
50-249	-0.025 (0.024)	-0.009 (0.012)

	High-skill jobs	Low-skill/unskilled jobs
250-499	-0.004 (0.024)	-0.031*** (0.012)
500+ (omitted: 10-19)	-0.001 (0.036)	-0.030** (0.015)
Change in size of establishment in past three years		
Decreased	-0.065*** (0.023)	-0.006 (0.008)
Stayed about the same (omitted: Increased)	-0.048*** (0.017)	0.001 (0.007)
Industry (NACE Rev. 1.1)		
Construction	0.001 (0.016)	0.014* (0.008)
Wholesale and retail trade	-0.073*** (0.026)	-0.010 (0.008)
Hotels and restaurants	0.053 (0.048)	0.074** (0.035)
Transport and storage	-0.100*** (0.038)	-0.036*** (0.009)
Finance and business activities	-0.166*** (0.025)	-0.037* (0.022)
Real estate activities	-0.027** (0.013)	-0.022** (0.009)
Public administration and defence	-0.101*** (0.016)	-0.013 (0.026)
Education	-0.034 (0.077)	-0.006 (0.018)
Human health and social work	0.041** (0.020)	-0.011 (0.020)
Other (omitted: Manufacturing)	-0.086*** (0.021)	0.014 (0.019)
Country dummies	√	√
N	18 975	18 808
Log-likelihood	-11 881.64	-5 812.5881
Pseudo R2	0.06	0.08

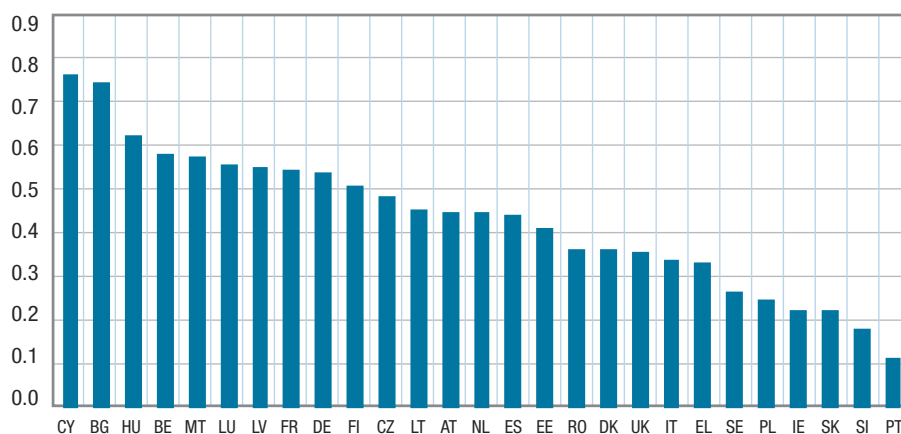
NB: Marginal effects of probit estimates at the variable mean for continuous variables and for discrete changes of categorical variables; Robust standard errors in parentheses, clustered for country in EU-27 sample; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; The dependent variable in column (1) is a dummy variable taking the value one if the managers in the survey replied affirmatively to the question: Does your establishment encounter any of the following problems related to personnel? Difficulties in finding staff for skilled jobs. In column (2) Difficulties in finding staff for low-skill/unskilled jobs. The annex includes definitions of the summary variables obtained via principal components analysis.

Source: Microdata based on Eurofound, ECS-2009; Cedefop estimations.

2.4.1. Economic activity sector

Firms operating in health and social care are more likely to experience difficulties in filling skilled jobs relative to those in manufacturing, once other characteristics of firms operating in different industries are considered. This is an important result in light of the growing demand for health care services that Europe is likely to face in coming decades, as a consequence of the continuing demographic squeeze in European societies. In the EU the human health care and social work sector is found to be 4% more likely than manufacturing to report recruitment problems. Member States facing the most prominent bottlenecks of workers in the health care sector in the year 2009 included Bulgaria, Cyprus and Hungary, although establishments in Germany, France and Finland also faced non-trivial shortages (Figure 12). Firms that operate in finance, wholesale and retail trade, transport and public administration in the EU-27 also have a lower probability of facing a high-skill bottleneck relative to manufacturing firms. Firms in the hotels and restaurants sector, on the other hand, have a 7% greater likelihood of facing shortages of low-skilled or unskilled workers than manufacturing establishments, as is also the case for construction firms.

Figure 12. **Difficulties in finding staff for skilled jobs in health care, EU-27, 2009**



Source: Eurofound, ECS-2009; establishment weights applied.

2.4.2. Wages and working conditions

The empirical analysis reveals a significant negative relationship between the existence of collective wage bargaining and the chance that a firm faces difficulties filling low-skill posts. By collectively setting pay or by widening the

coverage of compensation, particularly among lower-paid jobs, there is a lower chance of companies facing difficulties in attracting labour in low-skill or unskilled jobs.

Private sector establishments that rely on hiring casual labour and those requesting that their employees work at irregular hours are found to have a significantly greater chance of reporting hiring bottlenecks for both skilled and low-skill jobs.

These relationships tend to support the argument that low wages and poor job quality/working conditions may be important determinants of the shortages that employers face in particular economic sectors.

2.4.3. The recruitment pool

There are correlations between the proportion of female employees in an establishment and the probability of experiencing difficulties in finding suitable personnel. Workforce gender composition is likely to reflect historical recruitment decisions by firms. The negative relationship between the share of female staff and the incidence of high skill shortages may reflect that companies that are more willing to expand their recruitment practices to female candidates are less likely to encounter hiring difficulties, as their target talent pool is wider. By contrast, the positive relationship prevailing for low-skill positions in the firm may be an outcome of higher turnover rates of females in such jobs.

2.4.4. Human resource management practices adopted by firms

The empirical analysis reveals that companies affected by shortages of skilled labour are more likely to rely on the option of using overtime work to overcome production constraints. Hiring difficulties for skilled jobs are also positively correlated with the provision of high performance work (HPW) practices, including the offer of variable pay. This may reflect the fact that firms with more innovative product market strategies are also more likely to adopt high performance work practices, while there is also a positive association between innovative product market strategies and skill shortages (UKCES, 2011). Firms with difficulties in finding talent may also be more prone to adopting performance-related pay, given that the latter form of compensation can act as a sorting device that will attract more skilled workers to the company (Pouliakas and Theodossiou, 2009).

It is well-reported that recruitment and training practices adopted by firms, including assessing and screening job applicants, or vocational adjustment of new recruits, are critical aspects for avoiding skill mismatches and for raising

the overall performance of organisations (Cedefop, 2012a) ⁽¹⁵⁾. It would be expected that companies which invest in workforce continuing training will be less likely to encounter difficulties in finding staff to fill their jobs, or have a smaller need for external candidates to fill vacancies in the first place. This is likely to be true given that a superior pool of skilled applicants may be attracted by job offers that are accompanied by the provision of vocational training. Highly skilled workers will also be drawn to employers with a good reputation of investing in the skills of their workforce (Backess-Gellner and Tuor, 2010). Firms that offer continuing vocational education and training (CVET) may hire less externally, given that skills are developed internally; managers of these firms may have lower incidence of difficulty in the hiring process. Reverse causality, as supported by the empirical evidence presented below, would suggest that firms that are more likely to experience shortages, for reasons related to higher innovation and/or greater international competition, will have a greater tendency to offer CVET programmes, which would result in a positive correlation.

About 62% of establishments in the EU-27 Member States, mainly those of larger-size, gave their employees time off during the past year to undertake training (Cedefop, 2012a) ⁽¹⁶⁾. Also, about 73% of establishments in the EU-27 periodically checked the training needs of their staff in a systematic way. However, most of these firms concentrate on the training needs of their permanent high-skilled workforce, rather than those in lower-skilled posts or workers employed on temporary contracts (Table 4). This supports the argument that many European establishments do not continually invest in the skills of their non-permanent workforce, and prefer, instead, to rely on the outside market for finding the skills necessary for such posts. However, as this strategy is associated with higher labour turnover, it is also related to a greater likelihood that such firms will face hiring difficulties, as confirmed in Table 3.

The estimated relationship between firms' provision of continuing vocational training and the probability of facing hiring difficulties (for both skilled and low-skill jobs) is reported in Table 5 ⁽¹⁷⁾. Firms which offered the

⁽¹⁵⁾ For instance, employer-provided vocational training has been found to have positive productivity gains for firms, although the causality of the relationship is contentious given that most empirical investigations fail to distinguish the separate effects of alternative productivity-enhancing firm characteristics (Cedefop, 2013).

⁽¹⁶⁾ About 78% of those training firms offered such possibilities to its staff for the purposes of preparing them for new tasks, while 62% of managers in training establishments also identified as an important driver of the offer of training the need to invest in the vocational adjustment of their employees. A quarter of managers also reported that the key driver for training is the need to update the skills of workers after long periods of absence.

Table 4. Share of firms checking training needs periodically and systematically, EU-27, 2009

	Yes	No
Need for further training periodically checked in a systematic way	72.82	27.18
% among establishments checking training with focus on specific categories		
Permanent employees in skilled or high-skill positions	89.22	10.78
Permanent employees in low-skill or unskilled positions	73.59	26.41
Employees with fixed-term contracts	48.95	51.05
Older employees	72.52	27.48

NB: Percentage of firms in the EU-27 where employees are given time off normal duties in past 12 months to undergo further training; establishment weights applied.

Source: Microdata based on Eurofound, ECS-2009.

Table 5. Marginal effect of CVET on probability of hiring difficulties faced by establishments, EU-27, 2009

	High-skill jobs	Low-skill jobs
Training	0.027*** (0.009)	0.005 (0.004)
Check training	0.032** (0.015)	-0.007 (0.014)
Log-likelihood	-11 871	-5 821
Pseudo R2	0.06	0.08
Observations	18 975	18 808

NB: Marginal effects of probit estimates at the variable mean for continuous variables and for discrete changes of categorical variables; Robust standard errors in parentheses, clustered for country in EU-27 sample; *** p<0.01, ** p<0.05, * p<0.1; The dependent variable in column (1) is a dummy variable taking the value one if the managers in the survey replied affirmatively to the question: Does your establishment encounter any of the following problems related to personnel? Difficulties in finding staff for skilled jobs. In column (2): difficulties in finding staff for low-skill/unskilled jobs. The regressions control for a set of independent variables as shown in Table 3, including firm size, industry and country dummies, but has replaced the scale HPW with its constituent components.

Source: Microdata based on Eurofound, ECS-2009; Cedefop estimations.

(17) An empirical model has been estimated to investigate the impact of CVET on the likelihood of firms facing hiring shortages, albeit with the disaggregation of the variable 'high performance work practices' (HPW practice) into constituent parts. Five variables have been inserted independently in the regression analysis in place of the original HPW scale, including whether the organisation offers time flexibility to its employees, if teamwork is an important characteristic of the work organisation of the firm, if there exists a committee on health and safety matters in the firm and, crucially for the purposes of the specific analysis, whether the firm offered training opportunities to its staff in the previous year and if it checks periodically and systematically the training needs of its workforce.

possibility of further training to employees in the previous year are found to have a 2.7% greater chance of reporting difficulties in filling their skilled posts. Those which periodically and systematically assess the training needs of their staff are also found to have a 3.2% higher chance of encountering shortages in high-skill jobs. By contrast, no statistically significant relation between CVET and the chance of reporting hiring difficulties in low-skill or unskilled jobs is detected in the sample.

2.4.5. Dynamic changes and restructuring within the firm

Firms that increased in size in previous years, and those which experienced changes in their remuneration system, organisation of work processes or working time arrangements over the past three years, are found to be more likely to face recruitment bottlenecks. In the absence of longitudinal information on the incidence of bottlenecks, it is not possible to say whether such organisational changes are an optimal response to the long-standing hiring difficulties present in specific establishments; nevertheless, the positive estimated coefficients are likely to indicate that hiring difficulties are more prevalent in dynamic firms that are either expanding their capacity or are adopting new methods of organising their work processes. This is supported by the positive association between the incidence of organisational changes and improvement in labour productivity. Only 16% of establishments in the sample that did not undergo any change in workplace practices experienced a considerable increase in labour productivity during the three years preceding the survey. By contrast, about 31% of those that underwent such changes were found to have increased labour market productivity by a considerable margin.

2.5. Conclusions

From the evidence reported in this chapter, it is clear that greater difficulties in attracting and hiring skilled labour are typically faced by firms that:

- (a) have been undergoing changes in their organisational processes for the purposes of increasing their long-term productivity and economic performance;
- (b) have adopted innovative or higher performance work practices;
- (c) rely on labour that is temporary or is supplied in the external labour market (which does not require long-term investment in the skills of the existing or newly hired workforce);

(d) do not offer attractive wages and working conditions as part of their job offers, mainly in the private sector.

Important differences are also observed between Member States in the economic sectors more prone to skill bottlenecks, reflecting differences in the structures of their economies, although health and social care and the secondary sectors tend to be the ones universally affected at European level.

These findings suggest that self-reported level of difficulties employers face in filling their vacancies mask many factors not solely related to unmet demand for skills by firms in what could be termed a genuine skill shortage. The next chapter offers closer investigation of the extent to which recruitment difficulties of firms can be attributed to skill deficits in the workforce.

Vacancy bottlenecks and genuine skill shortages

3.1. Introduction

Part of the difficulties that European establishments face in finding the right talent reflect the fact that they are dynamic, innovative and, as consequence, are in greater need of skills to ensure high levels of productivity and competitiveness. Chapter 2 highlighted that claims of skill shortages by employers also hide other factors, such as their dependency on temporary labour or the offer of unattractive job packages (including inferior working conditions). This implies that only a subset of the 40% of EU firms that reported difficulties in finding suitably skilled workers in 2013 are truly faced with a genuine skill shortage, where the available workforce does not possess the desired skills.

To see the extent to which there are genuine workforce skill deficits, it is necessary to explore further the reasons that underlie the recruitment bottlenecks. It is also important to gauge the willingness of employers to offer appropriate compensation and working conditions as a means of attracting skilled workers, as well as their inclination to invest in product market and business strategies that rely on the long-term skill development of their workforce. The extent to which the hiring difficulties in firms are a genuine reflection of skill shortages is examined further in the remainder of this chapter. We need to rely on additional sources of information because the European company surveys (ECS), explored in Chapter 2, do not include information on the reasons for the difficulties in attracting talent experienced by employers. Chapter 3 relies on a new analysis of two flash Eurobarometer surveys that cover important employer segments in Europe ⁽¹⁸⁾.

The first data set explored in this chapter is the flash Eurobarometer survey 304, carried out in 2010 (European Commission, 2010b). In addition to identifying the background of recent recruits with a higher education degree, the survey covered the importance of various skills and abilities and the

⁽¹⁸⁾ More information on the surveys used in this chapter is available in Annex 1.

degree of satisfaction of companies with these skills by the graduates they recently recruited. Crucially, the data set contains explicit information on the reasons behind the difficulties of firms attempting to fill vacancies. It enables more accurate analysis of the extent to which such difficulties are linked to the skill deficits of employees or to other important factors. Related data also exist on the HRM strategies that firms adopt, such as the amount and type of training given to graduates, whether firms recruit labour from abroad and if they cooperate with higher education institutions.

The second data set used draws on evidence from the flash Eurobarometer survey 196 (European Commission, 2007), administered in 2006 (before the outbreak of the 2008 financial crisis) on behalf of the European Commission (Directorate-General Enterprise and Industry). Information was collected from more than 15 000 firms from about 30 European countries (including Turkey). The survey focused on the difficulties that mainly small and medium-sized enterprises (SMEs) in Europe face, including the absence of skilled labour, and contains comparative information on business practices, recruitment issues and on difficulties encountered in areas important for the success of the business.

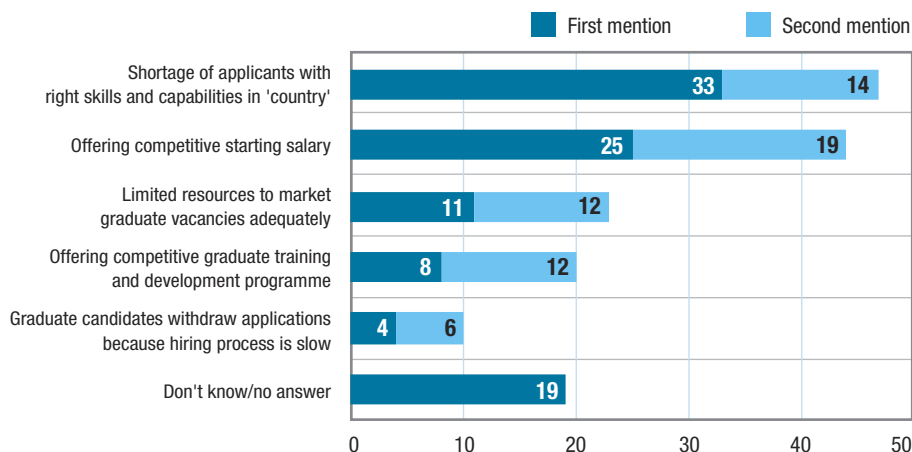
3.2. Skill shortages among graduate recruiters

3.2.1. Challenges in filling vacancies

In the flash Eurobarometer survey 304 (European Commission, 2010), a sample of 7 036 graduate recruiters was asked to name the two most important challenges they faced in filling their vacancies. Interviewers read out the following five potential challenges and asked respondents to choose the two most important ones:

- (a) shortage of applicants with the right skills and capabilities in country;
- (b) limited resources to market graduate vacancies adequately;
- (c) offering a competitive starting salary;
- (d) graduate candidates withdraw applications because the hiring process is slow;
- (e) offering a competitive graduate training and development programme.

Asked to identify the greatest challenges in filling their vacancies in their country, almost half (47%) of graduate recruiters selected a shortage of applicants with the right skills and capabilities to do the job; a lower number (43%) quoted difficulty in being able to offer a competitive starting salary (Figure 13).

Figure 13. **Greatest challenges in filling vacancies, EU+, 2010**

NB: Q5.1 What are the greatest challenges you face in filling your vacancies? Please select the two most important ones.

Base: all companies, % total.

Due to rounding, the percentages for 'first mention' and 'second mention' do not always add up exactly to the total percentages.

Source: Flash Eurobarometer survey 304 (European Commission, 2010 p. 48).

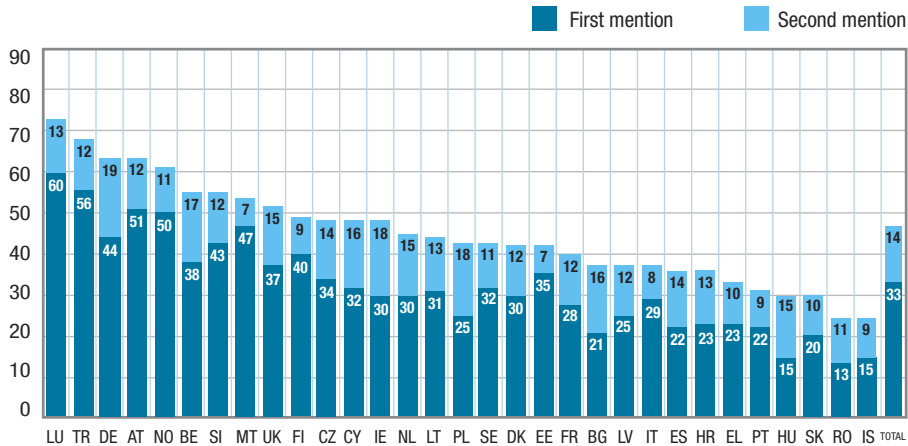
All other challenges, broadly referring to inefficiencies in the ability of firms to compete in the recruitment market, were mentioned by less than a quarter of graduate employers: 22% referred to limited resources to allow adequate marketing of graduate vacancies and 20% found it difficult to offer competitive graduate training and development. Just 10% of respondents said that one of the greatest challenges in filling graduate vacancies was that candidates withdrew applications because the hiring process was slow.

Important differences are also observed across countries in the share of firms that see a skill shortage as constituting a major barrier to filling their vacancies (Figure 14). More than 60% of firms in Austria, Germany, Luxembourg, Norway and Turkey reported a shortage of applicants with the right skills as the main obstacle. In Iceland and Romania, in contrast, only a quarter of respondents saw this as a serious constraint.

