Chapter 6

The skill mismatch challenge in Europe[1]

1. Skill mismatch, a waste of human capital and productivity

The financial and economic crisis has increased unemployment in the EU but, despite that, enterprises in particular regions and sectors cannot meet their labour demand and skill needs. In the fourth quarter of 2011, there were more than six unemployed persons for each available vacancy in Europe, ranging from only two to four unemployed workers per vacancy in Austria, Germany, Belgium and Finland to over 20 unemployed persons per vacancy in Spain and Greece[2]. Skill mismatch – the discrepancy between the qualifications and skills that individuals possess and those needed by the labour market – negatively affects economic competitiveness and growth, increases unemployment, undermines social inclusion, and generates significant economic and social costs.

Skill mismatch in the EU is increasing. This has manifested itself in terms of both a collapse in demand for low-skilled workers and a greater number of higher-educated people taking up jobs that are not commensurate with their skills and competences. One out of three European employees is either over- or under-qualified, with the mismatch especially high in Mediterranean countries. The results show that countries with higher-skill mismatches share some common characteristics. They tend to have lower levels of public investment in education and training, which might reduce their quality and ability to respond to changing labour market needs. They also have lower expenditure on labour market programmes and more rigid and segmented labour markets, as the qualification mismatch predominantly affects younger male workers on non-standard contracts. Young people and immigrants suffer more from over-qualification, while ageing workers are more prone to skills obsolescence.

Skill mismatch can take various forms. Even in the case of an overall balance between aggregate labour supply and demand (i.e. macro-level quantitative balance), micro-level qualitative mismatches can still occur due to frictions, barriers to mobility within and across countries, regions, sectors and occupations and asymmetric information between employers and employees (Pissarides, 2000; Sattinger, 2012). Whether people constitute a good 'fit' for their jobs given the wide-ranging heterogeneity in job tasks and workers' preferences and talents requires acknowledgement that the traditional focus on education or qualification mismatch provides only a partial and sometimes misleading picture of reality. A good match in terms of educational qualifications does not necessarily imply that individuals possess the skills that are required by their jobs, or that skill mismatches will not materialise over time due to insufficient training, skills obsolescence or emerging job requirements.

The EU has to overcome any skill mismatch in order to make effective use of its talent and to prevent the waste of its human capital. Adaptation of education and training to the changing requirements of the world of work by increasing transparency and recognition of skills supply is a prerequisite for preventing current and future labour market imbalances, as argued in the Communication of the European Commission *Re-thinking Education* (European Commission, 2012d). This is especially true given that the relation between skills formation and labour market needs can be self-reinforcing in that a greater availability of appropriate skills in the economy will stimulate labour demand and strengthen long-term economic growth. However, tackling skill mismatch also requires demand side policies. The European Commission's *Employment Package* rightly emphasized that more high-skilled jobs have to be created to bring the supply of skills in closer alignment with the needs of the economy (European Commission, 2012a).

The analysis in this chapter estimates the incidence of both macro- and micro-level mismatches in both qualifications

(1) Mr Konstantinos Pouliakas (CEDEFOP Expert), author of the chapter, undertook the data and empirical analysis with the invaluable contribution of Cedefop experts Mr Giovanni Russo, Mr Alex Stimpson, Mr Jasper van Loo, Ms Rena Psifidou, and under supervision of Ms. Pascaline Descy (Head of Area, Research and Policy Analysis at CEDEFOP).

(2) See European Vacancy Monitor (EVM), a monitoring tool of short-term labour market needs of the European Commission's Directorate-General for Employment, Social Affairs and Inclusion (http://ec.europa.eu/social/main.jsp?catId=955&langId=en).

and skills in the EU and across Member States. It explores their variation across important determinants such as sectors and various socio-economic groups and, on this basis, considers successful policies to tackle skill mismatch. The chapter emphasises the important advantages of policy measures that focus not only on education or qualification mismatch but also on the match between individuals' skills in relation to their job requirements.

The chapter is composed of sections as follows. **Section 2** focuses on macroeconomic labour market imbalances, paying close attention to the incidence of skill shortages among European enterprises and the rising trend of aggregate mismatch as a result of the economic crisis. **Section 3** considers different forms and the incidence of micro-level qualitative skill mismatches among European Member States. **Section 4** discusses the negative labour market implications of both qualification and skill mismatch for all labour market actors, economies and societies. **Section 5** explores the determinants of educational and skill mismatch among European employees and between countries. **Section 6** focuses on recent evidence on mismatch in skills for important target groups of the population, such as young and ageing workers and migrants. **Section 7** summarises the results of recent skills forecasting exercises concerning the anticipated trends of skill mismatch in Europe in the next decade. **Section 8** suggests various preventive skills policies, focusing on education and training, human resource strategies of enterprises, active labour market policies as well as employment and innovation policies. **Section 9** concludes.

The analysis reported in the chapter is based on detailed analysis of the EU Labour Force Survey (EU-LFS), European Working Conditions Survey (EWCS) and European Company Survey (ECS).

2. Aggregate skill imbalances in the European labour market

2.1. Aggregate imbalances reflect the dynamic interplay of skill supply and demand

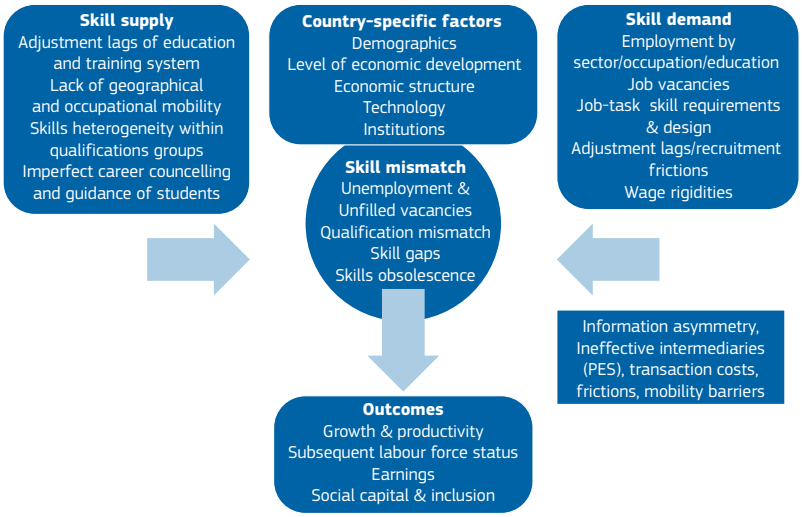
Skill mismatch is the outcome of the complex interplay between the supply and demand of skills within a market economy, both of which are constantly affected by adjustment lags and market failures and are shaped by the contextual conditions prevailing (e.g. demographics, technological progress, institutional settings) (Chart 1).