Empirical analysis of the Eurobarometer microdata (Annex 2) ⁽¹⁹⁾ reveals that several important firm characteristics increase the chances of employers perceiving a skill shortage as a key reason for difficult-to-fill vacancies. In

⁽¹⁹⁾ The output of the multivariate regression analysis is available from the authors upon request.

Figure 14. **Skill shortages as the greatest challenge in filling vacancies, EU+, 2010**



NB: Q5.1 What are the greatest challenges you face in filling your vacancies? Please select the two most important ones.
 Base: all companies, % by country.
 Source: Flash Eurobarometer survey 304 (European Commission, 2010, p. 49).

particular, recruiters of higher education graduates are more likely to say that one of their greatest challenges during the hiring process is the shortage of applicants with the right skills if they:

- (a) compete in an international rather than a domestic market:

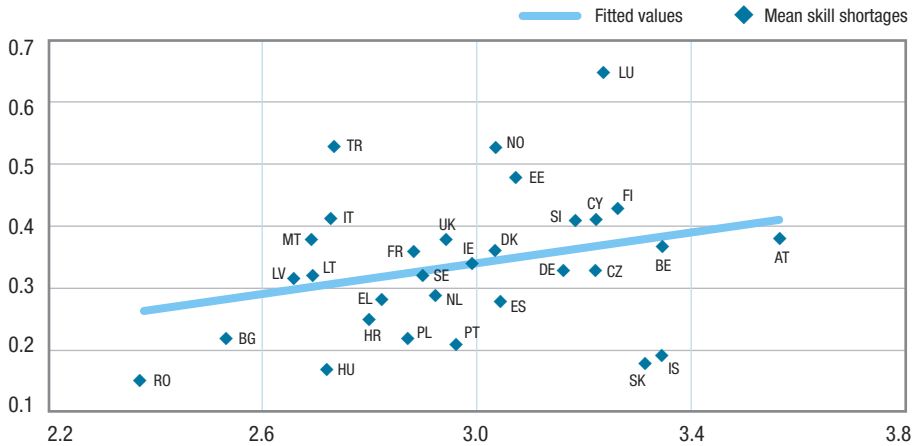
firms that spend much of their day-to-day operations dealing in an international market are more likely to have skill-related difficulties, given that such firms are more likely to be in need of a multicultural or multilingual workforce. Such firms also have a greater tendency to recruit higher education graduates from other countries when they cannot satisfy their skill needs domestically. By contrast, firms operating mostly in the domestic market are more likely to face difficulties in relation to their ability to be attractive recruiters;
- (b) operate in the private sector:

skill shortages are also less frequently seen as a major obstacle by respondents working in public organisations relative to those in the private sector. The main challenges that public companies faced in filling their vacancies are related instead to other factors, such as having limited resources for adequate marketing of graduate vacancies;

- (c) face higher skill needs:
companies facing shortage of applicants with the right skills tend to be those that have a greater share of graduates from higher education institutions in their workforce; those with difficulties offering a competitive starting salary rely more on a lower-skilled workforce;
 - (d) demand specific occupational/industry skills:
the underlying reasons for hard-to-fill vacancies also differ according to the type of sector-specific skills that the company mostly requires from its graduate recruits. Firms that rely on recruiting engineering or medical graduates are more likely to identify skill shortages as the primary reason for bottlenecks; those recruiting graduates from legal and communication and information sciences have a harder time filling their vacancies because they offer uncompetitive starting salaries;
 - (e) provide training to the workforce:
particularly important finding is the statistically positive correlation between the incidence of training and the share of firms identifying a shortage of skills as a primary reason for hard-to-fill vacancies. Figure 15 shows a positive relationship between the mean participation of the workforce in training in different countries and the share of companies concerned explicitly with skill shortages. The analysis further confirms that firms with more than half of their graduate staff participating in training to update their skills in the past two years were more likely to face skill shortages, relative to those organisations where none of their graduates participated in training. This finding corroborates the analysis in Chapter 2, which also found a positive relation between difficulties in finding skills and the provision of employer-provided training. It is possible that firms are more likely to provide remedial internal vocational training to mitigate the skill gaps of new recruits when they cannot fully satisfy their unmet skill needs from the external recruitment market. Alternatively, the positive link may reflect the fact that such companies are more likely to have a higher demand for skills because of their innovative product market strategies, with accompanying adoption of high performance work practices, including training ⁽²⁰⁾.
- In sum, firms that identify skill shortages as their main challenge in filling their vacancies are more likely to be private sector enterprises with an international orientation, and characterised by higher (mostly vocational) skill needs.

⁽²⁰⁾ Unfortunately, the data do not allow for further exploration of the nature of the causality due to limited information available on business strategies and because of its cross-sectional nature.

Figure 15. Mean % firms with ‘skill shortages’ versus participation of graduate recruits in training, EU+, 2010



NB: A score of 3 in the horizontal axis corresponds to a EU+ average of 10-50% of higher educated employees participating in training; 2 = < 10%; 4 = > 50%.

Source: Microdata based on the flash Eurobarometer survey 304 (European Commission, 2010); Cedefop calculations.

3.2.2. Genuine and apparent skill shortages

Given that in the flash Eurobarometer survey 304 employers were allowed to select up to two factors, the large share of graduate employers (47%) identifying skill shortages as the greatest challenge in filling their vacancies may be an overestimate. Economic theory would suggest that a genuine skill shortage would require that the demand for skills by employers cannot be met by the available supply at market clearing pay rates. Part of the recruitment difficulty that some employers attribute to skill shortages may be an outcome of their inability to offer a competitive starting salary to attract the desired skills.

The assumption of market clearing wages that automatically adjust to eliminate market disequilibria is only likely to take place in frictionless labour markets. Nevertheless, it is difficult to dispel the claim that increasing wages are not a mechanism for addressing excess demand for skills in the case of higher education graduates. Instead, it is reasonable to expect that there is greater wage elasticity of labour supply for graduates of higher education institutions, in that employers will be more likely to compete for the higher skills possessed by such graduates.

A measure of genuine skill shortages has been derived from the flash Eurobarometer survey 304 data, defined by the share of firms that experience recruitment bottlenecks conditional on them offering a competitive starting

salary. Only the share of graduate recruiting firms that identified a skill shortage independently of salary constraints is categorised as genuine, while the remaining proportion of employers that identified both a skill shortage and wage constraints as important components of their hard-to-fill vacancies have been classified as being subject to ‘apparent’ skill shortages.

Table 6 summarises all potential two-way combinations of challenges identified by the employers in filling vacancies. About 24% of the respondents chose both factors ‘skill shortages’ and ‘salary constraints’ simultaneously. This implies that, among the total sample of 3 125 employers who identified skills as one of the two main challenges they face, the nature of such skill shortages may be characterised as ‘apparent’ for about 1 251 employers (40% of the total).

Table 6. **Type of bottlenecks among graduate recruiters, EU+, 2010**

Type of bottleneck	Number of firms	% total sample with difficulty filling vacancies
Genuine skill shortages		
• shortage of applicants with the right skills and capabilities in COUNTRY	1 874	34.09
• skill sole challenge	749	12.15
• skill and HRM	1 125	21.93
Offering a competitive starting salary		
• salary sole challenge	461	6.12
• salary and HRM	1 386	23.29
Apparent skill shortages		
• shortages of applicants with right skills and offering a competitive starting salary	1 251	23.97
HRM inefficiencies		
• one HRM challenge	356	5.91
• two HRM challenges	348	6.63
Total	5 676	100

NB: Appropriate weights applied; the sample includes all firms with non-missing responses (Annex 2).

Source: Microdata based on the flash Eurobarometer survey 304 (European Commission, 2010b); Cedefop calculations.

Focusing only on those cases where skills were mentioned as a challenge independently of wage constraints, the total proportion of graduate employers facing genuine skill shortages is 34%. This figure can be disaggregated further into two components: 12% of employers who mentioned the skills factor on

its own (no second mention was made) and the remaining 22% that mentioned skill shortages in combination with one of the three HRM constraints. The offer of a competitive salary as the main challenge in filling vacancies was mentioned by 29% (6% sole response, 23% in combination with HRM factors).

Table 7 shows important differences in the characteristics of graduate employers who experience either genuine or apparent skill shortages:

- (a) genuine skill shortages are more likely to be experienced by private sector firms. Public sector organisations are more prone to hiring bottlenecks due to constraints on their wage offers and other inefficiencies in recruitment;
- (b) firms that can compete in terms of starting salaries, yet suffer from a genuine inability to source required skills in the domestic market, are more likely to recruit from other Member States (fostering brain gain and brain drain within the Union).

Genuine skill shortages are more likely to be reported by employers relying heavily on the skills of higher education graduates (proxied by the share of graduates in the company's workforce), and specifically on medical graduates. Graduate employers that rely on a more skill-intensive workforce are more likely to have difficulties filling their vacancies because of skill deficits. Wage constraints are also more of a challenge in filling vacancies among firms that target graduates from law and ICT sciences.

Table 7. Determinants of different types of vacancy bottlenecks, odds ratios, EU+, 2010

	(1) Genuine skill shortage	(2) Salary constraint	(3) Apparent skill shortage	(4) HRM inefficiency
Ownership structure				
Private	1.579*** (0.205)	0.787 (0.118)	1.047 (0.136)	0.648** (0.129)
Mixed (base: Public)	1.284 (0.213)	0.870 (0.165)	1.208 (0.193)	0.612* (0.175)
International orientation (% day-to-day operations)				
25-50%	0.967 (0.081)	1.195 (0.147)	0.736** (0.092)	1.332 (0.269)
10-24%	0.863 (0.107)	1.362** (0.182)	0.848 (0.129)	1.017 (0.175)
< 10%	0.892 (0.095)	1.179 (0.136)	0.933 (0.124)	1.089 (0.198)

	(1) Genuine skill shortage	(2) Salary constraint	(3) Apparent skill shortage	(4) HRM inefficiency
None (base: > 50%)	0.871 (0.112)	1.355* (0.213)	0.745*** (0.085)	1.161 (0.211)
Share of higher education graduates employed in firm				
21-40%	1.358*** (0.116)	0.692*** (0.063)	1.014 (0.110)	1.093 (0.138)
41-60%	1.164 (0.151)	0.882 (0.110)	0.916 (0.130)	1.085 (0.167)
> 60% (base: 1-20%)	1.261** (0.132)	0.788** (0.076)	0.978 (0.088)	0.979 (0.175)
Fields mostly recruit higher education graduates				
Engineering	1.132 (0.106)	0.864** (0.059)	1.060 (0.099)	0.913 (0.090)
Law	0.869 (0.112)	1.353** (0.160)	0.887 (0.109)	0.828 (0.156)
Medical studies	1.317* (0.203)	0.738* (0.123)	1.163 (0.228)	0.833 (0.120)
Communication and information sciences	0.890 (0.096)	1.120* (0.076)	1.037 (0.105)	0.916 (0.151)
Other natural sciences	1.301** (0.140)	0.917 (0.141)	0.623*** (0.108)	1.373** (0.215)
Recruitment of higher education graduates from abroad				
Other Europe	1.305** (0.136)	0.715*** (0.080)	1.040 (0.076)	1.005 (0.123)
Other outside of Europe	1.185 (0.128)	0.800* (0.101)	1.009 (0.119)	0.970 (0.100)
CVET in past two years				
<10%	0.948 (0.190)	0.846 (0.126)	1.128 (0.190)	1.305* (0.193)
10-50%	1.053 (0.189)	0.852 (0.134)	1.213 (0.215)	0.951 (0.185)
>50% (base: None)	1.140 (0.223)	0.710** (0.111)	1.287 (0.242)	1.032 (0.222)
Other controls				
Mostly recruit higher education graduates: other fields	√	√	√	√
Importance of skills of graduates (i)	√	√	√	√

	(1) Genuine skill shortage	(2) Salary constraint	(3) Apparent skill shortage	(4) HRM inefficiency
Recruitment of higher education graduates in past five years (d)	✓	✓	✓	✓
Firm size (d)	✓	✓	✓	✓
Sector of economic activity (d)	✓	✓	✓	✓
Country (d)	✓	✓	✓	✓
Constant	0.493 (0.240)	0.399* (0.214)	0.364 (0.228)	0.091*** (0.057)
Observations	4 901	4 901	4 901	4 901

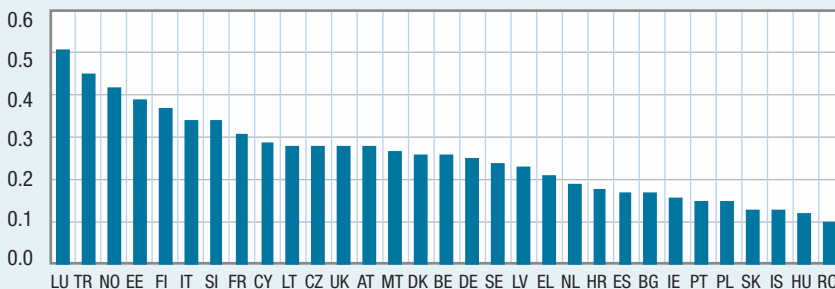
NB: Logit estimation; Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; (i) = index based on Cronbach's alpha; (d) = dummy variables; odds ratios that exceed one (below one) indicate a higher (lower) probability of a recruitment bottleneck in relation to changes in the independent variables.

Source: Microdata based on the flash Eurobarometer 304 survey (European Commission, 2010); Cedefop estimation.

Box 4. Differences in genuine skill shortages, EU+

The empirical analysis in the previous section identified the conditional probability of firms experiencing a genuine skill shortage in different European countries, after considering differences in the industrial composition and other characteristics of firms between the countries (as indicated by the country fixed effects). The following chart shows countries in terms of their probability of facing genuine skill shortages^(*). It is clear that graduate recruiting firms in some countries, which include Estonia, Finland, Luxembourg, Norway and Turkey, have higher chances of facing genuine skill shortages than Iceland, Hungary, Romania and Slovakia.

Adjusted probability of firms facing genuine skill shortages, EU+, 2010



NB: The adjusted probability of genuine skill shortages is derived on the basis of country fixed effects estimated by a linear probability regression (with no intercept) similar to column (1) in Table 7.

Source: Microdata based on the flash Eurobarometer survey 304 (European Commission, 2010); Cedefop estimation.



Variation in the adjusted probability of genuine skill shortages in different countries is likely to be a reflection of country-specific factors, including diverse institutional features and other macroeconomic forces. In the absence of a sufficiently lengthy series of data, it is not possible to perform a robust analysis of the underlying factors that may explain the cross-country variation in the likelihood of genuine skill shortages. Nevertheless, the remainder of this section engages in a heuristic exploration of the drivers of country differences in the likelihood of genuine skill shortages.

The table below outlines correlation coefficients between the country-specific adjusted probability of genuine skill shortages and several variables that summarise the macroeconomic, institutional or policy-related context of these countries. Some of these variables have been obtained from Eurostat and others from the IMD *World competitiveness yearbook* (WCY), which compiles a wealth of objective macroeconomic and other competitiveness indicators based on the subjective opinions of a panel of 4 300 executives in each country⁽⁶⁾. The correlations are obtained on the basis of only 30 data points and are, therefore, only indicative of general trends⁽⁶⁾.

Pairwise correlation coefficients of genuine skill shortages and macroeconomic/institutional factors, EU+, 2010

Attracting and retaining talents is a priority in companies	Employee training is a high priority in companies	GDP (purchasing power parity) per person employed per hour	Innovative capacity of firms (to generate new products, processes and/or services) is high in your economy	Share of active population (aged 15-64) with tertiary educational attainment (ISCED 5-6)
0.26 (0.25)	0.34* (0.07)	0.52*** (0.00)	0.34** (0.04)	0.43** (0.02)
Share of employed population (aged 15-64) with high-skilled professional status (managers, professionals, technicians and associate professionals)	Share of employed population (aged 15-64) with skilled manual professional status (service and sales workers, skilled agriculture, craft and related trades)	Unemployment rate	Education expenditure (% GDP)	Education system meets the needs of a competitive economy
0.67*** (0.00)	-0.51*** (0.00)	-0.34* (0.07)	0.44** (0.02)	0.36* (0.06)

NB: p-values in parentheses; *** p<0.01, ** p<0.05, * p<0.1; 30 European countries in sample (EU-28, Iceland and Norway).

Source: Microdata based on the flash Eurobarometer survey 304 (European Commission, 2010); IMD WCY; Eurostat; Cedefop analysis.



Given the above caveats, the probability of genuine skill shortages is found to be higher in countries where companies give higher priority to employee training. There is also a positive correlation with labour productivity and the (subjectively assessed) innovative capacity of firms in the economy, defined in terms of generating new products, processes and/or services. Related to the above is a statistically significant positive relationship between the likelihood of genuine skill shortages and the share of the highly educated or highly skilled workforce in a country (the latter given by the proportion of the labour force that is employed in high-skill occupations such as managers, professionals, technicians and associate professionals).

All of these correlations indicate that the prevalence of genuine skill shortages tends to be higher in economies in which companies are operating close to the technological frontier and in which there is a greater need for high-skilled labour. By contrast, there are smaller odds of genuine skill shortages in countries in which the share of the workforce is mostly employed in skilled manual occupations. The significant negative correlation with the unemployment rate is also a reflection of subdued genuine skill shortages in countries in which there is an excess supply of labour available to take up vacant jobs.

-
- (e) The data reported in this section need to be treated with caution, as they are based on very small cell sizes of fewer than 200 companies per country.
 - (f) IMD World Competitiveness Centre: *World competitiveness yearbook*
<http://www.imd.org/wcc/wcy-world-competitiveness-yearbook/>
 - (g) Turkey has been excluded from the analysis. The correlations are robust when Luxembourg and Romania are taken out of the sample as outliers.

3.3. Genuine skill shortages in SMEs

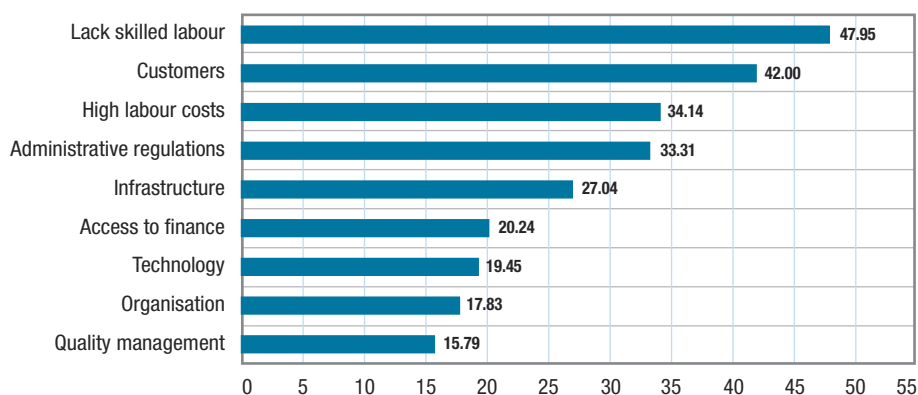
3.3.1. The magnitude of genuine skill shortages

Making up the greatest share of all enterprises, SMEs are the backbone of Europe's economy. According to the flash Eurobarometer survey 196 (European Commission, 2007) that took place in 2006, which focused mainly on SMEs, the most commonly cited difficulty faced by such firms is lack of skilled labour ⁽²¹⁾.

⁽²¹⁾ The timing of the Eurobarometer survey might be considered positive because the information was collected before the 2008 financial crisis. The relationships described in this section will not be contaminated by strategies that firms may have deployed in response to the recession.

The types of difficulties encountered by the firms in the sample are summarised in Figure 16; 48% of firms reported lack of skilled labour as the most important difficulty they encountered, followed by lack of purchasing power of customers (42%). About one third of firms experienced difficulties with high labour costs (34%) and administrative regulations (33%), while 27% experienced difficulties in infrastructure quality. Fewer firms reported difficulties with access to finance (20%), the introduction of new technologies (19%), the introduction of new forms of organisation (18%) and lack of quality management (16%) ⁽²²⁾.

Figure 16. **Difficulties encountered by firms in past two years, 2006 (unweighted sample, N=15 273)**



Source: Cedefop computation, based on the flash Eurobarometer survey 196 (European Commission, 2007).

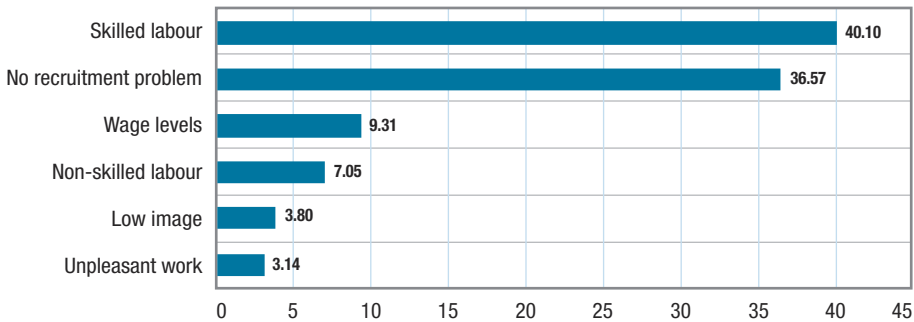
The survey also asked about the difficulties experienced by firms during recruitment. Figure 17 shows that in this case the biggest problem for SMEs seems to relate to their ability to attract skilled workers (40%). The second biggest group of firms are those without recruitment problems (37%). Fewer firms have problems with too high wage levels (9.3%) and with their ability to recruit non-skilled labour (7%). Few firms related their recruitment problems to the low image of the sector, occupation and workplace (4%) and to unpleasant work or working conditions (3%).

These data stress that unavailability of skills is perceived by employers to be one of the most important constraints for SMEs. However, the ability of

⁽²²⁾ The sum of the percentage is well beyond 100 because firms could report more than one difficulty; the average number of difficulties encountered lies between 2 and 3 (2.57).

such firms to compete effectively is also influenced by high labour costs, access to credit, the quality of their infrastructures and the deadweight cost imposed by the need to comply with administrative regulations.

Figure 17. **Difficulties encountered by firms during recruitment (unweighted sample, N=14 204)**



Source: Cedefop computation, based on the flash Eurobarometer survey 196 (European Commission, 2010).

Taken at face value, the evidence seems to point to a generalised lack of skills problem in the European job market. However, firms' difficulties in sourcing skills might have various causes, as described earlier; in particular failure to attract the right skills may be traced back to inability and/or unwillingness to pay the right price for the skills sought. Firms considering labour to be too expensive might experience difficulties in attracting skilled candidates, but this is a different problem (related to the ability/willingness to pay the market price for the skills sought) from a generalised lack of skills in the labour market (i.e. skills are in short supply). Firms facing hiring difficulties may also be offering poor working conditions or may be characterised by poor recruitment practices. Other important elements affecting the ability of firms to attract skilled workers are the amount of workplace learning and the quality of the training offer.

Table 8 attempts to unpack the relationship between the ability to attract skilled workers and the wage level/compensation package the firms are willing to offer. It cross-tabulates the share of firms facing lack of skilled labour with those that said that high labour costs also constituted a problem for the firm. The association between the two types of difficulties is strong ⁽²³⁾; 45% of the firms that reported difficulties related to lack of skilled labour also reported that

⁽²³⁾ A chi-square test reveals that the correlation is statistically significant at a 95% confidence level, i.e. $\chi^2(2) = 767.2$.

they experienced difficulties because of high labour costs. This suggests that, for a significant share of employers, their difficulties in finding skilled labour may be driven by an underlying inability to offer the going wage rate for the skills sought, rather than by a genuine absence of skills in the labour market.

Table 8. Firms facing difficulties due to lack of skilled labour versus high labour costs

Lack of skilled labour	High labour costs		Total
	No	Yes	
No	6 145 (76%)	1 956 (24%)	8 101
Yes	3 913 (55%)	3 259 (45%)	7 172
Total	10 058	5 215	15 273

Source: Cedefop computations, based on the flash Eurobarometer survey 196 (European Commission, 2010).

In addition to high labour costs, poor recruitment and retention practices contribute to lack of skilled labour. For example, of the 3 913 firms reporting genuine problems due to lack of skills, 785 (20%) also simultaneously reported that they had difficulties in attracting low-skilled workers, or had other recruitment problems related to poor working conditions or a low image of the industry or occupation.

Firms' difficulties in attracting skilled workers might also be caused by their inability to tap into a sufficiently large talent pool, given a tendency to recruit locally. According to the flash Eurobarometer survey 196 data, the average share of employees recruited in the same region in which the firm is located is as high as 84.5%. This might arise because of relatively scarce information on where suitable applicants can be found (labour market frictions) and due to reliance on informal recruitment channels, such as social networks and personal contacts. Informal recruitment channels are used by 946 (30%) of the 3 128 firms that encounter genuine skill shortages (3 913-785) so part of the problem might be the suboptimal recruitment strategies of firms.

Of the remaining 2 182 firms (3 128-946) which indicated that they had difficulties due to lack of skilled labour in the recent past, 260 (12%) reported no problems in recruitment. This suggests that even though these firms were recently confronted with a skill-related constraint, they believed they still had access to the skills needed in the external labour market.

Of the initial 7 172 firms reporting difficulties related to lack of skilled labour, only 26.7% (1 922 = 2 182-260), close to a quarter, faced problems that cannot be directly related to poor working conditions (including wages) or inferior recruitment strategies. This figure drops even further (to 1 504, equivalent to 21% of the initial number of firms reporting difficulties due to lack of skilled labour) if we exclude an additional 418 firms for which long working hours are an important aspect of their business strategy, which may be an further indicator of poor working conditions.

This forensic investigation shows that employers claims of difficulties in finding skilled labour must be treated with caution and that only a subset of these self-reports are associated with a genuine occurrence of skill deficits in the workforce. While it is true that genuine skill shortages may be an issue of real concern for some employers, particularly those who wish to hire specific profiles of job applicants in fast growing and/or innovative economic activities, the exact magnitude of genuine skill shortages is considerably lower compared to the total skill difficulties reported: in this particular sample of SMEs, it corresponds to $1\,504/15\,273 = 9.8\%$ of the total sample of firms.

3.3.2. Determinants of genuine skill shortages in SMEs

Table 9 isolates the independent influence of several firm characteristics, and, in particular, of a firm's business strategy, on the likelihood of experiencing genuine skill shortages in the past two years. To do so, a multivariate regression analysis is carried out that focuses only on the share of firms that are genuinely affected by lack of skilled labour, i.e. after excluding other potential causes that may lead to positive perception of skill-related difficulties by employers.

The empirical findings confirm that the perceptions of firms of the difficulties they face in finding skilled labour are confounded by other non-skill-related factors, such as financial constraints (high cost of labour or limited access to finance) or administrative barriers. The unique EU-wide data set of SMEs explored here also allows for investigation of the relationship between a firm's business strategy and the incidence of skill shortages. There has been limited evidence in literature of the ability of firms to adopt and pursue a chosen business strategy and on the implications of such strategies for the occurrence of skill deficits. UKCES (2011), for instance, has confirmed that in the UK there is a positive relationship between skill-shortage vacancies and the product market strategy choices by firms, the latter constituting one significant component of a firm's wider business strategy. The estimated effects in Table 9 also suggest that EU SMEs that rely on business strategies

based on quality improvements and on forming partnerships are more likely to experience higher skill needs and, as a consequence, a higher likelihood of skill shortages ⁽²⁴⁾.

Table 9. **Likelihood of experiencing genuine skill shortages, 2006, EU SMEs**

Constraints encountered in the past two years	Not controlling for recruitment difficulties	Controlling for recruitment difficulties
Cost of labour too expensive	0.177** (0.009)	0.142** (0.0080)
Limited access to finance	0.049** (0.010)	0.036** (0.009)
Problems with administrative regulations	0.098** (0.009)	0.071** (0.008)
Problems with infrastructure (roads, utilities, etc.)	0.092** (0.009)	0.072** (0.008)
Problems with the purchasing power of customers	0.045** (0.008)	0.037** (0.008)
Business strategy to face competition		
Reduce cost	-0.006 (0.008)	-0.014 (0.008)
Forming strategic partnerships	0.035** (0.008)	0.016** (0.008)
Price reduction	0.002 (0.008)	-0.001 (0.008)
Quality improvements	0.049** (0.009)	0.030** (0.008)
Increase product differentiation	0.016 (0.009)	0.003 (0.008)
Expand in foreign markets	0.012 (0.009)	0.002 (0.008)
Increase working hours	0.019** (0.009)	0.019** (0.008)
Reduce production	0.003 (0.012)	0.011 (0.011)
Increase marketing budget	0.006 (0.009)	-0.010 (0.009)

⁽²⁴⁾ The evidence of the relationship between business strategy and skill shortages is only tentative because the dataset does not contain important information on other variables (business culture, job design, learning opportunities, support for investment in skills by colleagues and supervisors) that may mediate the relationship between the choice of business strategy and skill shortages.

Constraints encountered in the past two years	Not controlling for recruitment difficulties	Controlling for recruitment difficulties
Recruitment problems		
Lack of skilled workers		0.463** (0.009)
Lack of non-skilled workers		0.374** (0.015)
Low image profession/industry		0.295** (0.019)
Wage levels too high		0.152** (0.013)
Unpleasant working conditions		0.218** (0.021)
Do not know/NA		0.134** (0.020)
Other controls		
number of employees (log)	0.037** (0.003)	0.020** (0.003)
Subsidiary	-0.027** (0.013)	-0.023 (0.012)
Non for profit	-0.108** (0.020)	-0.056** (0.019)
Craft	0.057** (0.009)	0.033** (0.009)
Simple waste management	-0.007 (0.008)	-0.010 (0.008)
Complex waste management	-0.012 (0.015)	-0.026* (0.014)
NACE	YES	YES
Country	YES	YES
Constant	0.115** (0.026)	0.041 (0.024)
R2	0.1692	0.3161
number of cases	15 273	14 693

NB: * significant at 5% ** significant at 1%. Standard errors in parenthesis. The reference groups are given in parenthesis: recruitment problem (no recruitment problem), waste management (no waste management). The regression includes eight industry dummies (reference group: other community and social and personal services) and 30 country dummies (the reference country is Sweden).

Source: Microdata based on the flash Eurobarometer survey 196 (European Commission, 2010); Cedefop estimation.

3.4. Conclusions

Consulting firms regularly produce reports voicing employers' difficulties in sourcing skilled workers (ManpowerGroup, 2014; MGI, 2012a) ⁽²⁵⁾. These reports take the concerns of employers at face value and they are rarely critically assessed. In this chapter, two Eurobarometer surveys covering important segments of the European business world (SMEs and recruiters of higher education graduates) have been analysed and show that a significant fraction (between 60-80%) of firms claiming to have encountered difficulties related to lack of skilled labour may actually be facing other non-skill-related issues. Factors that can impair employers' ability to attract and retain (skilled) workers, such as the high cost of labour and poor working conditions, may actually confound the perceptions of employers on the existence of skill deficiencies in the workforce.

However, the evidence draws attention to the fact that a smaller subset of European firms face genuine skill deficits. These tend to be private sector companies that compete in the international market and so have greater and more demanding skill needs. As these firms have difficulties sourcing the required talent domestically, they are more likely to rely on skill available outside their country, potentially in other European economies, rendering them increasingly dependent on national and EU immigration policies. In such cases, greater collaboration between stakeholders from the worlds of education and work, as described in Section 1.4.4, would serve to anticipate and prevent genuine skill shortages from acting as barriers to firm productivity. Firms that face genuine skill shortages are likely to suffer from unfavourable business performance outcomes, an issue explored in depth in Chapter 4.

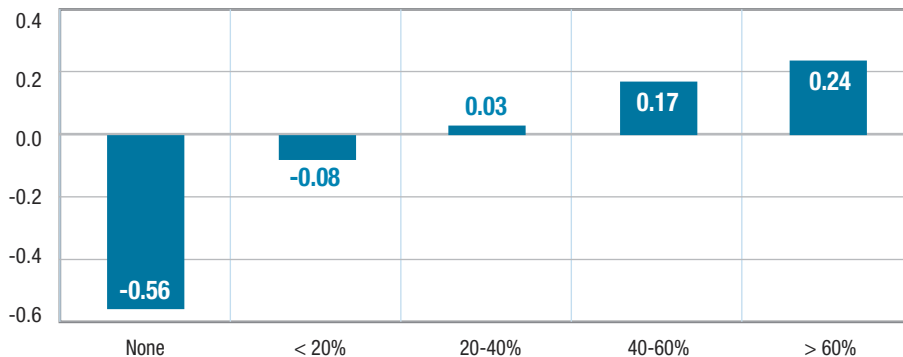
⁽²⁵⁾ See also PricewaterhouseCoopers. *PwC's annual global CEO survey*. <http://www.pwc.com/gx/en/ceo-survey/about-the-ceo-survey.jhtml> [accessed 6.5.2015].

Skill bottlenecks and organisational performance

4.1. Introduction

Chapters 2 and 3 have highlighted that the difficulty in fill vacancies is an imperfect indicator of the extent to which an employer may be truly facing a deficiency of available skilled labour in the labour market. It has been shown that such an indicator may mask other important constraints faced by firms, such as the inability to offer a competitive wage, job offers characterised by poor working conditions or by precarious contracts and other administrative complexity. Nevertheless, the subset of firms facing genuine skill shortages are also characterised by higher chances of relying on business strategies focused on quality and, as a consequence, a higher likelihood of adopting high performance work (HPW) practices (time flexibility, employee committees, training, variable pay, teamwork). HPW practices are more prominent in establishments that are dependent on a greater share of high-skill jobs (Figure 18) and, thus, are characterised by greater demand for high skills.

Figure 18. **Mean value of HPW scale by proportion of employees working in high-skill jobs in the establishment, EU-27, 2009**



NB: High-skill jobs are defined as those which usually require an academic degree or a comparable qualification; the construction of the HPW scale is defined in the Annex 2; establishment weights applied.

Source: Eurofound, ECS-2009; Cedefop calculations.

Several authors have reported a negative effect of skill shortages on firm productivity and performance. More than a half the employers in the global talent shortage surveys also reported that talent shortages significantly impact their ability to meet client needs (ManpowerGroup, 2014, p. 6); 40% said that talent shortages reduce their competitiveness and productivity (ManpowerGroup, 2014, p. 7). Several academic studies have also identified negative consequences of skill shortages for firm performance, although these have typically focused on a particular set of countries such as Australia, Ireland and the UK (Haskel and Martin, 1996; Bennett and McGuinness, 2009; Healy et al., 2015). The European company survey (ECS) used in this report enables the investigation of the impact of recruitment difficulties on the relative performance of establishments in all Member States. Further, this chapter also exploits data from the 2006 flash Eurobarometer survey 196 (European Commission, 2007) of mainly SMEs, with exploration of the impact of skill shortages on various facets of organisational performance, including innovation and anticipated employment growth and turnover.

4.2. Skill shortages and organisational performance

In the ECS-2009, managers were asked to evaluate subjectively labour productivity in their establishment relative to other firms in the same sector of activity. Although this is a subjective assessment, several studies have shown that such measurements can be highly correlated with more objective measures of firm performance. In the sample, 18.5% of managers declared that labour productivity in their firm is a lot better than that of competitors in the same industry, 34.6% somewhat better, 44.6% stated that it is at about the average value of the sector while only 2.2% said that it is below average.

Since the ECS does not contain information on the reasons why firms face recruitment difficulties, more accurate measurement of genuine skill shortages in the data set is not possible. Nevertheless, a new variable has been constructed that attempts to isolate the impact on organisational performance of hiring difficulties for high-skill jobs only. This measure may be considered a better proxy of 'shortages of skill'. By contrast, it is plausible to assume that recruitment difficulties for jobs requiring low skills/unskilled labour reflect 'shortages of labour', as opposed to skill⁽²⁶⁾. While the former could (partially) arise because of a genuine deficiency in the availability of skilled labour⁽²⁷⁾, this cannot be true for the latter. The overall severity of recruitment bottlenecks

faced by firms, captured by circumstances where both high-skill and low-skill vacancies are hard to fill, has also been measured separately. The type of recruitment bottleneck among EU firms is summarised in Table 10.

Table 10. Type of recruitment bottlenecks in establishments, EU-27, 2009

No difficulties in finding staff for jobs	60.3%
Labour bottleneck: only difficulties in finding staff for low-skill or unskilled jobs	3.4%
Skill bottleneck: only difficulties in finding staff for skilled jobs	29.3%
Both labour and skill bottleneck: difficulties in finding staff for both skilled and low-skill/unskilled jobs	7.0%

NB: Based on the combined responses of managers to the question: Does your establishment encounter any of the following problems related to personnel: (i) difficulties in finding staff for skilled jobs; (ii) difficulties in finding staff for low skilled/unskilled jobs.

Source: Eurofound, ECS-2009; Cedefop calculations.

Empirical investigation of the impact of recruitment bottlenecks on organisational labour productivity reveals that employers concerned with their ability to attract talent are also more likely to believe that they have a productivity disadvantage relative to competitors. Establishments with difficulties only in finding staff for skilled jobs have lower labour productivity relative to competitors: these firms have a 3% lower probability of enjoying labour productivity that is a lot better than industry average (Table 11). The economic significance of this effect is non-trivial and robust (Annex 2). For illustrative purposes, it is noted that the size of the effect is half of the respective marginal probability of the impact of the variable 'share of workforce in high-skill jobs in the establishment', at 6% ⁽²⁶⁾. Reducing the difficulties that firms face in finding skilled workers may raise labour productivity by an

⁽²⁶⁾ The determinants of each of the components of the severity of skill shortages have been estimated on the basis of a multinomial probit model. The results are available from the authors upon request.

⁽²⁷⁾ Such high-skill bottlenecks are likely to be an overestimate of genuine skill shortages, as they could also arise because of non-equilibrium wage rates or uncompetitive job conditions, as mentioned in Chapter 3.

⁽²⁸⁾ On average, the proportion of employees who work in high-skill jobs in establishments, namely jobs that usually require an academic degree or a comparable qualification, is 25%.

equivalent degree as would be the case if the share of employees working in high-skill jobs in the establishment was raised by half a percentage point.

Table 11. Estimated marginal probability of establishments with a lot better labour productivity than average firms in same industry, EU-27, 2009

Only difficulties in finding staff for low-skill or unskilled jobs	1.7%
Only difficulties in finding staff for skilled jobs	-3.1%***
Difficulties in finding staff for both skilled and low-skill/unskilled jobs (omitted: no difficulties in finding staff for jobs)	-2.1%
Casual or atypical workforce	-1.4%***
Variable pay	1.7%***
High performance workplace practices	2.5%***
Changes in establishment in past 3 years	0.5%
Atypical hours	-0.1%
A single independent company or organisation	-1.3%
Public sector	-2.6%
Proportion of female employees	4.3%**
Proportion of employees who worked overtime in past 12 months	3.2%**
Proportion of employees in high-skill jobs	6.3%**
Size of establishment	
• 20-49	-0.8%
• 50-249	-3.6%***
• 250-499	-3.2%***
• 500+ (omitted: 10-19)	-2.9%**
Change in size of establishment in past 3 years	
• decreased	-8.3%***
• stayed about the same (omitted: Increased)	-5.2%***
Industry dummies	√
Country dummies	√
Probability (lot better labour productivity)	0.18%

NB: Marginal effects for the highest value of the dependent variable {a lot better than average}, calculated at the mean of the explanatory variables based on an ordered probit regression; *** p<0.01, ** p<0.05, * p<0.1;

Source: Eurofound, ECS-2009.

Other estimated effects that are important for policy include the statistically significant negative relationship between the reliance of firms on temporary contracts and labour productivity. By contrast, establishments which adopt variable pay schemes and other high performance work practices are more likely to be characterised by a superior relative performance. Private sector firms, those with a greater share of female workers, and those with a greater proportion of employees working in high-skill jobs are also more likely to have higher labour productivity.

4.3. Skill shortages as a constraint for innovation

The flash Eurobarometer survey 196 of mainly European SMEs (European Commission, 2007) collected information on various performance metrics of firms, such as their ability for innovation (introduction of new technologies and forms of work organisation) and the anticipated direction of company turnover and employment growth. Roughly 28% of firms that responded to the survey said that they were constrained in the implementation of innovation activities in the two years prior to the interview. As the data set also contains information on other important ingredients needed by a firm to sustain a competitive advantage, including its business strategy, access to credit, the quality of the infrastructure, or the degree of deadweight cost imposed by administrative regulations, it is possible to isolate better the independent impact of skill bottlenecks on firm performance. The analysis also purges the responses of employers on the occurrence of skill-related difficulties from other possible culprits, such as high labour cost or other recruitment constraints (unpleasant working conditions, low image of sector).