Aggregate labour market imbalances are caused by discrepancies between the labour needs of the economy and the available supply of manpower. Aggregate labour demand is usually approximated by the available job openings (both new jobs and replacement ones) in the economy, reflecting the diverse needs of the different sectors and/or occupations across the labour market. On the other side of the labour market, the size of the active labour force is typically used as a proxy of the aggregate labour supply in an economy. In practice, discrepancies between aggregate labour demand and supply often arise because of large flows of job creation and job destruction taking place in emerging or declining sectors and occupations, respectively, coupled with long-term demographic evolutionary patterns (see Box 1). Significant inertia and limited flexibility of education and training systems, for instance due to inadequate skills guidance, insufficient validation of non-formal and informal learning and inadequate continuing training at company and sector level, may also contribute to the emergence and perpetuation of skill mismatches in an economy.

Skill supply and demand interact dynamically rather than statically. In practice the demand for skills is intrinsically linked to the pace of change in the economy, while the supply of skills is driven by shifting economic and social incentives that affect the cost and benefits of human capital investments. Skill mismatch might also be influenced by the different phases of the economic cycle (Cedefop, 2010a) in that, in times of economic prosperity, mismatches arise mainly due to there being insufficient numbers of people available with the specific skills needed to satisfy demand[3]. On the other hand, the onset of the recession has resulted in a slowdown in job growth that has encouraged individuals to remain longer in the education system.

The reconciliation of demand and supply for skills in an economy is subject to complex feedback mechanisms and interactions. First, in the face of genuine skill shortages for higher-skilled workers that cannot be addressed by paying at or above the market rate of pay, employers may be forced over the short term to adjust their skill demand by, for example, hiring less qualified workers for the tasks required and seeking to upgrade them to the required skill level through training. In the long term, though, employers may adjust their recruitment, training and overall human resource strategy, or

Chart 1: Components and dynamics of skill mismatch



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(3) For example, during the 'dot.com' boom in the late 1990s and early 2000s, firms had trouble recruiting the information technology specialists they needed, while in recent years there is particular concern for skill shortages among professionals and technicians possessing Science, Technology, Engineering and Mathematics (STEM) skills.

Box 1: Trends in skill supply and demand in European job markets

Over recent decades the industrial and occupational structures of most developed economies have undergone significant changes. A steady shift in employment and skill demand towards knowledge-intensive activities (e.g. ICT, insurance, consultancy) has taken place, mostly in the services sector, along with smaller, yet positive, growth for lower-skilled elementary occupations (e.g. restaurants, hotels, retail, etc.) (European Commission, 2011).

The shift towards increased demand for skills in modern labour markets has been primarily attributed to the spread of information and communication technologies (ICT), which have resulted in an acceleration in demand for skilled workers that outweighs the available supply (known as *skill-biased technological change*) (Katz and Autor, 1999; Acemoglu and Autor, 2011). Closely related to and partially driven by technological advances of the knowledge-based economy is the shift in organisational practices from 'Tayloristic' or lean methods of production to new flexible forms of workplace practices (Caroli and Van Reenen, 2001). International trade, in particular, is thought to have played a key role in reshaping the optimal product mix of the European economy, as it involved the outsourcing of domestic production of low-skill-intensive goods to less developed countries facing lower unit labour costs (Machin and van Reenen, 2007). Additionally, trade in services across the globe, made possible by rapid declines in information transmission and communication costs, has become an increasingly prominent phenomenon in the form of off-shoring (Blinder, 2009).

The adoption of new technologies has resulted in a reduction in demand for routine cognitive and manual tasks and an increased reliance of production on non-routine tasks that cannot be easily substituted by technological automation (Autor et al., 2003). This has led to a polarisation (*hollowing out*) of employment in the years preceding the recession (Autor et al., 2006; Goos et al. 2009; Cedefop, 2010b; European Commission, 2011).

Shifts in labour demand and supply are also reflected in the wage distribution trends observed in many advanced Western economies. Rising wage inequality in the 1980s-1990s between individuals of different skill types (e.g. highly vs. lowly educated) and an observed compression in the lower half of the wage distribution is believed by some to be an outcome of institutional changes and of market forces. Recent studies have also emphasised the substantial increase in inequality that is increasingly observed within skill groups (e.g. between individuals possessing similar education credentials). A large part of this widening within-group variation in earnings has been attributed to the growing importance of ability, skills, competences and attitudes as driving forces of individual labour market success (Katz and Autor, 1999). Others have shown that more centralised wage-setting institutions, rather than a smaller dispersion in skills, can account for the slower growth in wage inequality in Western European countries than in the US (Devroye and Freeman, 2001).

Recent and anticipated demographic trends affecting the size and age structure of the European workforce highlight the need for lifelong learning policies that will maintain and raise the skills of an ageing population. In Europe, the population of working age has been shrinking in the past four decades due to declining fertility rates in many Member States. By 2014, the overall EU workforce will start declining, and only the segments of the population aged over 45 years are anticipated to grow. Over the coming years the ageing of the European population will thus constitute an additional barrier to the efficient matching between labour supply and demand. For this reason, more open and flexible learning pathways have become a necessity to allow the ageing workforce to react to changing skill needs, building on the transversal competences acquired in formal education and training.