It is well-established that a skilled workforce helps the adoption of new technologies and the introduction of new forms of work organisation (Freel, 2005; Toner, 2011). Therefore, lack of skills should diminish the ability of firms to introduce new technologies and methods of work organisation. The analysis (Table 12) reveals that difficulties related to lack of skilled labour tend to hinder innovation⁽²⁹⁾. However, skill deficits are not the only problem: for small firms, lack of access to credit has detrimental consequences for their ability to

⁽²⁹⁾ The multivariate regression analysis of the association between firms' difficulty to innovate and a lack of skilled labour has been carried out using linear probability models. The linear probability models returns only a very small fraction (1.6%) of predicted values falling outside the [0,1] interval. The effects of the variables remain significant and retain their sign when a logit specification is adopted instead, which accounts for the binary nature of the dependent variable.

innovate. Contextual issues also play a role: rules and regulations, poor infrastructure and lack of demand (the purchasing power of clients) have a negative impact, as do high labour costs through their negative effect on recruitment efforts.

Examining the relative importance of the various constraints, it is apparent that lack of access to finance is the greatest barrier to innovation (10.8 percentage points), followed by high labour costs. The combined impact of the direct and indirect (via recruitment) effects of high labour costs on having difficulties introducing innovative practices is 9.36 percentage points (0.0483 + 0.0453). Lack of skilled labour follows in third place, with an overall impact equal to 7.7 percentage points.

When a strictly defined variable of genuine skill shortages (only skill-related problems, purged of any other confounding influences) is used instead as a regressor, the relative impact of the constraints on the ability to innovate changes. The effect of a genuine lack of skilled workers on the ability to innovate is 5.5 percentage points (instead of 7.7) ⁽³⁰⁾. At the same time, the direct effect of expensive labour costs increases the likelihood of difficulties in adopting innovative practices by 6.83 percentage points. The combination of the direct and indirect (via recruitment) effects of high labour costs on having difficulties introducing innovative practices is now 12.39 percentage points (6.83 + 5.56) ⁽³¹⁾; experiencing difficulties due to high cost of labour becomes the biggest obstacle.

Despite these limitations, the data show that, after netting out the effects of other difficulties that may be associated with a perceived lack of skilled labour by employers, genuine skill deficits have a negative impact on the ability of smaller-sized firms to introduce innovative practices. However, inadequate access to credit can be a relatively more significant barrier. This suggests that the credit crunch that has taken place in recent years, as a result of the financial crisis, will have had a marked negative impact on the ability of small firms to innovate.

⁽³⁰⁾ The variable 'genuine skill shortages' in this case is obtained by filtering out all other potentially confounding influences, as described in Section 3.3.1. The regression output is not shown here, but is available from the authors upon request.

⁽³¹⁾ The business strategy adopted by firms also has an impact on the ability to introduce innovative practices, albeit a small one. Difficulties in introducing innovation are higher in businesses that rely on partnership formation (with other businesses) and product differentiation. Also a strategy based on long working hours is not conducive to the introduction of innovation.

Table 12. **Difficulties in relation to introduction of new technologies and forms of organisation, EU SMEs, 2006**

	Not controlling for recruitment difficulties	Controlling for recruitment difficulties
Constraints encountered in the past two years		
Lack of skilled labour	0.075** (0.008)	0.077** (0.009)
Cost of labour too expensive	0.055** (0.008)	0.048** (0.008)
Limited access to finance	0.109** (0.009)	0.109** (0.009)
Problems with administrative regulations	0.076** (0.008)	0.074** (0.008)
Problems with infrastructure (roads, utilities, etc.)	0.057** (0.008)	0.057** (0.009)
Problems with the purchasing power of customers	0.054** (0.008)	0.053** (0.008)
Recruitment problems		
Lack of skilled workers		-0.003 (0.010)
Lack of non-skilled workers		0.026* (0.015)
Low image profession/industry		0.009 (0.020)
Wage levels too high		0.045** (0.014)
Unpleasant working conditions		0.008 (0.021)
Other control variables		
Business strategy	√	√
Industry (NACE 1 digit)	√	√
Country dummies	√	√
Constant	-0.055* (0.024)	-0.056* (0.024)
R2	0.108	0.109
N	15 273	14 693

NB: * significant at 5% ** significant at 1%; additional control variables include number of employees (log); subsidiary; not for profit; craft; simple waste management; complex waste management; the regression includes eight industry dummies (reference group: other community and social and personal services) and 30 country dummies (the reference country is Sweden).

Source: Microdata based on the flash Eurobarometer survey 196 (European Commission, 2010); Cedefop estimation.

4.4. Skill shortages and expected employment growth

The constraints organisations face also affect expected business outcomes, such as anticipated growth or decline in employment or expected increase or decrease in (business) turnover. A genuine lack of skilled labour (after considering the effect of difficulties due to a high labour cost) is associated with a positive outlook on employment and turnover growth (Table 13). Employers that expect higher employment and turnover growth in the next year are thus significantly more likely to be concerned with lack of skilled labour, presumably because a deficit in the pool of skills may ultimately act as a constraint on the ability of such businesses to continue expanding. By contrast, employers facing high cost of labour are less likely to expect an expansion in employment in the year ahead and anticipate a contraction in turnover instead. Difficulties related to weak demand (problems of low purchasing power of customers) are also associated with lower likelihood of expansion in employment and turnover taking place in the near future.

Defensive business strategies, based on cost reduction and contraction of production, tend to be associated with reduced likelihood of expected positive business outcomes (employment and turnover growth) and increased likelihood of expected negative outcomes (employment and turnover decline). In contrast, business strategies based on quality improvements and on product differentiation tend to be associated with positive expectations of business growth.

The positive association between employers' concerns about lack of skilled labour and positive employment growth suggests that organisations are aware of the importance of a skilled workforce for business growth. Organisations are typically concerned during recruitment with the fit of applicants' profiles (skills, knowledge, but also personality traits, attitudes and values) with those required by the organisation; McKee-Ryan and Harvey, 2011)⁽³²⁾. The analysis in this section suggests that concern with labour quality is the hallmark of a growing business, while a concern with the cost (price) of labour is a characteristic of failing businesses⁽³³⁾.

⁽³²⁾ Another reason why firms may encounter skills-related problems is related to job complexity (Chapter 5). When firms organise their jobs in a way that they require a particular and very specific skills mix that it is not generally adopted in other organisations, finding the right applicant may become very difficult (Lazear, 2009).

⁽³³⁾ See Healy et al. (2015), who reach to a similar conclusion using data from the Australian business longitudinal database.

Table 13. **Expected development of employment and turnover in firm one year ahead**

	Employment		Turnover	
	growth	decline	growth	decline
Constraints encountered in the past two years				
Lack of skilled labour	0.080** (0.008)	-0.002 (0.005)	0.044** (0.008)	-0.009* (0.005)
Cost of labour too expensive	-0.017* (0.008)	0.026** (0.006)	-0.017 (0.009)	0.030** (0.005)
Limited access to finance	0.017 (0.009)	0.055** (0.006)	0.019 (0.010)	0.018** (0.006)
Problems with administrative regulations	0.016* (0.008)	-0.001 (0.006)	-0.001 (0.009)	0.009 (0.005)
Problems with infrastructure (roads, utilities, etc.)	0.016 (0.008)	0.018** (0.006)	0.009 (0.009)	0.012* (0.005)
Problems with the purchasing power of customers	-0.050** (0.008)	0.028** (0.005)	-0.033** (0.009)	0.041** (0.005)
Business strategy to face competition				
Reduce cost	-0.035** (0.008)	0.015** (0.005)	-0.009 (0.009)	0.013** (0.005)
Forming strategic partnerships	0.036** (0.008)	0.002 (0.005)	0.052** (0.008)	-0.013** (0.005)
Price reduction	0.024** (0.008)	-0.006 (0.005)	0.005 (0.008)	0.004 (0.005)
Quality improvements	0.012 (0.008)	-0.008 (0.006)	0.055** (0.009)	-0.013* (0.005)
Increase product differentiation	0.027** (0.008)	0.002 (0.006)	0.030** (0.009)	-0.003 (0.005)
Expand in foreign markets	0.050** (0.008)	-0.001 (0.006)	0.059** (0.009)	-0.012* (0.005)
Increase working hours	0.018* (0.008)	-0.002 (0.006)	0.003 (0.009)	-0.007 (0.005)
Reduce production	-0.042** (0.011)	0.037** (0.008)	-0.099** (0.012)	0.056** (0.007)
Increase marketing budget	0.043** (0.009)	-0.026** (0.006)	0.103** (0.010)	-0.032** (0.005)
Other control variables (see footnote)				
Industry dummies (NACE 1 digit)	√	√	√	√
COUNTRY dummies	√	√	√	√
Constant	0.115** (0.024)	0.012 (0.017)	0.202** (0.026)	0.090** (0.015)
R2	0.1092	0.0773	0.1200	0.0592
N	15 273	15 273	15 273	15 273

NB: * significant at 5% ** significant at 1%. Standard errors in parentheses. Additional control variables include: number of employees (log); subsidiary; not for profit; craft; simple waste management; complex waste management. The regression includes eight industry dummies (reference group: other community and social and personal services) and 30 country dummies (reference country is Sweden).

Source: Microdata based on the flash Eurobarometer survey 196 (European Commission, 2010); Cedefop estimation.

4.5. Conclusions

Empirical research has revealed that the hiring difficulties of firms, particularly those targeted to high-skill jobs, can be a constraint for firm productivity and for adoption of innovative technologies and forms of work. Firms with difficulties finding staff to fill their skilled job vacancies are more likely to have lower labour productivity relative to other competitors in their industry.

However, the analysis has also highlighted that, in organisations that adopt business strategies which are reliant on a skilled workforce, such as those that place greater focus on quality improvements and product differentiation, lack of skilled labour is associated with positive business outcomes (in terms of expected increase in employment and turnover). Overall, concerns about the quality of labour are thus associated not only with lower productivity equilibrium but are also considered to be a significant barrier to the continued growth of firms.

Other common obstacles to the firm, such as high labour cost and lack of access to credit, may also pose a great obstacle to organisational performance as they are found to be negatively related to employment growth.

Tackling skill gaps within organisations

5.1. Introduction

5.1.1. Internal skill gaps in firms

Previous chapters have confirmed that skill bottlenecks are marker of a dynamic approach by firms to skills resourcing and to skill- and innovation-intensive product market strategies and that, when genuinely linked to a shortage of high skill, can constrain organisational performance and innovation. It has also been shown that the type and magnitude of recruitment bottlenecks that firms encounter is linked to their business and HRM strategies. In this chapter, attention is on optimal firms' responses to the skill challenges they may encounter, not only when finding it difficult to hire skilled labour in the outside market but also with skill gaps in their existing workforce. Several recently available data sets are used, including the OECD survey of adult skills (PIAAC survey) and a new pilot survey on skills obsolescence administered by Cedefop in 2011. These enable scrutiny of the relationship between the skill needs and skill gaps of firms and their overall talent management strategies.

Skill gaps are not only relevant for firms when searching externally for suitable staff: significant gaps in the skills of existing workers and the skill needed by employers may occur in the existing workforce⁽³⁴⁾. Skill gaps may emerge because workplaces are dynamic environments. The balance of skill demand and supply can also change over time due to evolving technologies, changing consumer tastes or other economic/social shocks, leading to skills obsolescence.

Temporary skill gaps may sometimes be acceptable, as with newly hired workers who typically require an induction period of training to get accustomed to the way in which the organisation operates. Another acceptable

⁽³⁴⁾ The fact that skill gaps are a common occurrence in firms is evident from the fact that many consultants offer skill gap analysis tools and most organisations routinely review the skill needs in their workforce. For example, 73% of EU companies review internal skill needs (Eurofound, 2012; see also Table 4).

misalignment between the skills required for the job and the skill set possessed by workers is when candidates have little or no work experience, – as in school to work transition. Candidates may possess the necessary technical and theoretical knowledge, but they often lack the mindset as well as the applied knowledge and skills needed to function properly in the workplace (European Commission, 2010; Hettich and Landrum, 2014). A temporary wedge between the skills needed to carry out jobs and workers' skills could also develop because of the dynamic nature of work: workers change jobs (promotions, job rotation, and career developments), job requirements change (new machinery or changes in the way production is organised), or because organisations themselves change (merger, acquisitions or changes in work organisation).

For most firms the need to address external or internal skill gaps is a significant concern, although how they attempt to tackle the problem varies between enterprises. According to the talent shortage surveys, almost half of employers addressing talent shortages do so through alternative people practices (training and development for existing staff, using non-traditional or new recruitment practices). Only one in four employers explores new talent sources and 23% implement alternative work models (such as increasing the focus on their talent pipeline, redesigning current work procedures, or integrating contingent workers). More than one in five employers with talent shortages (22%), have no strategies as response to the problem (ManpowerGroup, 2014, p. 8).

5.1.2. Talent management in firms

Firms can be expected to demonstrate heterogeneity in their responses to skill shortages and gaps. Even within narrowly defined industries, some firms are top performers in terms of their HRM practices and others are laggards. The world management surveys, for instance, have revealed important differences in management practices between countries, but also the marked discrepancies that exist even within countries and sectors (Bloom and Van Reenen, 2007; 2010; Eurofound, 2011). These diverse management practices, of which talent management is a key pillar, can partially account for the residual productivity gap between firms even after considering dissimilar stocks of factor inputs.

This diversity of practices between firms is often the outcome of strategic choices dictated by technological forces, factor input endowments and other relevant market factors (location, marketing strategy, organisational culture *inter alia*), which are taken to secure competitive advantage. The type of

business and product market strategy, which is mirrored in the design of job tasks, will have marked implications for the nature of a firm's demand for skills and allocation of tasks to workers according to their skills. The choice and effectiveness of diverse HRM practices is dependent on business strategy and so are skill needs ⁽³⁵⁾. Business strategies based on a high degree of product diversification and product customisation tend to be accompanied by more complex jobs, a greater demand for skills and, subsequently, a higher chance of firms experiencing skill shortages (Stahl, 2013).

For example, some firms decide to adopt lean production systems that extract maximal value from physical assets. The organisation of work according to Tayloristic or Fordist principles breaks down operations into their basic components, resulting in jobs consisting of few, preferably simple, tasks. Job routines are precisely described and often involve the repetitive execution of tasks. In such firms there is thus a derived demand for low-skilled labour. Other companies focus more on worker performance and talent management, which includes a search for the best way to attract and retain human capital in the organisation, whether and how to offer training to up-skill staff and how to structure reward systems so that they either incentivise greater worker effort or penalise poor performance.

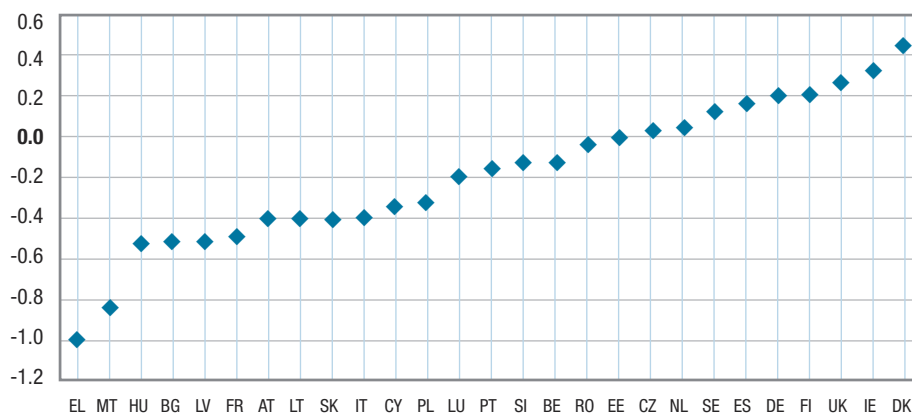
In this respect, marked differences in the share of establishments that use high performance work practices are typically observed between EU Member States. Figure 19 illustrates that countries such as Denmark, Germany, Ireland, Spain, Finland, Sweden and the UK are ranked above average on the HPW scale (derived in Chapter 2) while firms in countries such as Bulgaria, Greece, Hungary, Malta and Latvia are less likely to employ innovative methods of human resource management.

Given that skill gaps tend to materialise more often in dynamic work environments, organisations typically seek to recruit employees who can learn new jobs quickly and have personality traits that allow them to sustain high performance over time. Organisations with modern workplaces spend a lot of time in evaluating the fit between prospective workers and company culture and in validating job applicant skills (Cedefop, 2014b). The bundle of competences, attitudes and skills required by their jobs (job design) needs to be embodied in the 'right worker' and not in just any worker (Kristof-Brown et al., 2005). Unfortunately, it is not always possible to find individuals who

⁽³⁵⁾ An employer survey in the UK, for example, indicated that 69% of establishments agreed with the proposition that their human resource strategy is closely linked to their business strategy (UKCES, 2008).

possess all of the desirable attributes, so some degree of compromise is generally required. The prevailing view among human resource managers is to select applicants with right personality traits (those fitting the job requirements) and subsequently use training to build the needed (technical) skills. In this strategy organisations may choose to develop the skills needed internally as a response to skill gaps, unless they can easily hire the skills needed (CVTS-4 2010) ⁽³⁶⁾.

Figure 19. Mean value of HPW scale by country, EU-27, 2009



Source: Eurofound, ECS-2009; establishment weights applied.

To mitigate skill gaps in jobs, the European Commission has emphasised the relevance of skill development for the future knowledge economy in lifelong learning policies (European Commission, 2001; 2013). Skill development depends on individual factors, in particular the learning motivation and attitudes of individuals which enable coping with changing workplace requirements (Candy et al., 1994). Nevertheless, as will be shown in the remainder of this chapter, the workplace is also crucial to continuing individual skill development.

⁽³⁶⁾ Eurostat. *Your key to European statistics*. <http://ec.europa.eu/eurostat/web/microdata/continuing-vocational-training-survey> [accessed 6.5.2015].

5.2. The learning organisation and worker skill gaps

Research has shown that while learning in the workplace via formal training is of value, just as important is learning taking place in non-formal and informal settings. Workers can develop skills while doing their work, especially in contexts where such learning is encouraged and made possible. Organisations seeking to develop skills internally need to encourage workers to invest in skills and support them in the process (Maurer et al., 2003; Kyndt and Baert, 2013). Workers need to be engaged in the process or training provision or else training may lead to very little additional human capital (Foss and Lindenberg, 2013; Nyberg et al., 2014). Positive learning contexts are those where it is ingrained into work and driven by the need to solve new and complex problems and by mastering the challenges that workers are confronted with in their jobs (Anzai and Simon, 1979; Eraut, 2004).

Learning will occur in situations where individuals have to go beyond standard routines; complex work that confronts individuals with unstandardised situations can result in them using different abilities, inducing a learning process (Örtenblad, 2002). Work autonomy can mean that challenges are mastered by the individuals themselves instead of others (e.g. managers, supervisors): exposure to such challenges provides a learning stimulus, even if the learning process is not intended. Work reduced to routine tasks, by contrast, requires few skills and does not improve them (Krahn and Lowe, 1998). Also, a learning supportive social climate (Leonard, 1994) characterised by social exchange of work-related issues, can induce reflection in the social context.

From the above it is clear that skill gaps in firms may be reduced by providing appropriate contexts for training, learning and designing autonomous or complex jobs in the workplace. Where managers have leeway in designing such talent management practices (Argote, 2013; Svensson and Ellström, 2004), the enterprise has a critical role to play in preventing skill gaps in competitive job markets.

Given the scarcity of European evidence on the relationship between organisational support for learning, job design and the incidence of skill gaps in the workforce, Cedefop conducted in 2011 a survey on skills and skills obsolescence in four Member States (Germany, Hungary, the Netherlands and Finland). An online survey was carried out in each country, targeting a respective population of about 1 000 prime-aged full-time individuals who were

between 30 and 55 years at the time of the survey and were working 30 hours a week or more in their job ⁽³⁷⁾. All respondents were contacted by email and selected from a panel list for online surveys according to the population criteria.

The survey asked the individuals to rate, on a 0 to 100 scale, the extent to which they believed their skills deviated from the level necessary to carry out their job as well as possible. This self-reported measure of the distance between the skills needed to do the job in the best possible way and workers' own skills is a unique measure of internal skill gap ⁽³⁸⁾. Such a measure differs relative to other constructs used in literature, which have typically asked employees to evaluate their skills in relation to those needed to carry out their job duties (regardless of how well these tasks are carried out). The measure in the Cedefop survey is a summary of the degree to which an employee's skills diverge from those needed to achieve optimal performance in his/her job.

The measure of skill gap used here tends to emphasise the extent of underskilling among employees, and seems to be at odds with the claim that over 30% of EU workers are overskilled (European Commission, 2012b). The two claims are not in contradiction as the simultaneous presence of overskilling (the potential to do more demanding job duties) and underskilling (the need to further develop one's skills) is at the heart of talent management (Cappelli, 2008; Cappelli and Keller, 2014). Workers might, at the same time, have skill gaps with regards to achieving higher productivity dividends from their job but may be broadly overskilled in relation to the execution of their daily job tasks. Workers generally have a variety of skills but not all are useful for the organisation at a given point in time (Ployhart and Moliterno, 2011; Ployhart et al., 2014). The talent approach focuses on the potential of workers rather than on the immediate skill match for the job: some of workers' skills will become useful to the organisation at some point in the future. It also considers that the maximum productivity potential of jobs may change within organisations over time, given that the organisation may alter the way in which it approaches the market, change product lines or revise the production process altogether.

⁽³⁷⁾ The focus on prime-aged workers was a deliberate choice, given the need to minimise the confounding effects arising from the school-to-work transition, or the impact of retirement choices.

⁽³⁸⁾ Given the pilot nature of the survey, this self-reported measure of a skill gap is experimental. In hindsight the question could have been phrased differently by asking the respondent to report what he/she thinks would be the supervisor's/rater's assessment of his/her skill gap (if any). This could be a better option given that in the field of performance assessment the latter formulation appears to yield a higher correlation with a rater's true assessment than the own self-reported measure of performance by an employee (Schoorman and Mayer, 2008; Schat and Frone, 2011).

The employee skill gap is inversely related to the self-reported relative measure of skills in the survey [skill gap = 100 – relative skill level]. The higher the score on this variable, the higher is the extent to which workers' skills match those needed to perform their job in the best possible way. In the sample, 57% of workers reported a skill level that is equal to or higher than 90% of what is needed to perform their jobs (a corresponding skill gap smaller or equal to 10%).

Figure 20 depicts the distribution of the responses to the survey. The upper and lower sides of the boxes are the first and the third quartile, so 50% of the sample is included in the box. On average, in the pooled sample (all four countries grouped together) the skill gap is equal to 14%: workers in the sample possess, on average, 86% of the skills needed to perform their job in the best possible way⁽³⁹⁾. The average skill gap is rather stable across countries, ranging from 13% in Finland to 14% in Hungary and Germany and 15% in the Netherlands. The median relative skill level (denoted by the line within the box) is 90% in Germany, Hungary and Finland and 85% in the Netherlands, so the corresponding skill gap is 10% in the former group of countries and 15% in the Netherlands.

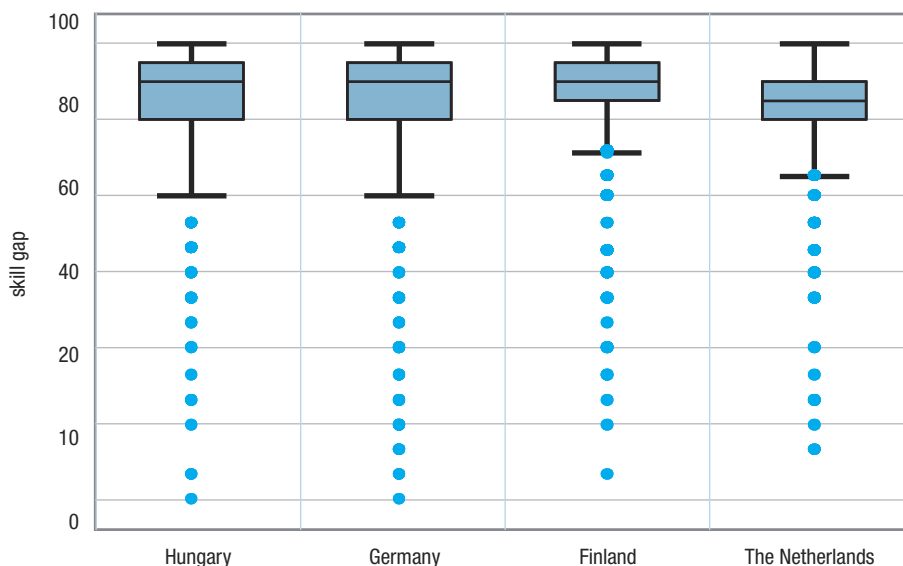
The relative skill level ranges between 80-95% in Germany and Hungary, 85-95% in Finland and 80-90% in the Netherlands. A quarter of the sample in each country has a relative skill level below the lower edge of the box; these are individuals with a 'severe skill gap'. In particular, one quarter of the German, Hungarian and Finnish samples had a relative skill level below 80% (or a skill gap above 20%) and one quarter of the Dutch sample had a relative skill level below 85% (a skill gap above 15%)⁽⁴⁰⁾.

Empirical analysis carried out with the data from the Cedefop pilot skills obsolescence survey reveals the relationship between the self-reported measure of skill gaps in the four Member States and several organisational, job and personal characteristics (Annex 2 and Table 14). Individuals working in organisations that give them the opportunity to develop their skills and to multitask are more likely to say that they suffer from larger skill gaps. Complex jobs tend to require many skills, and this larger and more complex skill set needed to perform a job in the best possible way tends to be reflected in larger skill gaps. By contrast, workers with smaller skill gaps are more likely to

⁽³⁹⁾ The sample is not representative of the entire workforce population in the surveyed countries.

⁽⁴⁰⁾ The whiskers – the lines going out from the boxes – suggest a range of values that could be considered as typical. Observations outside this range – those marked by a dot – might be hard to model (i.e. outliers).

Figure 20. **Skill gaps among prime-age employees, four Member States, 2011**



NB: The skill gap is derived by the difference between a worker's self-reported level of skills relative to the skill level needed to perform the job in the best possible way; the sample comprises of N=3876 employed workers aged between 30 and 55 years.

Source: Cedefop, pilot skills obsolescence survey.

receive support from their supervisors, highlighting the critical role of the latter for assessing and tackling any skill deficits of employees. Skill gaps are smaller when workers have the opportunity to use a variety of skills in their daily work routine and also in jobs that involve learning among colleagues. By contrast, there is no significant relationship between jobs that offer greater autonomy or reward systems based on performance and the occurrence of a skill gap ⁽⁴¹⁾.

Careful recruitment and selection strategies by firms are also found to be critical for mitigating skill gaps; the enterprise ensures a good fit between a job applicant's skills and those required by the job at the beginning of employment. When considering a subjective measure of the initial relative skill level of employees (Model 2), it is confirmed that individuals with a lower skill gap at the time of job entry are also characterised by a lower skill gap at the

⁽⁴¹⁾ However, Finland is an exception, since a higher degree in autonomy and the choice of how to perform tasks is associated with a smaller skill gap in that country.

time of the survey ⁽⁴²⁾. Recruiting suitably skilled workers is therefore a key ingredient for avoiding future occurrences of significant skill gaps, and could effectively complement and support internal skill formation strategies (such as training and on-the-job learning).

Routine or simple jobs (those that never confront workers with complex problems) are associated with a smaller skill gap, as are those that involve working at high speed. These jobs are associated with smaller skill gaps probably because they have modest skill requirements and so it is easier for workers to achieve the optimal level of performance.

Workers on permanent contracts also tend to have a smaller skill gap, which highlights the important role of job stability in enabling employees to develop skills necessary for reaching the highest possible level of performance.

Focusing on individual traits, the empirical findings are consistent with a learning curve: age and experience on the job are both associated with smaller skill gaps ⁽⁴³⁾. This is also consistent with the fact that workers who had the opportunity to develop their skills during their career have smaller skill gaps on average. Skill gaps are also influenced by personal dispositions and constraints. A positive attitude to learning ⁽⁴⁴⁾ and towards assuming a wider number of roles than that implied by the job description, is associated with a lower skill gap. The disposition toward performing a larger number of roles can be partly considered a personality trait, but it is also influenced by workplace policies that encourage the assumption of extra tasks and initiatives by employees (Wright et al., 1993; Miles et al., 2002; Spitzmuller et al., 2008).

Larger skill gaps are observed among individuals with greater perceived work-life conflicts. Health is also found to play an important role in the skill matching process, given that good health is associated with smaller skill gaps. Finally, men are found to be characterised by a skill gap that is, on average, two percentage points larger than that of women with comparable characteristics.

⁽⁴²⁾ Nevertheless, the relationship is weak, suggesting the presence of a high degree of heterogeneity in the learning experiences (or in the skill development) of workers. Also, the coefficients in Model 2 are almost identical to the corresponding ones in Model 1, suggesting that the amount of bias in the regression coefficients of Model 1 due to the omission of the initial relative skill level is modest.

⁽⁴³⁾ Given the limited age range in the sample, the variables age and tenure have been entered into the empirical specification in a linear fashion (rather than the more usual quadratic form).

⁽⁴⁴⁾ The scale consists of five items adapted from a comprehensive scale developed to measure the disposition towards lifelong learning (Kirby et al., 2010). Higher scores correspond to more favourable attitudes towards learning. The items used in the Cedefop survey to measure attitudes towards learning correspond to item numbers 1,2,3,9, and 10 of the above-mentioned scale.

Table 14. **Determinants of skill gaps among EU employees, four Member States, 2011**

	Model 1	Model 2
Learning organisation		
Encourages workers to broaden skills	-0.011** (0.005)	-0.009* (0.005)
Gives opportunity to workers to do different tasks	-0.011** (0.005)	-0.010* (0.005)
Support from supervisor	0.011** (0.005)	0.011** (0.005)
Workplace changes (*)	-0.010 (0.008)	-0.011 (0.008)
Tasks – Work complexity		
Never perform complex tasks	0.023*** (0.006)	0.021*** (0.006)
Job is challenging	-0.003 (0.006)	-0.002 (0.006)
Variety of skills used	0.017** (0.007)	0.016** (0.007)
Decide content of job tasks	0.004 (0.005)	0.002 (0.005)
Decide how to perform tasks	0.004 (0.005)	0.005 (0.005)
Working at high speed	0.013*** (0.004)	0.014*** (0.004)
Job requires helping colleagues to learn	0.013** (0.005)	0.013** (0.005)
Nature of job duties		
Supervising personnel	-0.010 (0.009)	-0.008 (0.009)
Dealing with clients and suppliers	-0.010 (0.008)	-0.007 (0.007)
Working with text and numbers	-0.011 (0.008)	-0.007 (0.008)
Working with objects and materials	0.013 (0.008)	0.016** (0.008)
Job conditions		
Working hours	0.025 (0.016)	0.023 (0.016)
Permanent job	0.025*** (0.007)	0.026*** (0.007)
Job tenure	0.001** (0.000)	0.001** (0.000)
First job	0.001 (0.006)	0.002 (0.006)
Wage depends on effort	0.001 (0.006)	0.000 (0.006)

	Model 1	Model 2
Worker characteristics		
Enjoy extra roles	0.008* (0.004)	0.008* (0.004)
Had opportunities to develop skills in career	0.014*** (0.005)	0.015*** (0.005)
Attitude to learning (see footnote 44)	0.099*** (0.012)	0.097*** (0.012)
Good health status	0.029*** (0.004)	0.029*** (0.004)
Work interferes with family	-0.011** (0.005)	-0.011** (0.004)
Age	0.001*** (0.000)	0.001** (0.000)
Male	-0.019*** (0.005)	-0.017*** (0.004)
Education		
Medium	0.001 (0.006)	0.003 (0.006)
High	-0.001 (0.007)	-0.001 (0.007)
Country		
Germany	-0.002 (0.006)	-0.004 (0.006)
Finland	-0.003 (0.007)	0.001 (0.007)
The Netherlands	-0.024*** (0.007)	-0.023*** (0.007)
Constant	0.619*** (0.063)	0.581*** (0.063)
Initial relative skill level		0.073 (0.008)
Observations	3 876	3 856
R-squared	0.080	0.102

NB: Ordinary least squares (OLS) estimates reported; standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, the reference group of the variables are given in parenthesis: Nature of job (other), Education (low), and Country (Hungary)
 (4) A scale consisting of six items capturing the changes resulting from the introduction of new or significantly changed
 (i) machines and techniques, (ii) method of work, (iii) product or services; (iv) if there was an increase in the contact with clients or customers and (v) if working conditions became more strenuous (consisting of two items, more physically or mentally strenuous). Higher scores on the scale correspond to a more intense rate of workplace change. The Cronbach alpha statistic is 0.61.

Source: Cedefop, pilot skills obsolescence survey.

5.3. The organisation as a shield against skills obsolescence

Skill gaps are not static; the balance of skill demand and supply can change over time, fostering skills obsolescence among employees (De Grip and Van Loo, 2002). The skills of employees and the skills required for jobs can diverge over time. Formerly necessary skills can become superfluous or less in demand and new tasks can become valuable due to changes in the job profile. The phenomenon whereby internal skill mismatches of employees rise over time has been labelled skills obsolescence.

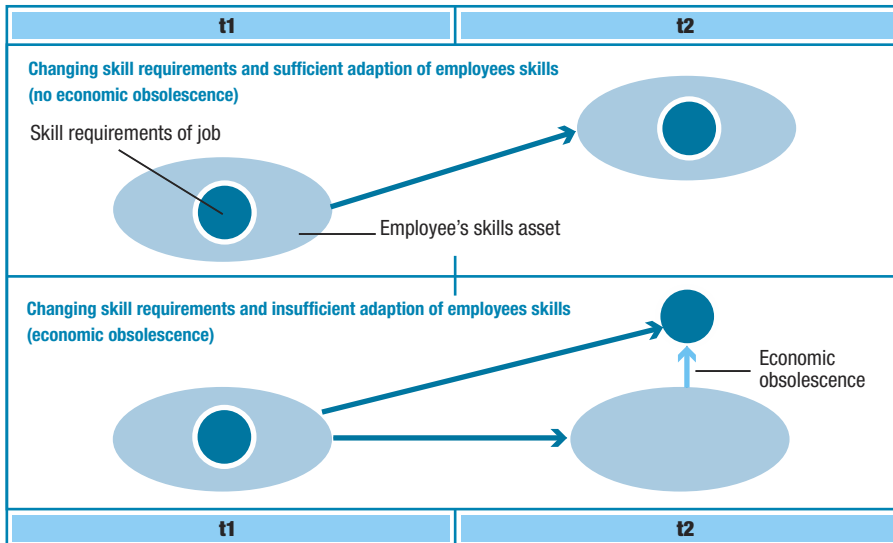
Skills obsolescence is typically subdivided into two main types; obsolescence due to skill depreciation – a reduced ability to perform a set of tasks due to wear, sickness or ageing – labelled ‘technical obsolescence’; and a second type called ‘economic obsolescence’, which is particularly relevant in the context of changing skill needs in economies because it results from changes in the work environment (Van Loo et al., 2001, p. 122) ⁽⁴⁵⁾. In contrast to technical obsolescence, economic obsolescence does not imply that the skills of workers have decreased. Employees can have the same set of skills as before, but a wider skill gap arises because of insufficient adaptation of their skills to changes in the work environment. This progressively reduces the economic value of their skills, which become less needed at work while the employee’s knowledge in using modern techniques and procedures becomes inadequate (Rosen, 1975). The degree of obsolescence can vary but will lead to the same negative consequences as other forms of skill mismatch: higher unemployment risks, lower productivity, and lower job satisfaction. On an aggregate level this may also affect the productivity of enterprises and ultimately lead to negative macro level effects, with productivity losses in the economy (Manacorda and Petrongolo, 1999).

Economic skills obsolescence is a dynamic process. It is assessed with reference to former performance and refers to the fact that an employee’s necessary skill assets for a job become significantly different over time. The process towards economic obsolescence is schematically illustrated in Figure 21. The upper and lower diagram symbolise the evolution of an employment relationship over time. The dark circles represent skill requirements for a position and the light blue ovals are the skill assets of employees. Both diagrams show that in the initial phase (t1) the employee’s skill assets are

⁽⁴⁵⁾ In this section economic obsolescence will be emphasised and other types of obsolescence disregarded. For a discussion of other types of obsolescence see Van Loo et al. (2001, p. 122).

matched to the skill requirements of a certain post. Over time skill requirements change. At a second period (t2) the dark circle has moved away from the initial point. While in both pictures the movement of the skill requirements is identical, the situation is different for the skills of employees. In the upper diagram the skills of employees adapt to changes. In this case no economic skills obsolescence occurs ⁽⁴⁶⁾, while in the lower diagram the skill assets of employees fail to keep up with changing skill requirements. At the end of this process a skill gap materialises. The strength of this gap can vary in degree, so obsolescence can be weak or strong.

Figure 21. **Process of economic skills obsolescence**



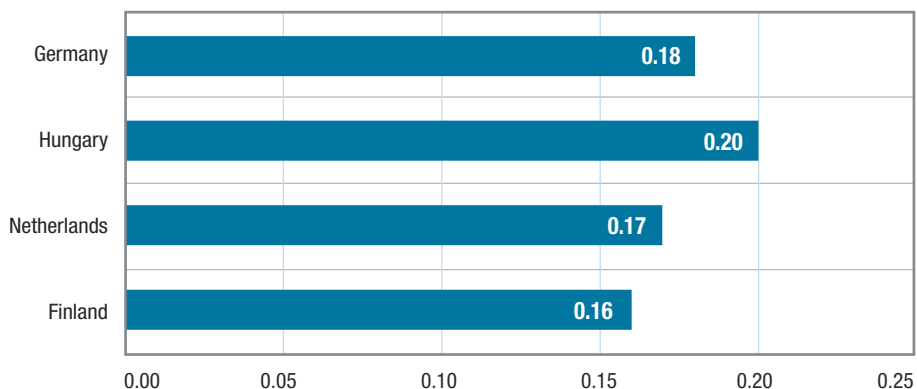
Knowledge of efficiency principles and determinants of skill development and use in the work context are necessary to implement and support appropriate business and policy strategies that prevent widespread skills obsolescence. Cedefop’s pilot skills obsolescence survey collected important information that enables the assessment of relevant factors linked to the development of economic skills obsolescence among employees in four Member States. The data capture several aspects of individual economic obsolescence subjectively rated by the respondents. These responses have

⁽⁴⁶⁾ The movement of the circles only symbolise the change between t2 and t1 and are not intended to imply particular vertical or horizontal movements in skill mismatch.

been summarised by an overall index of economic obsolescence (Annex 2) ⁽⁴⁷⁾: the higher the score, the higher the degree of economic obsolescence.

Figure 22 illustrates the differences in the economic skills obsolescence index between the four countries in which the pilot survey was carried out in 2011. However, the differences between the countries are quite low, with employees in Hungary appearing to suffer most, in contrast to Finns. The average obsolescence score does not point to widespread skills obsolescence problems affecting the workforce of the surveyed countries but a non-trivial degree of obsolescence can be detected in each country.

Figure 22. **Mean economic obsolescence by country**



NB: Scale range between [0-1].

Source: Cedefop, pilot skills obsolescence survey.

Relevant factors affecting skills obsolescence that have been identified in previous studies have focused on the individual, including the health-related reduction in abilities and learning or lifecycle changes and interruptions in career (De Grip, 2006; Desjardins and Warnke, 2012). But organisational policies are also crucial in terms of enabling continuous knowledge accumulation and adaptation to new technologies. Similar to the analysis in Section 5.2, an empirical investigation of the determinants of skills obsolescence presented below uses data from the Cedefop pilot skills obsolescence survey, which enables the inclusion of a host of organisational, job and individual variables as potential explanatory factors in the analysis.

⁽⁴⁷⁾ The indicator is constructed as additive index. The list of variables that have been used as components to construct the index can be found in the Annex 2.