On top of these long-term sectoral and demographic changes, the economic crisis has had a dramatic impact on the European job market. Between mid-2008 and the first quarter of 2011 the EU lost around 5 million jobs due to the economic slowdown, and only about a fifth of those lost jobs (0.9 million) have since been recovered. Despite this economic downturn, the historical trend towards an increasing demand for high-level skills has been robust. Higher-skilled individuals (i.e. those possessing a degree at first or second stage of tertiary education, or above EQF level 5) increased their share of employment during the years of economic turmoil. In contrast, the recession hit the low-skilled (up to lower secondary education) the hardest, particularly the younger age group.

invest in a different mix of technology, capital and labour, so as to overcome the skill deficiencies – in effect embodying the skills in the capital equipment rather than in people. Equally, educational requirements may rise over time as jobs become more complex and as employers demand more highly qualified labour for jobs that were previously considered to be low-skilled.

Second, with weak demand in the job market, in particular during recessionary periods, high-skilled workers may be induced to take up jobs requiring a lower qualification than the one they have in the face of intensifying competition, thereby *crowding out* lower-qualified individuals from the labour market. While this may provide the more highly skilled with work, the evidence indicates that many such individuals can get trapped for a long time in unsatisfying lower level jobs (Cedefop, forthcoming[a]). This also has implications for skills obsolescence in general since the rate of skills depreciation is greater among those who work in a non-challenging job that does not exploit their full potential, as well as among those who are kept out of the labour market for long periods of time.

Concerns that the supply of higher-educated labour in Europe is rising faster than demand has been supported by evidence pointing to decreasing wage returns for recent cohorts of university graduates (McGuinness et al., 2009). This seems to be particularly the case in countries that have experienced a rapid expansion of their tertiary education systems in relatively short periods of time (e.g. UK, Ireland). Several studies have pointed to further market inefficiencies associated with the increasing supply of university graduates, such as an over-emphasis on credentials – sometimes termed 'credentialism' – and a tendency by firms to inflate qualification requirements at the time of hiring (Dolton and Silles, 2003).

In this sense it has been asserted that the expansion of higher education systems has served to diminish the value of a university degree as a 'signal' of higher individual productivity. Employers have subsequently responded by placing more value on other indicators of individual ability, such as the type of institution and the class/level of degree (Battu et al., 1999). For instance, some researchers have found that individuals who have been awarded higher final marks as part of their degree and graduates of higher esteemed universities are less likely to be over-qualified (Dolton and Vignoles, 2000; McGuinness, 2003; Green and Zhu, 2010).

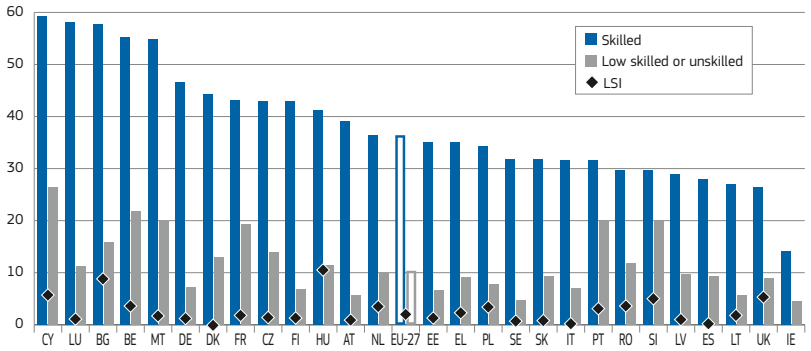
Although the aforementioned channels may lead to a misallocation of resources, to some extent labour demand is also a reflection of labour supply (Acemoglu, 2002). When work is organised in a manner that best takes advantage of, and complements, the skills and education of the available workforce, a well-educated and highly skilled workforce will have the effect of encouraging and enabling the adoption of new technologies. Work organisation can also be modified so that it can increase productivity which will, in turn, reinforce the demand for high skills in successful companies and industries. Upgrading the education of the workforce may thus, in itself, be a factor leading to increased demand for high skills. Bresnahan et al. (2002) have shown that firms could not have profited from the significant benefits of the ICT revolution unless there had been an appropriate increase in the supply of skilled workers who could cope with these new technologies. It is in this regard that the EU is developing common strategies, tools and principles to increase the link between the world of work and education systems.

Some economists and sociologists believe, however, that it is changes in the quality of jobs and segmented, or two-tier, labour markets, rather than shortages of human capital, that drive skill shortages and skill under-utilisation (Handel, 2003; 2005). They argue that the real causes of labour or skill imbalances are factors such as the decline of unionised manufacturing jobs, more competitive product markets, changing wage norms, the declining real value of the minimum wage, the increasing use of contingent work, outsourcing and offshore production and cheaper immigrant labour, all of which have served to compromise the pay and working conditions of jobs relative to the past. Others have emphasised that '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). From this perspective the deep-rooted skill deficiencies are seen to be the outcome of free-market government policies and management's shortcomings with respect to such issues as product quality, capital investment, work organisation and worker training. Discussions focused on the deficiency or non-responsiveness of education and training systems thus diverts attention away from the demand side of the economy, which is the true source of the problem.

2.2. Skill shortages are prevalent among European firms and sectors

A common sign of aggregate skill imbalances are skill shortages or the presence of hard-to-fill vacancies as a result of a discrepancy between the skills sought by enterprises and those available in the workforce. Skill shortages are regularly reported by European firms. According to data from the European Company Survey (ECS) (see Chart 2), about 36% of firms in the EU-27 experienced difficulties in hiring staff for skilled jobs in 2009. This figure ranged from above 50% in Belgium, Luxembourg, Bulgaria, Malta and Cyprus to below 20% in Ireland. 11% of enterprises faced difficulties in recruiting workers for low-skilled or unskilled jobs[4]. The aforementioned figures, even when focusing only on the manufacturing sector, exceed by a significant margin an alternative indicator

Chart 2: Skill and labour shortages in European firms, 2009, EU-27



Source: ECS (2009) and Eurostat EUROIND database.

Notes: Proportion of 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-skilled or unskilled jobs. ◆ LSI = 2009 annual average of labour shortage indicator, derived from the EU business surveys (% of manufacturing firms pointing to labour shortage as a factor limiting production). No data for IE.

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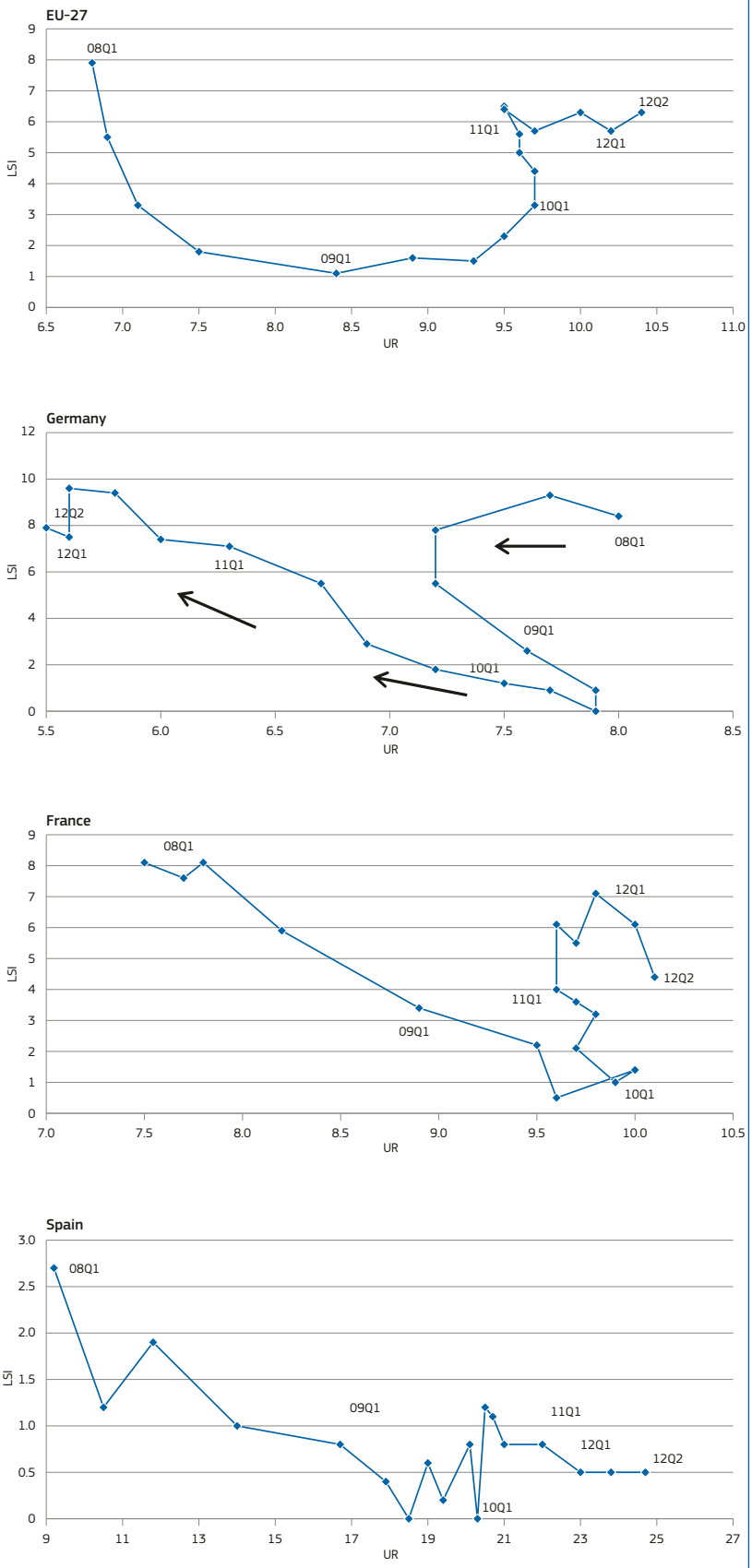
(4) Similar skill shortages are also evident in the latest wave of Manpower's Talent Shortage survey, which took place in 2012 (http://www.manpowergroup.com/index.cfm). Many national employer surveys further highlight the prevalence of skill shortages in European Member States. For instance, according to the English National Employer Skills Survey (NESS), about 3-6% of establishments reported skill-shortage vacancies between 2003 and 2009, defined as hard-to-fill vacancies which are attributable to a lack of skills, qualifications and/or work experience.

of short-term labour market pressure in the EU, namely the so-called labour shortage indicator (LSI). Derived from the European Commission's Business surveys, the LSI highlights that, in 2009, only about 2% of EU manufacturing firms considered that labour shortages were a factor limiting their production. This percentage was well below the 8% level that existed in the years preceding the economic crisis, but it has since increased to an EU average of around 5-6% in 2012 reflecting the upturn in overall economic activity.

The co-existence between job vacancies or skill shortages, on the one hand, and unemployment rates, on the other, is typically described and depicted by the Beveridge curve. As shown in Chart 3, in the years following the onset of the crisis the EU-27 Beveridge curve is characterised by an outward movement towards higher levels of both labour shortages and unemployment. This suggests an increasing risk of mismatch and of higher levels of structural unemployment in the European labour market in the post-crisis period if the outward *movement* in the curve disguises an outward *shift*. The EU pattern disguises important country differences reflecting the differential nature of the shocks and of previous macro-economic imbalances affecting the different economies. For example, some Member States, notably Germany, experienced a leftward movement in the Beveridge curve, indicating a tightening of the labour market, while Southern European countries such as Spain, Greece, Cyprus or Portugal have experienced marked increases in unemployment rates along with declining numbers of available vacancies, which is reflective of their decent into deep and protracted recessions.

The inability of employers to fill their open vacancies might also be an outcome of extended hiring times on their behalf as they can now afford to be more selective given the larger pool of unemployed workers on offer, without necessarily offering better wages or work conditions (Cappelli, 2012). Nonetheless, in the face of a considerable increase in unemployment rates, particularly among the low-skilled and the young, and given the acceleration of sectoral restructuring and downsizing that has been observed during the crisis in several countries (particularly in construction and manufacturing sectors), increasing skill mismatch

Chart 3: Beveridge curves of the EU-27 and selected Member States



Source: Eurostat. UR = unemployment rate (%), quarterly average seasonally adjusted. LSI = labour shortage indicator, derived from EU business survey results (% manufacturing firms pointing to labour shortage as a factor limiting production).