Table 15. **Determinants of economic skills obsolescence, four EU countries, 2011**

	Coefficient	Robust standard error	P>t
Organisation/workplace			
Change intensity workplace	0.10	0.01	0.000
Learn climate	-0.12	0.02	0.000
Work complexity	-0.06	0.02	0.000
Work autonomy	0.00	0.01	0.935
Job			
Time pressure	-0.01	0.01	0.428
Working hours	-0.02	0.03	0.596
Contract type: permanent	-0.03	0.01	0.055
Conflict: job and family	0.03	0.01	0.003
Wage depends on effort	0.02	0.01	0.053
Main task (ref.: supervisor)			
Deal with clients and suppliers	-0.01	0.01	0.330
Work with text and numbers	0.02	0.01	0.068
Work with objects	-0.02	0.01	0.251
Other	0.02	0.02	0.311
Individual			
Job tenure	0.00	0.00	0.086
Job interrupted	0.00	0.01	0.711
Age	0.00	0.01	0.523
Age2	0.00	0.00	0.353
Health level	-0.02	0.01	0.001
Male	0.01	0.01	0.320
Motivation for effort (ref.: to be satisfied)			
• ...to keep my job	0.06	0.01	0.000
• ...be useful for society	0.01	0.01	0.627
• ...to improve my wages	0.02	0.02	0.126
• ...to fulfil a duty	-0.01	0.01	0.354
• ...because it is interesting	-0.02	0.01	0.052
• ...other motivation	0.01	0.02	0.547
• ...put no effort	0.05	0.05	0.327
Education (ref.: low)			
• middle	-0.01	0.01	0.440
• high	-0.01	0.01	0.519
Training activity	0.02	0.01	0.075
Learn: for its own sake	0.01	0.01	0.114
Learn: related to practical issues	-0.03	0.02	0.203
Learn: autonomous	-0.09	0.01	0.000
Learn: prefer difficult problems	-0.05	0.01	0.000
Learn: when problems arise	-0.02	0.01	0.182

	Coefficient	Robust standard error	P>t
Country dummies			
Country (ref.: Hungary)			
• Country: Germany	0.00	0.01	0.909
• Country: Finland	-0.01	0.01	0.292
• Country: Netherlands	0.02	0.01	0.243
Constant	0.53	0.19	0.004
N	3576		
R ²	0.17		

NB: Based on ordinary least squares (OLS) regression, statistically significant coefficients in bold at 1% level of significance.
 Source: Cedefop, pilot skills obsolescence survey.

The results confirm that certain organisational and workplace characteristics play a significant role in determining the amount of economic skills obsolescence experienced by workers. The higher the intensity of changes in the work environment, the higher is the level of obsolescence observed among employees. A conflict between work and life obligations may also result in higher skills obsolescence, presumably because of the constraint it imposes on the ability of individuals to pursue continuous skill development efforts. By contrast, a favourable learning climate at the workplace and complex work reduces the amount of skills obsolescence ⁽⁴⁸⁾.

Individual traits are also found to contribute to skills obsolescence. Employees working mainly due to economic security motives – to keep their job – show a higher degree of obsolescence in comparison to the group of people that work to be satisfied. Learning focused on challenging problems and on autonomous learning activity have both a significant negative relationship with obsolescence. Health conditions also show a negative effect on obsolescence, with better reported health being associated with a lower level of obsolescence ⁽⁴⁹⁾.

⁽⁴⁸⁾ Workplace characteristics that show no significant effects are work autonomy, a payment scheme basing wages on effort, a permanent contract and the amount of working hours.

⁽⁴⁹⁾ Other individual characteristics and constraints such as gender, work life interruption, level of education, training participation and job tenure exert no significant effects on skills obsolescence in the specific sample under study. This applies also to the country dummies and occupational tasks characteristics.

5.4. Designing better jobs for better skills

Job design and the degree of task complexity are strategic decisions for organisations. One of the most challenging questions for managers is defining a job description: specifying the tasks assigned to a given job, the authority and discretion granted to employees performing such jobs, and the extent to which such jobs can influence the behaviour and motivation of workers. Prominent theories of job design stress the interaction with human capital and incentives when firms decide how to shape and structure job tasks (Lazear, 1992; Prendergast 1995). In the first half of the 20th century the Tayloristic principle of job fragmentation into separate and identifiable tasks was the norm. This involved clear-cut job roles among workers, sliced up into simple repetitive tasks and eased by piece rate pay and vertical bureaucratic hierarchies, which allowed for efficient monitoring of worker effort. Although this approach promoted organisational performance, particularly in assembly line environments, it implied a low demand for skills and a high level of employee job dissatisfaction.

Herzberg's two-factor theory of motivation and job enrichment, and the research it spurred in the 1970s, including the job characteristics model (Hackman and Oldham 1976), emphasised that allowing for employee control over aspects of the job (such as timing and methods of work) promotes employee motivation and organisational effectiveness. With the advent of skill-biased technological progress in recent decades, more organisations have also decided to enrich their jobs by allowing for a greater degree of discretionary effort among workers (Caroli and Van Reenen, 2001). Some have referred to this change as 'smart working', 'an approach to organising work that aims to drive greater efficiency and effectiveness in achieving job outcomes through a combination of flexibility, autonomy and collaboration, in parallel with optimising tools and working environments for employees' (CIPD, 2008, p. 4).

The so-called 'task approach' of labour economics (Autor et al., 2003; Autor and Handel, 2013) also emphasises that the core activities that workers undertake in their jobs are linked to the formal and informal skills required by workers. The degree to which labour at different skill levels is needed is determined according to technical changes, the relative availability of factor supplies and the comparative advantage of different skill types in the execution of distinct tasks (Acemoglu and Autor, 2011). As job task requirements are linked to evolving technologies, including the reduced cost of ICT, this is believed to have eased the automation of a large set of routine (cognitive or

manual) tasks and resulted in a shift in relative labour demand away from medium-skilled individuals and in favour of those with higher or basic skills⁽⁵⁰⁾.

Job design emphasising greater task discretion and employee control has been considered to be a key ingredient of the shift to so-called 'high performance workplaces' (HPW) (Huczynski and Buchanan, 2001). Literature on HPW has suggested that human resources are at their most productive when they are confronted with complex, autonomous and non-routine tasks (UKCES, 2009). Firms relying on HPW often use specific job design, hiring, training, communication and performance management measures to ensure that they attract a highly skilled workforce that continuously develops. Many studies have confirmed a positive relationship between HPW practices and measures of organisational performance (Huselid, 1995; Bauer, 2004; DTI and CIPD, 2006), including job satisfaction (Bauer, 2004), health and safety at work (Pouliakas and Theodossiou, 2013) and productivity (Bloom and Van Reenen, 2011). In this respect, it is usually assumed that the positive effect of innovative job design on productivity is mediated by higher levels of human capital. However, little evidence exists to confirm that this positive relationship arises because of the higher (cognitive) skills of workers in such jobs.

Using data from the OECD survey of adult skills (PIAAC survey), Cedefop's analysis confirms (Table 16) that the demand for skills in people's jobs is correlated with several descriptors of task complexity, such as the extent to which they engage in abstract, autonomous, interactive or manual tasks. This relationship is robust and holds even after the analysis takes into account that part of the differences in skill demand between jobs may be explained by a variety of other factors, including differences in the occupational and industrial distribution of jobs, establishment size, distinct recruitment requirements of employers, or other workplace and individual characteristics (Annex 2). In contrast to the positive effect of abstract reasoning and of job latitude on skill demand, it is found that jobs that involve more frequent interaction with clients or colleagues are associated with lower cognitive skill requirements⁽⁵¹⁾.

The empirical analysis also shows that required literacy and numeracy levels in jobs increase with the size of the workplace and are positively related to the provision of (formal or non-formal) training opportunities as part of the

⁽⁵⁰⁾ The task framework is believed to offer an original theoretical explanation for several stylised empirical developments in the labour markets of many advanced economies over the past three decades, including the hollowing out (polarisation) of the occupational distribution of employment.

⁽⁵¹⁾ However, Pouliakas and Russo (forthcoming) also find that workers undertaking interactive tasks in their jobs have a higher likelihood of using their skills more intensively in their jobs.

job. This indicates that CVT is more likely to be provided in jobs where the need for higher skills is greater. Further, there is a positive relationship between the skills needed by employers and qualifications, where the latter act as signals of individuals' skills. In particular, jobs with higher skill content are not only occupied by individuals with higher educational qualifications and positive attitudes to learning (a positive selection mechanism), but they also require more years of education from current job applicants. The fact that the human capital of employees and the qualification requirements of the jobs are taken into account as independent factors in the analysis, gives greater confidence to the conclusion that job complexity affects cognitive skill demand via channels other than the attraction of more highly educated employees to better designed jobs.

Table 16. **Impact of task complexity on cognitive skill demand: 22 OECD countries**

	(1) Literacy	(2) Numeracy
Tasks		
Abstract reasoning	2.145*** (0.205)	2.453*** (0.197)
Job latitude	2.241*** (0.385)	2.649*** (0.395)
Interaction	-1.021*** (0.343)	-1.467*** (0.342)
Physical work	-1.599*** (0.138)	-1.891*** (0.148)
Firm size		
11-50 workers	0.993** (0.436)	1.087** (0.487)
51-250 workers	2.098*** (0.457)	2.564*** (0.615)
251-1 000 workers	3.399*** (0.728)	3.531*** (0.982)
> 1 000 workers (base: 1-10 workers)	3.854*** (0.647)	5.032*** (0.897)
Formal human capital		
Hiring requirements: years of education needed to get the job if applying today	0.932*** (0.117)	1.232*** (0.113)
Formal or non-formal training	2.152** (0.809)	2.197*** (0.760)

	(1) Literacy	(2) Numeracy
Highest level of education (employee)		
Medium	11.940*** (1.671)	14.484*** (1.948)
High (base: low)	19.585*** (1.586)	24.347*** (2.336)
Attitudes to learning	3.124*** (0.558)	3.349*** (0.619)
Occupation dummies (1-digit)	√	√
Industry dummies	√	√
Country dummies	√	√
Constant	244.268*** (4.209)	238.484*** (3.007)
Observations	56 598	57 025
R-squared	0.419	0.440

NB: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Other (insignificant) explanatory variables include: economic sector (e.g. public, private, non-profit); workplace is part of a larger organisation; usual hours of work; fixed-term contract; supervisory duties; five age dummies; gender dummy.

Source: OECD/PIAAC; survey of adult skills; Pouliakas and Russo (forthcoming).

5.5. Conclusions

The findings of this chapter emphasise that to tackle the current and dynamic workforce skill gaps in Member States both individuals and organisations need to be closely involved in skill development and matching. Individuals need to have a positive attitude towards learning and to possess an appropriate set of core competences and motivations that will enable them to be flexible and adaptable in response to economic and organisational shocks. But, based on the evidence of the two data sets examined, organisations have a critical role to play in preventing skill gaps. This can be achieved by:

- (a) fostering a learning climate in the workplace, with emphasis on the provision of support for learning opportunities to employees by management and among colleagues;
- (b) supporting work complexity, including the ability of workers to use a variety of skills in their daily work routines and to have a certain degree of control when engaging in abstract tasks;

- (c) enabling a better balance between work and life responsibilities, given that skill development is an investment that requires time, so work-life conflicts may lead to larger skill gaps.

Dynamic firms, which respond to market forces by modernising technologies and production concepts to stay competitive, tend to experience larger skill gaps and skills obsolescence in their workforce. Such firms have higher skill needs: tackling the intensity and speed at which a skill gap unfolds will be intrinsically linked to the ability of their staff to keep their skills updated. Achieving continuous learning is dependent on the way that organisations design their jobs and the contextual support for learning within the firm. Breaking down jobs into simple tasks requiring only a limited set of skills may be associated with smaller current skill gaps. However, in the long term, employees may struggle to adapt to changing circumstances and suffer from greater skills obsolescence.

List of abbreviations

CVET	continuing vocational education and training
ECS	European company survey
ECS-2009	second European company survey carried out in 2009
ECS-2013	third European company survey carried out in 2013
EU+	the 28 EU Member States plus Iceland, Norway and Turkey
EU-27	the European Union from 1 January 2007 until 1 July 2013 with its 27 Member States
EU-28	the European Union from 1 July 2013 until today with its 28 Member States
Eurofound	European Foundation for Living and Working Conditions
Europe 2020	EU's growth strategy for the coming decade
HPW	high performance workplace
HRM	human resource management
OLS	ordinary least squares
PIAAC	Programme for the international assessment of adult competencies
SME	small and medium-sized enterprise
WCY	World competitiveness yearbook

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Descriptions of data sets used in report

A1.1. The European company survey

The European company survey (ECS) has been carried out every four years since its inception in 2004-05 as the European establishment survey on working time and work-life balance (ESWT). The second survey (under the new title European company survey) was completed in 2009 and the third took place in 2013.

The ECS is a questionnaire-based representative sample survey carried out by telephone in the language(s) of the country. A special feature of the survey is that interviews take place with the manager responsible for human resources in the establishment and, when possible, with an employee representative. The first wave of the survey (ECS-2004) covered issues around working time arrangements and work-life balance at company level. The second wave (ECS-2009) looked at different forms of flexibility, including working-time flexibility, contractual flexibility, variable pay and financial participation, as well as accompanying human resource measures, and the nature and quality of workplace social dialogue. The third survey (ECS-2013) examined workplace organisation and innovation, employee participation, and social dialogue in European workplaces.

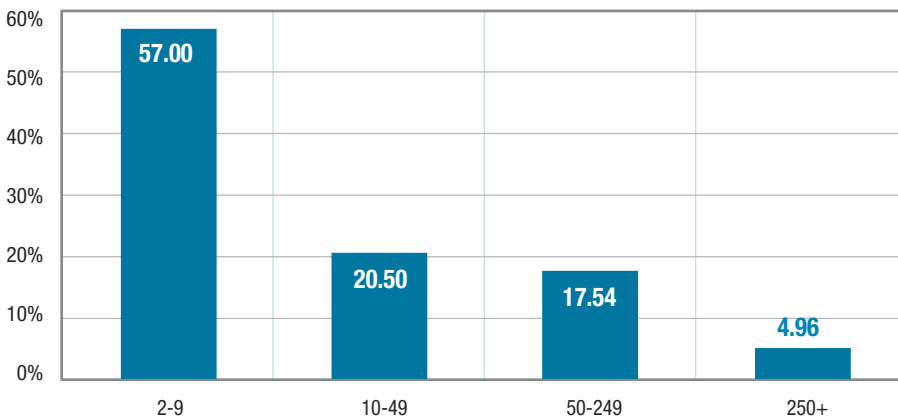
Following EU enlargement, the geographic scope of the survey has expanded over time to include 32 countries including 27 EU Member States and Croatia, the former Yugoslav Republic of Macedonia (FYROM), Iceland, Montenegro and Turkey. The target sample size for all 32 countries is 29 950, ranging from 300 to 1 650 depending on the country size. Interviewing took place from February to May 2013 and, as for the previous waves, interviews were carried out by telephone with managers and employee representatives in the language(s) of the country.

A1.2. Flash Eurobarometer survey 196

The flash Eurobarometer survey 196 (European Commission, 2010), carried out in 2006 on behalf of Directorate-General Enterprise and Industry, covers 30 European countries (Turkey included). It is aimed at SMEs which, therefore, tend to be oversampled. However, the survey also included some large organisations that allowed for some degree of comparison (European Commission, 2007). Figure A1:1 depicts the distribution of the sample by class size and shows the high percentage of very small firms (58%). The survey, carried out before the economic crisis, focused on constraints of firms' growth. It is interesting because it represents one of few company surveys carried out at EU level. It contains comparative information on business practices, recruitment issues and on difficulties encountered in relation to skills and other dimensions important for business success (such as lack of demand, access to finance, infrastructure and administrative rules and regulations). Other variables included in the survey were country and industry, business strategy and a measure of expected future developments (revenues and employment).

Unfortunately the data do not include information on the strategies adopted by firms to counter skill-related problems, such as training provision or the formation of partnerships with other firms or with training providers and schools. Nor did the survey probe firms on the practices they have in place that could have prevented skills problems arising, such as provision of workplace learning or a system of anticipation of skill needs.

Figure A1:1. Firms by class size (unweighted sample, N=15 273)



Source: Flash Eurobarometer survey 196 (European Commission, 2010).

In the analysis in Chapter 3, observations corresponding to firms without employees have been dropped, because they are likely to be self-employed workers and are therefore a specific category of entrepreneurs. The empirical analysis is based on observations with valid scores on all covariates included in the empirical analysis; 15 273 cases were eventually retained.

A1.3. Flash Eurobarometer survey 304

Data used in the Chapter 3 analysis are based on the flash Eurobarometer survey 304, *Employers' perception of graduate employability*. The main aim of this survey was to look at the extent to which employers are recruiting higher education graduates and at how the skills of this population group are valued in the workplace. A graduate is defined as someone who has completed a bachelor degree or a higher degree from any higher education institution.

This Eurobarometer provides unique insights into the skill needs of graduate recruiters in Europe, as it covered companies with at least 50 employees across a range of business sectors in all 28 EU Member States, Norway, Iceland and Turkey. Companies included in the survey had recruited higher education graduates in the past five years and/or were planning to recruit such graduates in the next five years. The targeted number of interviews varied depending on the size of the respective country. A total 7 036 companies were interviewed, between 30 August and 7 September 2010, using a fixed-line telephone approach. Eligible respondents were chief human resource officers or chief executive officers.

The flash Eurobarometer survey 304 contains the views of mainly medium and larger-sized employers in the EU. About three-quarters (76%) were medium-sized (with between 50 and 249 employees) and the rest (24%) were large companies with 250 employees or more. The largest share of companies included in the survey were active in industry (36%), followed by non-public services (23%) and public services (17%). About one in eight (12%) companies was active in trade, accommodation and food services and the same proportion in construction, transport and ICT. Although companies included in the study recruited graduates from various educational fields, areas most frequently mentioned were business or economic studies and engineering (54-55% of companies). For more details about the characteristics of the companies surveyed, see European Commission (2010b).

In addition to identifying the background of recent recruits with a higher education degree, the survey covered the importance of various skills and

abilities and the degree of satisfaction of companies with the possession of such skills by the graduates they recently recruited. Crucially, the data set contains explicit information on the factors that underlie the difficulties firms face in filling their vacancies. It enables a more accurate analysis of the extent to which such difficulties are linked to skill deficits or to other important factors. Related data also exist on HRM strategies that firms may adopt when faced with such recruitment challenges, such as the amount and type of training given to graduates, whether firms recruit labour from abroad, and if they cooperate with higher education institutions.

A1.4. Cedefop’s pilot skills obsolescence survey

The Cedefop pilot skills obsolescence survey was an original online data collection among adult workers (age 30-55) in full-time jobs (working 30 hours or more per week) carried out by Cedefop in 2011 in four Member States (Germany, Hungary, the Netherlands, and Finland). The pilot study was designed to assess the dynamics of skills obsolescence following the framework described in Figure A1:2. The sample size was 1 000 workers in each country. The data set allowed the development of skills (measured at three points: beginning of career, time of the interview, and whenever the respondents estimated their skills reached a peak) to be related to attitudes to learning, to learning opportunities in jobs, and to the degree of workplace change (Table A1:1). The survey also piloted the use of a scale on the self-reported degree of skills obsolescence.