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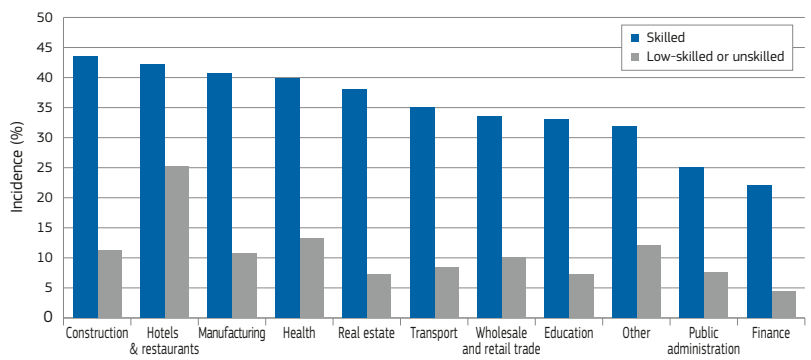
has been identified as one of the biggest challenges facing Europe in the post-crisis era (ECB, 2012). In particular, the rising duration of joblessness since the crisis, which has led to long-term unemployment accounting for over 45 % of the share of total EU unemployment, has raised the risk of so-called *hysteresis effects* prevailing. Unemployment may increase the risk of persistent unemployment in the future due to both discouragement of the individuals concerned and their skills becoming obsolete after prolonged periods of inactivity. Indeed, skill mismatch has been found to be positively related to the increase in the structural component of unemployment in European countries in the post-recessionary years (ECB, 2012).

Skill shortages may arise due to an inability on behalf of employers to find suitably qualified or skilled staff, but they may also reflect sectoral and regional reallocation of economic activity. The reallocation of the labour force from territories or sectors characterised by declining economic activities towards those in which jobs are expanding constitutes a major challenge for policy-making. High disparities in regional employment rates have always characterised many EU economies and the available evidence for the time period 2007-11 points to an increasing dispersion of regional employment rates in some EU countries (e.g. Italy, Spain, Bulgaria, Belgium, France, Romania, the Czech Republic, Portugal, Slovenia, the Netherlands and the UK). Sectoral employment shifts, particularly in the sectors of construction and in finance and business, have also been found to be important determinants of the observed Beveridge curve shifts across EU countries (ECB, 2012).

Chart 4 illustrates that in the midst of the crisis (in 2009) a significant share of European employers encountered difficulties in finding suitably skilled staff mostly in those sectors that were more affected by the crisis (e.g. construction, hotels and restaurants, manufacturing). The contribution of different sectors to the overall incidence of skill or labour shortages 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 the crisis (see Annex 1). For example, in the UK and the Netherlands the greatest share of shortages of skilled labour is observed in the financial and non-market services sectors, whereas in Italy, Portugal and the Eastern and Central European countries skill and labour shortages are more pronounced in the manufacturing sector. For many countries, between a third and a half of the shortages of skilled and unskilled workers can be found in the wholesale and retail trade and transport and storage sectors.

Key sectors in terms of their importance for European innovation and sustainability are often identified as suffering from skill shortages. Cedefop (2011a) has recently highlighted that some 'green occupations' (e.g. energy auditors, photovoltaic installers, insulation workers, environmental engineers, sheet metal workers) are facing skill gaps in practical and technical (STEM) skills. Skill shortages are likely to occur not only due to the fact that many occupations and skills related to the sustainable economy are new or emerging, but also because of difficulties in recognition and portability of new 'green' qualifications and in attracting young people into what are perceived as 'dirty' jobs with poor working conditions and low pay. Most Member States also do not yet have explicit national skill strategies or programmes integrated with their environment policies to develop low-carbon economies. Different policy domains often remain separate, hindering policy cooperation and coherence between environment and energy policies and skill and employment policies. A growing shortage of ICT professionals in Europe has also been predicted, resulting in an estimated shortfall of as many as 700 000 professionals by 2015 (European Commission, 2010c). Furthermore, about 1.5 million new 'white jobs' have been forecast to be generated in the health care sector by 2020, even though a shortage of both new technology and social intercultural skills has been identified in a sector traditionally seen to have both poor work conditions and low pay (Eurofound, 2006). Shortages of technical skills are often reported by micro and small enterprises too, although this can sometimes reflect bad working conditions in some specific sectors rather than a real lack of skills in the workforce as a whole (European Commission, 2008a). Finally, qualitative studies of the commerce and tourism sectors have revealed that employers in these sectors are likely to face shortages unless they improve the overall work conditions and address the geographical limitations that affect local markets (Cedefop, 2005).

Chart 4: Skill and labour shortages by economic sector, 2009, EU-27



Source: ECS (2009).

Notes: Proportion of 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-skilled or unskilled jobs'.

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2.3. Aggregate skill mismatch is increasing in Europe

Skill mismatch arises because of a discrepancy in the distribution of skill demand and supply, where the dispersion of skills is typically approximated by the variation of educational qualifications within an economy (e.g. high-, medium- and low-level qualifications). On the supply side, the steady growth of individuals with tertiary education qualifications as a share of the active EU workforce (from 21 % in 2000 to 29 % in 2011) is well-documented, reflecting the gradual retirement of older and less qualified cohorts and the process of educational upgrading. In contrast, the share of active lower-skilled workers (i.e. pre-primary,

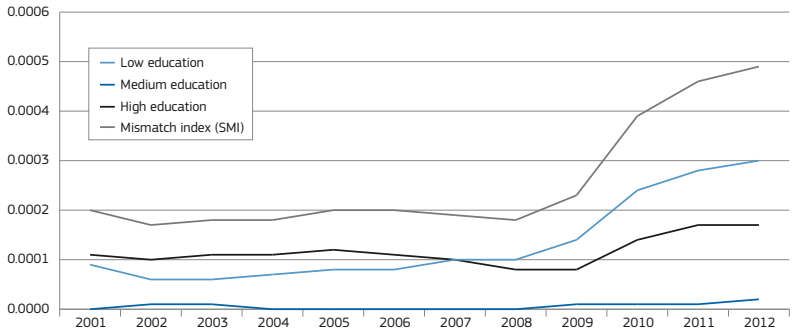
primary and lower secondary education graduates) has decreased (from 30% in 2000 to 22.5% in 2011), while those with medium-level qualifications (upper secondary and post-secondary non-tertiary) has remained stable at about 48%.

A similar trend has also taken place in the past decade on the demand side. Specifically, higher-skilled workers have increased their share in the overall pool of EU employment from 22% in 2000 to 30% in 2011, while the proportion of low-skilled workers decreased over the same time period (from 29% to 21%, respectively). The employment of lower-skilled workers, in particular, was more severely hit as a result of the economic crisis, and their relative unemployment rose faster during this period, while high-skilled employment continued to increase, albeit at a slower pace. Indeed, it has been estimated that EU countries that had a greater proportion of low-skilled workers in their labour force during the past decade had a greater probability of experiencing an outward shift in their Beveridge curves (ECB, 2012).

Due to the intense job destruction and its concentration in certain branches of economic activity a strong increase in structural mismatch has taken place since the start of the crisis, as evidenced by the so-called skill mismatch index (SMI). The skill mismatch index measures the distance between the relative demand and supply of a given skill *j*, where demand is captured by the share of employed persons with skill *j* in the EU economy/country/region at a given time period and supply is approximated by the share of the active workforce in possession of a given skill level (or, similarly, the stock of unemployed workers with skill level *j*) (Estevao and Tsounta, 2011). Confirming the analysis of the ECB (2012) for the euro area, Chart 5 exhibits a marked increase in the overall EU-27 SMI during the period of the crisis. Breaking down the SMI according to the individual components of skills, it becomes apparent that the intensification of skill mismatch during this era can be attributed primarily to the collapse in the demand for low-educated workers (by about 6.8 million workers). Another driver of the overall rise in the SMI is the increasing imbalance for high-educated workers since 2008. However, in this latter case it is the relative growth in demand for high-skilled workers (by about 5.6 million workers) in relation to their supply that lies behind the growing mismatch.

About three quarters of the increasing share of higher-educated employment during the crisis took place in so-called knowledge-intensive service industries and in high-skill occupations (managers, professionals and associate professionals and technicians). However, as observed in Chart 6 the number of higher-educated workers employed in skilled non-manual occupations (clerical support workers and service and market sales) also rose by 26.5% between 2007 and 2011, raising concerns about a potential increase in the incidence of over-qualification, i.e. university graduates accepting jobs that require lower qualifications than their own. In contrast, the significant fall in the employment of low-educated individuals in high-skill occupations (by about 26% during the period of the crisis) signals that such workers may have been dismissed faster during the economic downturn due to their lower productivity. In this case the

Chart 5: Skill mismatch index (SMI) by level of educational attainment, EU-27



Source: Cedefop calculations based on Eurostat data.

Notes: The SMI has been derived following the methodology of Estevao and Tsounta (2011) and the ECB (2012). The education levels are separated according to the ISCED classification i.e. *High education:* ISCED 5-6; *Medium education:* ISCED 3-4; *Low education:* ISCED 0-2.

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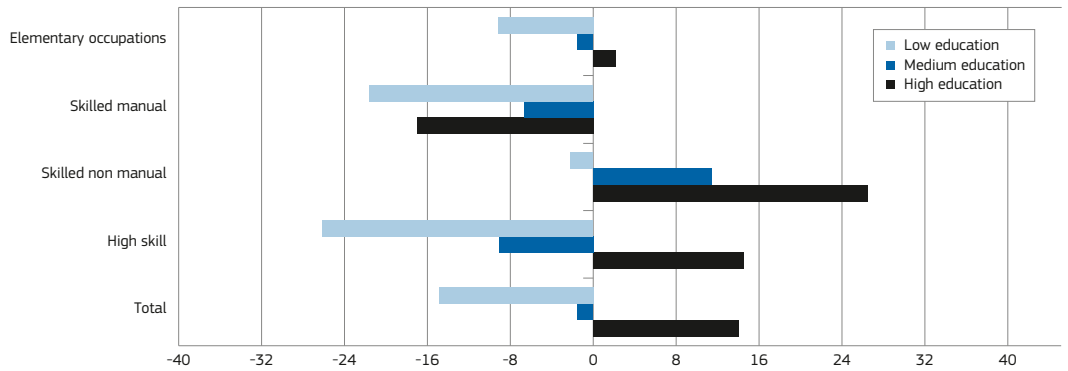
Chart 6: Change (%) in employment by occupational group and skill level, EU-27, 2007-11



Source: Cedefop calculations based on Eurostat data.

Notes: The occupations are separated according to the ISCO classification i.e. *High skill:* Managers, professionals, technicians and associate professionals; *Skilled non-manual:* clerical support workers and service and sales workers; *Skilled manual:* Skilled agricultural, forestry and fishery, craft and related trades and plant and machine operators and assemblers. The education levels are separated according to the ISCED classification i.e. *High education:* ISCED 5-6; *Medium education:* ISCED 3-4; *Low education:* ISCED 0-2.

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overall incidence of under-qualification in the EU economy (i.e. workers employed in jobs requiring higher qualifications than the ones they hold) is expected to have declined in recent years.

3. Qualitative skill mismatch in Europe

3.1. Qualitative skill mismatch takes many forms

Given that the SMI measures imbalances of labour demand and supply using educational attainment as a proxy of skills, it can only provide a partial picture of the nature of skill mismatch. Despite the strong correlation between formal education and skills, the SMI and other similar measures of mismatch fail to take into account the dynamic process of skill accumulation and obsolescence over individuals' working lives. They also do not account for the quality of the match between employees' skills and the required skill profiles of their jobs. For this reason, a comprehensive analysis of skill mismatch in Europe requires in-depth analysis of the qualitative mismatches between individuals' skills and job requirements.