Table A1:1. Indicators for index construction (N= 3576)

Index	Indicators	Agree	Disagree
Economic obsolescence	Q21f I am less qualified than I used to be for my job	10.49	89.51
	Q21n Tasks that I am good at, are becoming less important	21.03	78.97
	Q21o Technological developments make many of my skills outdated	15.55	84.45
	Q21p Several skills I have, are no longer appreciated by employers	22.65	77.35
	Q21q During reorganisations, jobs such as mine are often at risk	22.96	77.04
	Q21r My type of job is becoming less common in organisations	15.55	84.45

Index	Indicators	%	
		Agree	Disagree
Work complexity	Q10a My work is challenging	77.18	22.82
	Q10b I use a variety of skills in my job	88.62	11.38
Work autonomy	Q10c I can choose or change the content of my work tasks	44.63	55.37
	Q10d I can choose or change how I undertake tasks	73.07	26.93
Learning climate	Q17a My organisation encourages me to broaden my skills	58.11	41.89
	Q17b My organisation gives me the opportunity to perform very different tasks	54.81	45.19
	Q17c My organisation encourages me to try out new ways to perform tasks	46.78	53.22
	Q17d The many rules and regulations in this organisation prevent me from trying out new things ^(*)	60.51	39.49
	Q17e I can get support and help from my co-workers when needed	84.59	15.41
	Q17f I can get support and help from my supervisor when needed	72.34	27.66
	Q17g My job involves helping my co-workers to learn new things	74.86	25.14
	Q17h All in all, during my career, I have had many opportunities to develop my skills	68.32	31.68

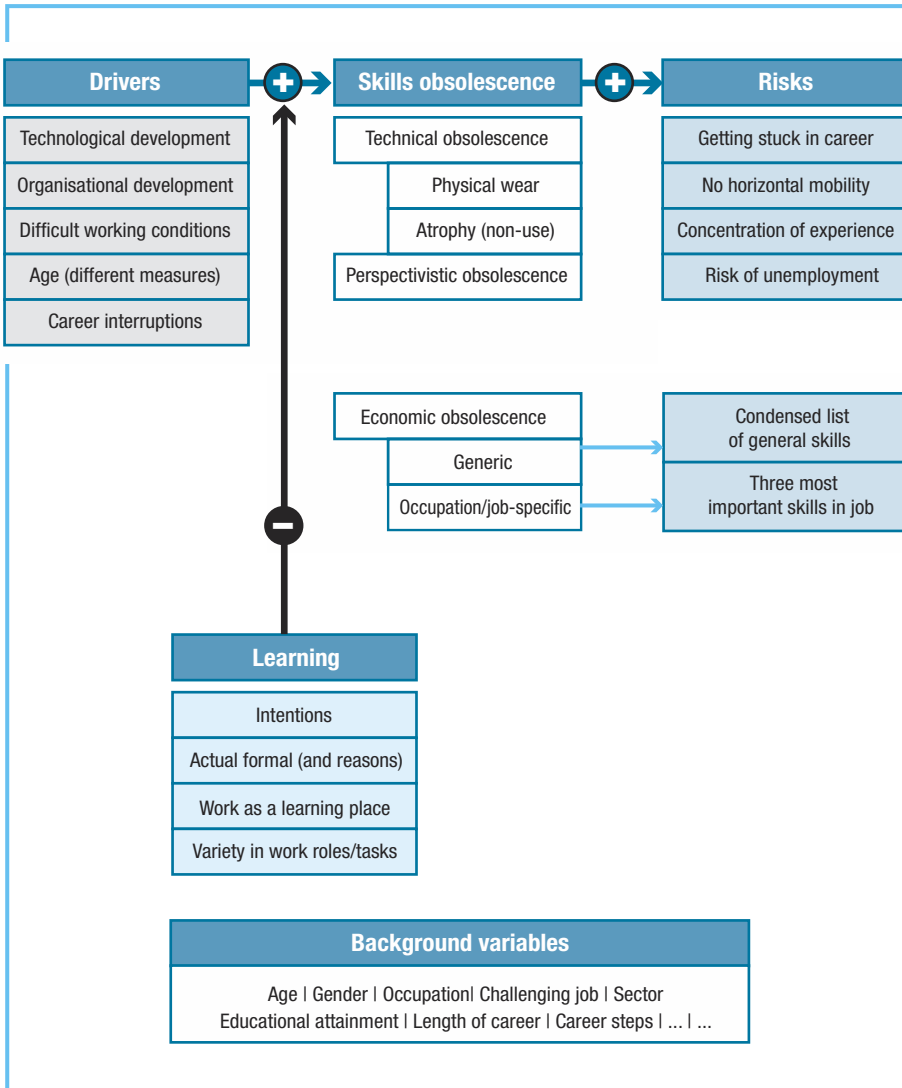
(*) Polarity reversed in the analysis.

Source: Cedefop calculation.

A1.5. OECD survey of adult skills (PIAAC survey)

In Chapter 5 of the report the critical disjuncture between skills and job tasks is analysed using a new rich data source generated by the OECD, the survey of adult skills (or PIAAC survey). This survey is a product of the OECD's programme for the international assessment of adult competencies (PIAAC) (OECD, 2013). The PIAAC survey is unique as it objectively assesses the level of foundation skills of individuals, specifically their literacy, numeracy and problem-solving (in technology-rich environments) cognitive functions. It also contains a separate module with information on the frequency of different job tasks which enables the construction of person-level (instead of conventional

Figure A1:2. **Conceptual approach to Cedefop’s pilot survey on skills obsolescence**



occupation-level) measures of heterogeneity in task demands ⁽⁵²⁾. Further, the survey identifies skill mismatch among respondents, in the correspondence between their skills and the demands of their jobs.

Data collection took place between August 2011 and March 2012 in households in 24 countries, but in this report only 22 countries were examined: Austria, Belgium (Flanders), Canada, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, South Korea, the Netherlands, Norway, Poland, the Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland) and the United States. Around 166 000 adults, aged 16 to 65, were interviewed in each country using a combination of computer-assisted and written personal interviews. The samples ranged from a minimum of approximately 4 500 to a maximum of nearly 27 300 in each country/subnational region.

For the survey, respondents undertook assessment tests specifically designed by experts to decouple the capacity of adults to respond to contemporary challenges of knowledge economies. The survey also enables identification of differences in skill proficiency between sub-groups of the population and the impact on their life chances, as it collects extensive background information on individuals' formal and informal learning activities, education attainment, employment status, demographics, socioeconomic and job characteristics.

A1.6. ManpowerGroup talent shortage surveys

The annual talent shortage survey carried out by the ManpowerGroup is one of the most extensive comparative exercises of the extent to which employers across different countries in the world face skill-related problems. The survey identifies the proportion of employers who report difficulty filling positions in their organisation. It reports on which jobs employers say are most difficult to fill and identifies shortcomings of applicants that prevent employers from filling positions. Employers are also asked to gauge the impact of talent shortages on their organisations and to identify which strategies they are using to overcome the skill gap. In 2004 over 37 000 employers across 42 countries and territories were surveyed. The 2014 survey is the ninth in the series and is the latest wave at the time of writing.

⁽⁵²⁾ Except for Autor and Handel (2013), researchers have typically imputed task requirements using data on job characteristics at the level of occupations as obtained from national occupational dictionaries or libraries, such as the information tool O*NET in the US.

Over 36% of employers surveyed across the world in 2014 were found to have difficulty filling their jobs. This percentage has increased for the second consecutive year and is at its highest level since 2007, the year before the global recession began. Employers in Japan reported the greatest talent shortages at 81%. Acute shortages of over 60% were also reported in Argentina, Brazil, India, Peru and Turkey. European employers were found to be generally less prone to intense shortages, with Hungary (45%), Bulgaria (44%), Austria (42%), Greece (42%), Germany (40%) and Romania (40%) featuring above average in the international rankings. In Belgium, the Czech Republic, Ireland, Spain, the Netherlands and the UK, a minimal share of employers had recruitment difficulties.

As in 2013, the most common reason employers struggled to fill jobs is that candidates do not have the technical competences required. Skilled trades positions are the most difficult jobs to fill for several consecutive years of the survey. Engineers and technicians follow in second position, while sales managers and representatives, accounting and finance staff, managerial and executive posts, IT staff, office support staff and drivers also feature in the top 10 list of jobs in which employers face the greatest challenges.

The list of shortage occupations is also mirrored in the responses of employers about the underlying reasons for such talent shortages. 35% of those employers having difficulty filling jobs identified lack of technical competencies (hard skills) as the primary reason, closely followed by lack of available applicants (31%). Other major reasons include lack of experience (25%) or employability/soft skills (19%). Employers in the survey consider other factors related to working conditions (relation of pay to the expectations of job seekers, image of business, offer of part-time/contingent contracts) to be of lesser importance.

A1.7. **IMD world competitiveness yearbook and online database**

The IMD world competitiveness yearbook (WCY) is considered the worldwide reference point on the competitiveness of nations, ranking and analysing how an economy manages the totality of its resources and competences to increase the prosperity of its population. It has been published since 1989 and compares the competitiveness of 60 economies on the basis of over 300 criteria. Providing more than 500 pages of key data and including in-depth profiles for each of the 60 economies, the IMD WCY is considered an

invaluable research tool for benchmarking competitiveness performance. Focusing primarily on hard facts taken from international and regional organisations and private institutes, the statistics are complemented with results from an annual executive opinion survey. Collaboration with 55 partner institutes worldwide helps ensure that the data are as reliable and up to date as possible. Since 2004, an online interactive database has also been available, including 19-year time series. The IMD WCY features 60 industrialised and emerging economies. It provides 338 criteria, grouped into four competitiveness factors: economic performance, government efficiency, business efficiency, and infrastructure. Hard data are taken from international or national organisations, private institutes and partners, while survey data are drawn from an annual executive opinion survey (4 300 respondents).

Empirical methodologies used in report

A2.1. Macroeconomic analysis of skill shortages (Chapter 1)

To investigate the determinants of average talent shortages experienced by employers in different global labour markets, country-level empirical analysis was undertaken that exploits and merges two separate macroeconomic data sources (based on Mane and Pouliakas, forthcoming). Information on the mean recruitment difficulties of firms was obtained over eight years (2006-13), collected as part of the respective annual waves of the ManpowerGroup talent shortage surveys. Information on the availability (or not) of skilled labour in different countries, and on other supplementary variables, was also obtained from the IMD World competitiveness yearbook (WCY) and online database. This information was merged with several macroeconomic variables (including GDP, unemployment, active population, educational attainment rates) drawn from Eurostat at each country level.

The statistical information obtained from these separate sources was merged into one master longitudinal data set with repeated observations of variables for the same country over time. The total database based on the IMD WCY comprises of a panel of 62 countries (31 European) over 20 years (1995-2014). Accounting for missing information on several variables, the final sample comprises a panel of 60 countries (29 European) over 13 years (2000-13). In the analysis, 710 observations are examined for the global sample (58 countries observed over an average of 12.2 years) and 358 observations for the European sample (28 countries over a mean of 12.8 years). As information on the difficulty to fill jobs from the talent shortage surveys is only available from 2006 onwards, for this analysis 239 (132) observations are used, comprising a panel of 38 (21 European) countries observed over an average of 6.3 years⁽⁵³⁾.

⁽⁵³⁾ The 31 European countries in the IMD WCY database include the EU-28 Member States plus Iceland, Norway and Switzerland. The 21 European countries in the Manpower sample are: Austria, Belgium, Bulgaria, the Czech Republic, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the UK.

The investigation uses longitudinal statistical models to explore the contribution of different macroeconomic aggregates to the overall variance in talent shortages observed between and within different countries. The analysis is based on econometric estimation of parsimonious models, given the limited number of observations (and degrees of freedom) in the data set and the high level of collinearity that exists between the variables (particularly among those variables based on the subjective perceptions of the same respondent). To reduce some of the indicators in the database, a principal components analysis was performed using several of the correlated items in the IMD WCY (for a similar analysis see European Commission, 2012b, 2014d). Three principal components with eigenvalues above one was found to account for 77% of the total variation in the survey items of interest.

First, a novel measure of skill shortages at country level was constructed as a principal components factor that loads heavily on the following items: skilled labour is readily available; finance skills are readily available; qualified engineers are available in the labour market; information technology skills are readily available; health problems do not have a significant impact on companies. This measure provides a summary of the availability of skills in the respective economies. Reversing the scale (skills are not readily available) leads to a variable that is used in the analysis as a proxy for (perceived) skill shortages.

A second factor obtained from the principal components analysis is composed of factor loadings that capture differences in terms of the ability of firms to commit to the skill formation process and to a high quality of working conditions. Specifically, the second factor loads more heavily on the following: employee training is a priority in companies; ethical practices are implemented in companies; social responsibility of business leaders is high; health and safety concerns are adequately addressed by management; worker motivation in companies is high.

A third factor is a summary measure of the degree of leniency of labour market regulations, described mainly by the extent to which: labour regulations (hiring, firing, minimum wages) do not hinder business; unemployment legislation provides incentives to look for work; labour relations are generally productive.

Further, it is assumed that the variation in the incidence of skill bottlenecks observed across different countries can be explained by key macroeconomic factors: GDP per capita; the structure of the economy, proxied by the share of the industrial sector in GDP; and the unemployment rate.

To examine further whether the above factors exert a statistically significant influence on the variance of skill shortages, random and fixed

effects models have been estimated on, first, a sample of countries from across the globe and, second, a sample of only European countries. The following specification of the model is assumed:

$$s_{ct} = \alpha_{ct} + \beta_1 GDP_{ct} + \beta_2 IND_{ct} + \beta_3 U_{ct} + \beta_4 LF_{ct} + \beta_5 FIRM_{ct} + \beta_6 REG_{ct} + \beta_7 T_t + \varepsilon_c + U_{ct} \quad (1)$$

where the incidence of skill shortages, s , in a given country (c) and year (t) is assumed to be a linear function of the determinants mentioned above. Unobserved heterogeneity in the model is given by the summation of country-specific time-invariant factors, ε , and another random error term, u . The model also includes time dummies (T), which capture the impact of any residual country-specific changes in talent shortages that took place across the respective time period. As is standard, a fixed effects regression identifies the impact of within-country deviations in the determinants (e.g. $\check{U} = (U_{ct} - \bar{U}_c)$) on the within-country variance in talent shortages ($\check{s} = (s_{ct} - \bar{s}_c)$). This allows identification of the effect of a given regressor on the dependent variable that is purged of any confounding influences of other country-specific factors that remain constant (or change very slowly) across time (such as the institutional environment).

A2.2. Multivariate regression analysis of recruitment bottlenecks (Chapter 2)

Multivariate regression analysis was used to obtain better understanding of the characteristics of firms which are correlated with the incidence of hiring difficulties in EU companies. The ECS data set contains a wealth of information on firm characteristics and HRM practices of employers. To examine the likelihood of an establishment reporting difficulties in finding staff to fill their vacancies, either skilled or low-skill, a probit model has been estimated assuming the following latent specification:

$$s_j^* = \beta_0 + \mathbf{x}_j \boldsymbol{\beta} + I_j + C_j + u_j, \quad s = 1[s^* > 0] \quad (2)$$

where s^* describes the propensity of a manager of a firm to report that the establishment j faces difficulties in hiring staff for their posts of varying skill requirements ($s = 1$ if $s^* > 0$). \mathbf{x} is a vector of determinants of the firms' perceived recruitment bottlenecks, including some basic characteristics (size

of the establishment and changes in size in the past three years, whether it is a single independent company or part of a wider organisation), the composition of the workforce in the firm (share of females, high-skilled and part-time workers) and a series of composite variables that proxy for the working conditions and HRM practices of the establishment. The latter are first principal components (with eigenvalue greater than one) summarising whether any given establishment is characterised by (the individual elements used to construct the groups are shown in parenthesis):

- (a) group 1: casual or atypical labour (temporary agency workers have been in company; staff with fixed-term contracts have been in company; freelancers have been in company);
- (b) group 2: variable pay (employees receive performance-related pay; profit sharing scheme offered in establishment; share ownership scheme offered in establishment);
- (c) group 3: high performance workplace practices (employees can adapt – within certain limits – the time when they begin or finish their daily work according to their personal needs or wishes; work in teams is important; a person or committee is in charge or representing employees in issues of safety and health at work; need for training is periodically checked; employees given time off normal duties for training);
- (d) group 4: changes in establishment in the past three years (major changes in remuneration system; changes in the organisation of the work process; changes in the working time arrangements; restructuring measures);
- (e) group 5: atypical hours (employees regularly required to work on Saturdays; employees regularly required to work on Sundays; employees required to work in a shift system or comparable; employees required to work at night between 11pm-6am).

Finally, I is a set of industry dummy variables and C are country dummies, which account for variation in recruitment difficulties that can be attributed to sectoral or other country-specific characteristics. The error term captures any unobserved factors related to whether firms report difficulties in filling their vacancies. It is assumed to be a random variable that is identically and independently distributed and is uncorrelated with the regressors in the specification [$u \sim i.i.d N(0, \sigma^2)$, $E(u/x=0)$].

Marginal effects following the estimation of a discrete choice probit model are reported, specifically the change in the probability of an establishment reporting hiring difficulties in relation to particular characteristics, at the mean level of the other explanatory variables of the model. The relationships estimated only indicate correlations between the respective variables, given

that the cross-sectional nature of the data does not allow for the detection of causal effects of the variables.

A2.3. Multivariate regression analysis of determinants of genuine skill shortages (Chapter 3)

Multivariate regression analysis was carried out to examine the relationship between (different reasons for) firms' difficulties in filling their vacancies and several important characteristics and strategies of firms. The dependent variables are discrete binary variables that take the value one for each type of challenge or vacancy bottleneck as identified in the flash Eurobarometer survey 304 (such as shortage of applicants with right skills, offering a competitive starting salary) and zero otherwise.

The following empirical specification has been estimated using a logit model:

$$\begin{aligned}
 BOTTLENECK_{ik}^* &= \alpha + \beta_1 FIRM_i + \beta_2 SKILLNEEDS_i + \beta_3 RECRUIT_i + \\
 &\quad + \beta_4 SATISFY + \beta_5 CVET_i + \beta_6 C_i + u_i, \quad (3) \\
 BOTTLENECK &= 1[BOTTLENECK^* > 0]
 \end{aligned}$$

where the probability that a firm, i , will identify a given type of bottleneck, k_s is modelled as a function of the following independent variables:

- (a) *FIRM* = a set of firm characteristics, including the size of the firm/organisation, ownership structure (public, private, mixed), international orientation (percentage of day-to-day operations involving dealing with people in or from other countries) and the main activity of the company (industry, construction, transport, ICT, trade, accommodation, public services, non-market services);
- (b) *SKILL NEEDS* = a set of variables that are proxies for the skill needs of a firm. These include the share of higher education graduates currently employed in the company and the need for technical or job-specific skills, the latter approximated by the educational fields from which an organisation mostly recruits its higher education graduates and the importance of sector-specific skills for the firm. The importance of a selected group of basic (numeracy, literacy, foreign languages, ICT) and transversal/soft skills (communication, analytical and problem-solving, ability to adapt and act in new situations, decision-making skills, team-

- working skills, planning and organisation skills) is also considered;
- (c) *RECRUIT* = a set of variables describing the recruitment practices of a firm, including whether it recruited higher education graduates in the past five years or is planning to recruit them in the next five years, the motives for recruitment (because of anticipated or actual growth in business, higher turnover of staff, increasing complexity of tasks, higher number of applicants), importance of employing higher education graduates from schools with high international rankings, frequency of cooperation with higher education institutions in recruiting graduates and the share of employees with higher education degrees that are recruited from other European countries or countries outside of Europe;
 - (d) *SATISFY* = a set of subjective variables capturing the organisation's degree of satisfaction with the skills of the graduates it recruited in the previous three-five years (only applicable for organisations that recruited higher education graduates in the past five years);
 - (e) *CVET* = % of employees with higher education degrees that participated in training to update their skills in the past two years;
 - (f) *C* = 31 country dummies (EU-28 + Norway, Iceland and Turkey).

The final sample on which the analysis has been carried out includes 5 676 companies, as 1 360 firms (19%) have been dropped from the analysis. These are organisations that failed to provide an answer to the question on the greatest challenges in filling their vacancies. Some of the firms dropped from the analysis may include valid cases of companies that face recruitment difficulties, although bottlenecks arise for reasons other than the list of five constraints provided (constituting a group of 'don't knows'). However, it is not possible to distinguish these companies from the sample of firms that do not have problems in filling their vacancies (the 'not applicable') as the two groups were merged in the questionnaire.

A Heckman probit selection model was also estimated using maximum likelihood methods, to test for the overall robustness of the analysis, in particular to examine whether there is sample selection bias due to the significant share of firms that did not give any response to the main question on unfilled vacancies (about 19%). Variables used as identifying restrictions (IVs) include: importance of increasing complexity of tasks as a factor in recruiting graduates; employers' perceptions on whether work experience is a crucial asset for new recruits; and whether it is important that new recruits have done an internship abroad. These IVs are significantly and positively correlated at the first stage of the two-step Heckman methodology, i.e. there is a greater probability that firms gave a response to the main vacancy

question in response to the IVs. However, the Wald test fails to reject the null hypothesis of independence between the selection and main vacancy equations ($\rho = 0$) [$\chi^2 = 0.60$; p-value = 0.44].

For subsequent examination of the determinants of genuine skill shortages, a multivariate empirical analysis similar to the one described above was carried out, using the two variables ‘genuine skill shortages’ and ‘weak skill shortages’ as separate dependent variables. A multinomial probit estimation further confirms the main findings of the analysis. All related regression output is available from the authors upon request.