Even if imbalances between the aggregate labour demand and supply of European states were adequately addressed via appropriate market signals and/or policy regulation, skill mismatches would not disappear completely. 'Qualitative' mismatches at the individual level arise because of the inevitable heterogeneity in job tasks and workers' talents. These interact in imperfect job markets characterized by substantial asymmetries in the information available to labour market agents, imperfect mobility and inevitable frictions (Pissarides, 2000; Sattinger, 2012) (Box 2).

Table 1: Definitions and types of qualitative skill mismatch

Vertical (qualification) mismatch	A situation in which the level of an individual's education is less or more than the level of education required by his/her current job. *General causes*: business cycle effects, heterogeneity among individuals and jobs, information asymmetry between employers and employees, incomplete mobility, transaction costs, slow responsiveness of education and training to labour market needs.
Over-qualification	A situation in which an individual has more education (in terms of qualifications) than the current job requires. *Specific causes*: lack of suitable jobs in the labour market, inflexibility of education and training system, heterogeneity of skills and/or ability within levels of education, inadequate career guidance, ineffective intermediaries, recruitment frictions.
Under-qualification	A situation in which an individual has less education (in terms of qualifications) than the current job requires. *Specific causes*: skill shortages, heterogeneity of skills and/or ability within level of education, cohort effects, availability of firm-specific training and skills accumulation (Sloane et al., 1996).
Horizontal (qualification) mismatch	A situation in which the level of education matches job requirements, but the type of education (e.g. field of study) is inappropriate for the current job. *Specific causes*: occupational specificity of field of study (Wolbers, 2003), occupational regulation, signalling value of respective field (Reimer et al., 2008), existence of multiple 'pathways' for entry into employment (European Commission, 2008b).
Skill mismatch	A situation in which the level and/or type of skills and abilities of an individual is less or more than the required level of skills and abilities in the job. *Specific causes*: diffusion of new technologies, changing work organisation, job design, career development, provision of continuous training, inflexibility of education and training systems.
Over-skilling	A situation in which an individual is not able to fully utilise his or her skills and abilities in the current job.
Under-skilling	A situation in which an individual lacks the skills and abilities necessary to perform the current job to acceptable standards.
Skills obsolescence	A situation in which the level of skills and abilities of an individual required to maintain effective performance in his or her job deteriorates or becomes outdated over time (Kaufman, 1974). *Specific causes*: ageing, lack of use of skills at work (atrophy), diffusion of new technologies, changing forms of work organisation, career interruptions (De Grip and van Loo, 2007).
Economic skills obsolescence	A situation in which skills previously utilised in a job are no longer required or have diminished in importance.
Physical (technical) obsolescence	A situation in which physical or mental skills and abilities deteriorate due to atrophy or wear and tear.

Source: Cedefop (2010a).

Notes: (a) Confusion is sometimes caused by the unfortunate use in the literature of the term 'skill mismatch' both as the narrow concept described in the table, and as an encompassing term that may encapsulate qualification mismatch (i.e. vertical and horizontal);

(b) According to the official definitions adopted in the context of the European Qualifications Framework:

- **'qualification'** means a formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards;
- **'skills'** means the ability to apply knowledge and use know-how to complete tasks and solve problems (cognitive and practical);
- **'competence'** means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development (e.g. responsibility, autonomy).

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Box 2: Search theory and active labour market policies

Short run qualitative mismatches arise as a consequence of extensive job and worker heterogeneity combined with imperfect information and frictions in the labour market that require workers and employers to engage in costly search to establish employment. 'Search' theory (Mortensen and Pissarides, 1999; Petrongolo and Pissarides, 2001) refers to the study of how workers go about finding a job, and how firms recruit workers. When looking for a job, a worker does not know which firms would be willing to hire him or her. When the worker gets an offer from a possible employer, the worker needs to decide whether to accept the offer or continue looking. Search theory describes the optimal strategy for a worker looking for a job, and has been extended to describe how firms look for workers. Since the wage offer that a worker could get at different employers varies according to the relation between the worker's characteristics and the characteristics of the job, a continued search by the worker can generate a higher wage.

However, since searching is costly, the worker at some point will decide to stop searching and accept a job that pays less than the maximum attainable wage. Similarly, the productivity of a worker at a particular job varies depending on the worker's characteristics, but the employer fills the job before finding the ideal worker because it would be costly to leave the job vacant for too long. As a consequence of this search, the characteristics of the worker and firm are not perfectly matched compared to the best assignment determined with perfect and costless information.

These short-run qualitative mismatches are an inevitable consequence of the operation of the labour market in the presence of costly information obtained through search. Although inevitable, the short-run qualitative mismatches cause losses to both workers and firms. Workers lose because they spend time unemployed, are paid less than they could potentially earn, and must perhaps engage in on-the-job searches to obtain further advancement in their careers. Employers lose because a job may remain vacant until they can find someone to fill it, they may get less production from the worker than they could hope for, and the worker may leave for a better job, generating a costly separation.

The prevention of losses from qualitative mismatches in the short run depends on active labour market policies that promote efficient matching. This assumes greater importance given the lags of the education and training system in terms of addressing short-term labour demand needs. Labour market intermediaries and temporary help agencies can potentially reduce short-run qualitative mismatches by placing workers in jobs more efficiently than the rest of the labour market. However, the efficiency of such policies can be compromised by the fact that employers tend to attach a negative stigma to previously mismatched employees.

Source: Sattinger (2012).

As described in Table 1, qualitative mismatch manifests in many different forms (in particular, vertical qualification mismatch, horizontal qualification mismatch, skill mismatch and skills obsolescence) and has different causes, implying that markedly different policy responses may be needed in each case (Cedefop, 2010a).