A2.4. Impact of recruitment bottlenecks on organisational productivity (Chapter 4)

Following the construction of a measure of the type of hiring difficulties in establishments (Table 11), the following empirical specification has been estimated to uncover the partial correlation of the constructed variable with the subjective assessment of labour productivity in establishments:

$$Labprod_j^* = \alpha + \beta_1 Bottleneck_j + \beta_2 X_j + v_j \quad [\alpha_1 < Labprod^* \leq \alpha_2] \quad (4)$$

where $Labprod^*$, labour productivity of establishment j , is an ordered latent variable, the values of which (below average, about average, somewhat better than average, a lot better than average) are determined according to specific cut-off points (α). Bottleneck is an explanatory variable assuming four different values: no hiring difficulties, only low-skill, only high-skill, both low- and high-skill. X is a vector of other explanatory variables that can explain the variation in labour productivity among EU establishments and $v \mid X \sim N(0,1)$ is the unobserved error term.

Given the ordered discrete nature of the main dependent variable, Table 12 reports the output of an ordered probit regression applied to equation (2). The regression controls for firm characteristics (such as single independent establishment, public sector, size of establishment), the demographic composition of the workforce (share of female employees, proportion of staff on high-skill jobs, employment of temporary labour), the adoption of different human resource practices (use of high performance workplace practices, use of atypical work hours, teamwork, continuing training) and industry and country dummies.

The robustness of the statistically significant negative effect of skilled labour bottlenecks on labour productivity has been confirmed using several tests. First, equation (2) has been estimated after including as separate independent variables the trend growth in labour productivity and in the size of the establishment. In particular, a separate variable has been added to the regression, which controls for whether labour productivity in establishments has increased considerably, increased slightly, decreased or remained the same relative to three years ago. This is important, given that hiring difficulties for skilled workers are more likely to be encountered by those firms that have experienced continuous growth in staffing numbers and productivity in recent years and so may be closer to capacity constraints. The sample has been restricted to include establishments that are only in the private sector. This allows for the inclusion in the specification of further information (only asked for private establishments) related to whether the organisation experienced any of the following changes during the previous three years: acquisition of another organisation; takeover by another organisation; merger; relocation; or demerger. As confirmed in Table A2:1, despite the inclusion of such trend variables in the regression, the statistically significant negative effect of high-skill hiring difficulties on labour productivity persists.

The examination also investigated whether the severity of the negative impact of bottlenecks on labour productivity is mediated by different factors that may be correlated with the underlying reasons for the emergence of such hiring difficulties. To do this, the main skill bottleneck variable has been interacted with the variables 'HPWPs in firm', 'casual or atypical workforce' and 'atypical hours'. In this manner it is possible to examine whether the negative effect of hiring difficulties on relative labour productivity changes depending on the reason for such bottlenecks (whether it is higher in firms that adopt innovative work practices or in those firms that offer bad working conditions). A statistically significant negative interaction coefficient is found between skill bottlenecks and the adoption of atypical working hours in establishments ⁽⁵⁴⁾. This suggests that the negative influence of skill bottlenecks on labour productivity is attenuated when firms offer bad working conditions.

⁽⁵⁴⁾ Results are available from the authors upon request.

Table A2:1. Determinants of the probability of higher labour productivity in firms compared to establishments in the same industry, ordered probit estimates, EU-27, 2009

	All sample	Private sample	All sample (impact of CVET)	All sample (controlling for trend productivity)
Labour bottleneck: only difficulties in finding staff for low-skill or unskilled jobs	0.067 (0.104)	0.049 (0.121)	0.071 (0.103)	0.060 (0.100)
Skill bottleneck: only difficulties in finding staff for skilled jobs	-0.122*** (0.041)	-0.126*** (0.038)	-0.122*** (0.040)	-0.104*** (0.038)
Both labour and skill bottleneck: difficulties in finding staff for both skilled and low-skill/unskilled jobs (omitted: no difficulties in finding staff for jobs)	-0.085 (0.054)	-0.073 (0.068)	-0.085 (0.052)	-0.08 (0.070)
Casual or atypical workforce	-0.054*** (0.012)	-0.067*** (0.009)	-0.054*** (0.012)	-0.039*** (0.013)
Variable pay	0.065*** (0.011)	0.064*** (0.009)	0.065*** (0.011)	0.060*** (0.011)
High performance workplace practices	0.097*** (0.017)	0.102*** (0.020)		
Employees can adapt working time			0.077*** (0.022)	
Work in teams important			0.222*** (0.057)	
Time for further training			0.054** (0.023)	
Employee representation (committee) on health and safety			0.049 (0.032)	
Need for further training periodically checked in systematic way			0.132*** (0.047)	
Changes in establishment in past three years				
Acquisition of another organisation		0.074* (0.044)		
Takeover by another organisation		0.050 (0.041)		
Merger		0.017 (0.035)		

	All sample	Private sample	All sample (impact of CVET)	All sample (controlling for trend productivity)
Relocation		0.120* (0.067)		
Demerger		-0.326*** (0.094)		
Labour productivity compared to three years ago				
Increased slightly				-0.479*** (0.048)
Remained about the same				-0.632*** (0.042)
Decreased (omitted: Increased considerably)				-0.961*** (0.067)
Other control variables (see footnote)	√	√	√	√
Industry dummies	√	√	√	√
Country dummies	√	√	√	√
Observations	17 907	13 939	17 907	17 853

NB: Marginal effects of an ordered probit regression, calculated at the mean of the explanatory variables; robust standard errors in parentheses, clustered for country in EU-27 sample; *** p<0.01, ** p<0.05, * p<0.1; other control variables include: changes in establishment in past three years; atypical hours; a single independent company or organisation; proportion of female employees; proportion of employees who worked overtime in past 12 months; proportion of employees who work in high-skill jobs; size of establishment.

Source: Eurofound, ECS-2009; Cedefop estimation.

A2.5. Multivariate regression analysis of skill gaps (Chapter 5)

A2.5.1. Determinants of skill gaps among EU workers (Section 5.2)

Table 15 illustrates the output of a regression analysis that relates the extent of workers' skill gaps to several organisational, job and individual characteristics. The dependent variable gauges workers' skill level as a percentage of the skills required to perform their job in the best possible way, i.e. the relative skill level. A positively signed coefficient on a variable implies that workers with higher scores on that variable tend to possess a higher percentage of the skills required, or a smaller skill gap. A negatively signed coefficient implies that workers' skills are further away from skills required to perform the job in the best possible way. Thus, higher coefficients on variables

with negative coefficients correspond to larger skill gaps.

As explanatory variables, the model considers that the gap between own skills and those required by the job is influenced by investment in skills as well as skill demand.

Skill development is influenced by various factors such as individuals' attitude to learning and the provision of learning opportunities on- and off-the job to employees. Information on workers' attitudes to learning and on their participation in training activities, during the previous year and over their career, is included in the empirical analysis. A reported measure of the support that workers receive from the organisation in developing their skills or in engaging in different tasks was also considered.

The ability of workers to learn is also influenced by contextual factors, such as the degree of support they receive from the organisation, their supervisor and their colleagues. This also involves a degree of cooperation among workers who are ready to support and help their colleagues, in accordance with organisational citizenship behaviour (Organ et al., 2006).

The job itself can also support learning when it confronts workers with complex situations. Job complexity has been shown to be able to influence cognitive processes in workers (Schooler, 1984; Finkel et al., 2009).

Learning also requires time and energy but these assets might not be available (or not be available in sufficient amounts) to workers experiencing a degree of conflict between the time demanded for training and the time needed to cater to other personal circumstances (typically the family, especially when obligations arise because of the presence of children in the household or the need for elderly care). Lack of time and pressure from the job are often mentioned as important barriers for engaging in learning activities by adults (Rubenson and Desjardins, 2009). For this reason, a measure of the degree of conflict between work and the private sphere is included in the empirical specification.

Finally, a measure of changing skill needs in the organisation was included, proxied by whether the organisation recently introduced new products, new work processes or a new organisational structure.

Given the quite short time of the Cedefop pilot skills obsolescence survey (about 10 min), many constructs in the questionnaire were measured by one or two items only. An obvious improvement on the current specification for future research will be the development and implementation of a scale that measures the degree of support for learning experienced by workers within organisations.

A linear probability model was estimated, despite the fractional nature of the dependent variable (Papke and Wooldridge, 1996). The model is robust as none of the predicted values fall outside the 0 to 1 interval. To gain in efficiency (and precision) the model was estimated on the whole sample, pooling observations for the four Member States samples together. This strategy is not rejected, as there are few cases where significant country differences in the estimates are observed. Additional robustness checks were also undertaken to ensure that the particularly low values of the relative skill level (as shown in Figure 21) do not pose any problems in the estimation; low relative skill levels (below 35%) were dropped from the analysis. The model is generally stable and the coefficients obtained with the model using the trimmed relative skills measure do not differ appreciably from those obtained using the full sample.

A2.5.2. Measuring and estimating skills obsolescence (Section 5.3)

Skills obsolescence can vary in its dimensions in addition to its degree; little consensus exists in literature on how to measure it. Objective measurement strategies are based on direct testing of employee skills. If this is not possible, indirect measures of objective consequences can be used to capture obsolescence. In economics, for instance, human capital levels are estimated by wage changes. Wages cannot measure mismatches directly but they are a consequence and so, in theory, indicate human capital variation. A third approach used is the subjective method (De Grip, 2006): skills obsolescence is measured by self-assessments by employees of their own extent of skill depreciation. Respondents are typically asked about their situation and role in the work environment and whether they believe that their skills are not needed or not up to date.

Due to their complex nature, workplaces cannot be captured by one variable only but have to be regarded as multiple variables. The Cedefop pilot skills obsolescence data have several indicators to capture relevant job characteristics, including time pressure, conflicting work and family life, incentive schemes at work, and characteristics of employment contracts.

Several further aspects of organisations are complex constructs and have thus been measured as indices to be used as explanatory variables in Table 16. The intensity of changes in the workplace has been measured by combining information about technological change, changes in work processing and realignments of strategies in the establishments. A supportive learning climate is measured by multiple variables indicating management support for learning and a learning climate between employees. Work

autonomy has been measured by combining information on the respondents' freedom to organise their daily work. Work complexity has been measured by summarising information on the difficulty and variety of work tasks.

To capture individual learning attitudes relevant for skill development, the data provide a selection of indicators to measure lifelong learning characteristics, as developed by Kirby et al. (2010). Further individual characteristics considered are age, health status, education, individual training participation. Work motivation was also divided into several reasons for motivation. Further control variables are task profile of jobs as an indicator for occupation-related factors and country dummies.

A2.5.3. Examining the relationship between job complexity and skill demand using the OECD survey of adult skills⁽⁵⁵⁾ (Section 5.4)

To examine the empirical relationship between the way in which firms design their jobs and the level of skills necessary to perform the job duties, a multivariate regression analysis was undertaken using a sample of 22 advanced countries from the OECD PIAAC data set. First, several descriptors of task complexity characterising the job duties of employees were constructed, including the extent to which they engage in abstract, autonomous, interactive or manual tasks. Second, to describe the heterogeneity of skill needs between the different jobs of EU employees, the analysis has used the assessed literacy and numeracy skill scores of individuals collected based on the PIAAC survey. It then focused only on those jobs in which individuals' skills are well-matched to their job duties. The degree of skill match is measured both in a subjective and an objective fashion: either the respondents have stated themselves that their skills are matched to their job duties, or their assessed skill level falls within a 'normal' range of skill levels within their occupation, as derived by Pellizzari and Fichen (2013). Given that in this subset of jobs the skills of individuals are matched to the level needed to perform the job tasks, it is reasonable to assume that the assessed level of cognitive skills of individuals broadly corresponds to the level of skill demanded by those jobs.

For the purposes of the analysis, international public use data files were obtained for each country from the OECD website and merged into a file of 152 514 individual cases⁽⁵⁶⁾. The sample was restricted to include only paid civilian employees. The final sample comprised 80 602 cases.

⁽⁵⁵⁾ The analysis in this section is based on Pouliakas and Russo (forthcoming).

⁽⁵⁶⁾ OECD. *OECD skills surveys: PIAAC: public data and analysis*.

<http://www.oecd.org/site/piaac/publicdataandanalysis.htm> [accessed 6.5.2015].

The analysis relies only on two of the three domains of skills assessed in PIAAC, literacy and numeracy. To derive measures of task complexity, the procedure adopted in recent analyses in literature was followed (Spitz-Oener, 2006, Autor and Handel 2013). Job tasks were modelled along four main dimensions: abstract reasoning, job latitude, interaction/influencing tasks, and physical work, as shown in Table A2:2. The information used to derive the dimensions of task complexity was compiled from the relevant modules of the PIAAC survey, which measure the frequency of use of skills at work, or directly from the background questionnaire. PIAAC is defined on a 1-5 scale, such that a higher score on the scale corresponds to a higher incidence/importance of the task in terms of frequency or percentage of time dedicated to the task (1 = never; 5 = every day).

Table A2:2. Indicators of task complexity and of frequency of job tasks

Main job complexity variables		Group of tasks
Abstract reasoning (Cronbach's alpha scale reliability coefficient = 0.7)	How often are you usually...? <ul style="list-style-type: none"> • faced by relatively simple problems that take no more than five minutes to find a good solution • confronted with more complex problems that take at least 30 minutes to find (think of) a good solution 	
Job latitude and control (alpha = 0.8)	To what extent can you choose or change...? <ul style="list-style-type: none"> • the sequence of your tasks • how to do your work • the speed or rate at which you work • your working hours How often does your job usually involve...? <ul style="list-style-type: none"> • plan your own activities • organise your own time 	
Interaction and influence (alpha = 0.8)	In your job, what proportion of your time do you usually spend...? <ul style="list-style-type: none"> • cooperating or collaborating with co-workers; How often does your job usually involve...? <ul style="list-style-type: none"> • sharing work-related information with co-workers • instructing, training or teaching people, individually or in groups • making speeches or giving presentations in front of five or more people • selling a product or selling a service • advising people • plan the activities of others 	

Group of tasks	
	<ul style="list-style-type: none"> • persuading or influencing people • negotiating with people either inside or outside your firm or organisation
Other indices of frequency of job tasks	
Basic cognitive tasks (alpha = 0.7) In your job, how often do you usually...?	
Reading	<ul style="list-style-type: none"> • read documents (directions, instructions, letters, memos, emails, articles, books, manuals, bills, invoices, diagrams, maps)
Writing	<ul style="list-style-type: none"> • write documents (letters, memos, emails, articles, reports, forms)
Numeracy	<ul style="list-style-type: none"> • calculate prices, costs or budgets; • use fractions, decimals or percentages; use calculators; prepare graphs or tables; use simple algebra or formulas; use advanced math or statistics (calculus, trigonometry, regressions)
ICT	<ul style="list-style-type: none"> • use email, Internet, spreadsheets, word processors, programming languages; conduct transactions online; participate in online discussions (conferences, chats)
Learning at work (alpha = 0.7)	<p>In your job, how often do you...?</p> <ul style="list-style-type: none"> • learn new work-related things from supervisors or co-workers • learning-by-doing • keeping up to date with new products or services
Physical work	How often does your job usually involve working physically for a long period?
Manual dexterity	How often does your job usually involve using skill or accuracy with your hands or fingers?

NB: In your job, what proportion of your time do you usually spend on...? 1 = None of the time → 5 = All of the time; How often does your job usually involve...? 1 = never → 5 = Every day; To what extent can you choose or change...? 1 = Not at all → 5 = To a very high extent.

* correlation coefficient with OECD's (2013) measure of task discretion = 0.8;

** correlation coefficient with OECD's (2013) measure of influence = 0.9;

Source: OECD/PIAAC survey of adult skills.

Part of the variance in the level of skill demand across such jobs may be explained by several socioeconomic and job characteristics, and, in particular, by differences in the economic sector and occupation group under which these jobs are categorised. For instance, part of the reason why skill demand is

higher in some jobs than others may be attributed to the higher skill needs of professional and managerial occupations. Nevertheless, about two-thirds of the variation in cognitive skill demand cannot be attributed only to the nature of the economic activity and occupational group of jobs. Part of the significant residual variation in job-skill requirements may be explained, instead, by other firm characteristics and HRM practices, including the manner in which employers design the jobs and tasks to be carried out by their workforce.

In decoupling the independent influence of job design on the skill requirements of jobs, the well-known endogeneity bias may come into play. Specifically, the cross-sectional nature of the data set does not allow a researcher to establish the exact causal nature of the relationship between job design and skill demand. For example, are more challenging and/or autonomous jobs a recipe for higher skill needs among firms, or are employers with higher skill demand more likely to select higher skilled workers, who will then shape jobs in a non-routine fashion? Also, is the adoption of innovative task design dependent on greater availability of skilled workers in the labour market, which will also lead, in equilibrium, to higher skill needs as firms will be able to adopt and absorb new technologies?

As illustrated by Acemoglu and Autor's (2011) assignment framework, the equilibrium assignment of skills to tasks will be determined in accordance with the comparative advantage of different skill groups across task categories and the rewards for those tasks. Individuals may self-select into challenging jobs with more task discretion depending on their own attitudes to learning and other intrinsic preferences and dispositions. Also, skill demand interacts with the relative supply of skills, both internally and in the external labour market. As more workplaces transit towards a flatter and horizontal hierarchical structure, rendering workers increasingly empowered and independent, higher skilled employees are, in turn, more likely to have opportunities to design their own ways of working and perhaps even their own job descriptions (Syedain, 2007; CIPD, 2008, p. 19). Also, when the ability to select highly skilled candidates from the labour market increases, as is the case, for instance, in thick labour markets, firms will have an incentive to increase the overall complexity of a given job (Blázquez and Jansen, 2008; Gavrel, 2009). Task heterogeneity is also intimately linked to other factors that cannot be observed in the PIAAC data set, such as the nature of business strategy, itself an outcome of evolving technologies, and the quality of employer-employee relations. For example, business strategies based on a high degree of product diversification and product customisation tend to be accompanied by more complex jobs; they are also characterised

by a greater demand for skills and, subsequently, a higher chance of firms experiencing skill shortages (Stahl, 2013).

Although it is not possible for the analysis to address fully the problems of endogeneity bias, the empirical specification controls for the typical level of human capital required by jobs. In particular, the specification considers the usual qualifications and work experience needed by job seekers who would apply for the given job in the current period. Formal human capital individual characteristics have also been included in the multivariate analysis, such as job tenure, highest education qualification of job holders and attitudes to learning. Several important socioeconomic and job characteristics have also been considered. These include the type of economic activity (NACE), broad occupational groups (1-digit ISCO) and the sector of the economy (public, private, non-profit). They also describe the size of the workplace, whether the place of work is part of a larger firm or organisation and the mean number of usual weekly hours in the job. The stability and level of importance of the job for the firm is proxied by whether there it is a temporary (fixed-term) contractual arrangement and if it entails supervisory responsibilities.

Given the continuous nature of the dependent variables (numeracy and literacy scales) the relationship between job complexity and skill requirements is empirically estimated using ordinary least squares (OLS) on the basis of the following specification:

$$S_{D_{js}} = \alpha + \beta_1 T_j + \beta_2 X_j + \beta_3 C_j + \varepsilon_j \quad (5)$$

where S_D , the cognitive demand for skill domain s (literacy, numeracy) in a given job, j , is modelled as a linear function of task design (T) and of other job/individual characteristics (X). Country dummy variables (C) are also included in the specification to purge the effect of country-specific effects that may account for the variation in skill needs across different countries. $\varepsilon \sim N(0, \sigma^2)$ is a Gaussian random disturbance term. Robust standard errors clustered at the country level are also estimated.



Skill shortages and gaps in European enterprises

STRIKING A BALANCE BETWEEN
VOCATIONAL EDUCATION AND TRAINING
AND THE LABOUR MARKET

The global crisis has increased unemployment in the EU to unprecedented levels, yet many employers claim they have difficulties finding skilled workers to fill their vacancies. This report shows that most vacancy bottlenecks arise because of factors other than general skill deficits, including job offers of poor quality. Genuine skill shortages affect a small group of dynamic, internationally oriented European enterprises in specific economic sectors (health and social care, ICT, advanced manufacturing).

To mitigate skill bottlenecks, European companies must commit to offering high-quality apprenticeship places and good-quality jobs, which can be supported as part of a process of social dialogue between VET providers and labour market actors. Ultimately, the business and product market strategies of a greater share of European firms will have to become reliant on higher skill needs. The role of VET in developing creativity and entrepreneurial capacity in the European workforce will be crucial.



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