3.2. Qualification mismatch is widespread in EU Member States

Vertical (qualification) mismatch, when the level of an individual's qualification differs from that required by his/her job, is a widespread phenomenon in Europe, although it tends to vary widely across countries. Meta-analyses of several studies that have taken place since the 1980s, which mostly rely on datasets of graduate cohorts and on samples drawn from particular countries (e.g. the US, UK, Netherlands, Germany, Sweden, Belgium, Portugal), have found that over-qualification typically affects around 25-30 % of the population (Groot and Maasen van den Brink, 2000; McGuinness, 2006; Leuven and Oosterbeek, 2011). The respective figure for under-qualification is slightly higher at 31 %. When compared to other areas of the world, however, Europe appears to be characterised by a higher incidence of under-qualification, with a share of over-qualified workers that is lower than in the US/Canada but higher than in Asia, Australia and Latin America (Table 2).

According to OECD (2011) estimates for the year 2005, which cover a wide range of OECD countries and examine a representative sample of the entire workforce, some 25 % of workers were over-qualified on average, and 22 % under-qualified. Taking better account of the degrees of severity of skill mismatch, the OECD also reports that over 17 % of workers are 'severely over-qualified' and nearly 9 % suffer from 'severe under-qualification'[5].

Using comparable data from the European Labour Force Survey (EU-LFS) the average incidence of vertical mismatch over the past decade (2001-11) is found to vary significantly across European

Table 2: Incidence of vertical mismatch by continent

	Under-qualification (% employed)	Over-qualification (% employed)
Asia	21	26
Australia	n/a	8
Europe	31	30
Latin America	21	24
US/Canada	16	37

Source: Leuven and Oosterbeek (2011); Figures estimated by the authors using meta-analytical methods of (unweighted) means of the reported shares of skill mismatch in a database constructed from a number of existing studies. The European sources mostly focus on the following countries: NL, ES, PT, UK, DE, BE, AT, CZ, SE.

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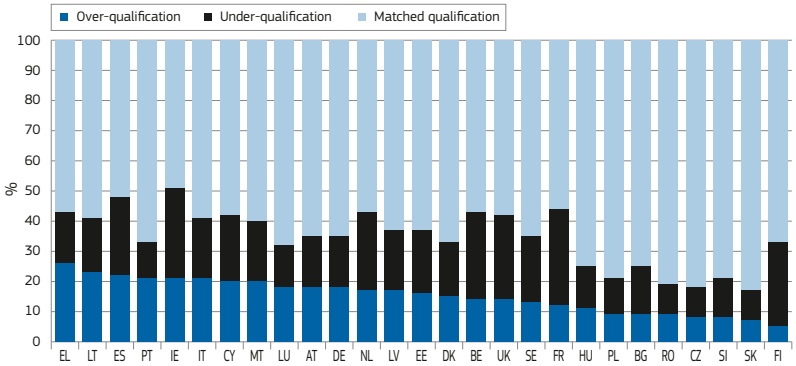
(5) Individuals are classified as severely mismatched if their qualification level is more than one step away from the required qualification in their job on the five-point ISCED scale. For example, if an individual holds a tertiary education degree (ISCED 5), he/she is classified as severely over-qualified only if he/she is employed in an occupation with a required educational level equivalent to upper secondary qualifications (ISCED 3) or below.

Chart 7: Average incidence of vertical mismatch (2001-11) in EU-27 countries, % of employees (aged 25-64)



Source: Cedefop, based on EU-LFS data.

Notes: Over-qualified (or under-qualified) workers are those whose highest level of qualification attained is greater than (or lower than) the qualification requirement of their occupation. The modal qualification in each occupational group at the two-digit level is used to measure qualification requirements. The appropriate EU-LFS weighting variable (COEFF) is used in the calculation of the modal qualification.

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Member States[6]. Chart 7 illustrates that nearly 15% of European employees are over-qualified, on average, while 21% are under-qualified, implying a total incidence of vertical mismatch in the EU of about 36%. Some 8-9% of European workers are found, on average, to be either 'severely over-qualified' or 'severely under-qualified' (see Annex 2)[7].

The EU average masks significant variation between EU countries, with more than one in five employees experiencing over-qualification in Greece (26%), Lithuania (23%), Spain (22%), Portugal (21%), Italy (21%) and Ireland (21%). In contrast, the incidence of over-qualification is much lower (7-9%) in Eastern and Central European countries (Poland, Czech Republic, Slovakia, Slovenia, Bulgaria, Romania) and in Finland (5%). Similarly, the proportion of under-qualified workers ranges from as high as 32% in France to as low as 10% in Slovakia, Romania and the Czech Republic.

The magnitude of vertical mismatch differs significantly between individuals with different levels of qualifications and skills. About 30% of tertiary education graduates in the EU are found to have been over-qualified in 2009, a figure which corresponds closely to estimates of mismatch based on studies that rely on data of higher education graduates[8]. The corresponding rate falls to around 12% for medium-educated graduates (i.e. those with at least upper secondary education). In other words, over-qualification disproportionately affects graduates with tertiary education.

For Europe as a whole almost two thirds of its over-qualification can be characterised as 'severe' (see Annex 2 and 3). In some countries (Bulgaria, Finland, France, Slovenia, Slovakia) the entire qualification mismatch is of the severe type by default, given that the post-secondary non-tertiary educational classification (ISCED 4) is not recorded or forms a very small group. In these cases the majority of the rate of over-qualification can be explained by university graduates (ISCED 5) taking up jobs requiring only upper secondary education diplomas or below (ISCED 1-3). Under-qualification arises instead primarily because of lower-secondary or primary school graduates who are employed in jobs requiring an upper secondary qualification, while a quarter of it is also due to upper secondary graduates working in jobs that require a university diploma.

Greece and Cyprus remain at the top of the mismatch ladder even when comparing the countries in terms of the severity of their mismatch. However, in some of the other high mismatch countries (Spain, Ireland, Portugal) a significant share of their overall mismatch is 'moderate'. For example, almost half of the over-qualification rate in Spain can be attributed to upper secondary graduates (ISCED 3) taking up jobs that are mostly performed by lower secondary graduates (ISCED 2). A sizeable 41% of the Spanish over-qualification rate, however, also arises because of the fact that university graduates take up jobs at upper secondary level or below. For Lithuania only about a fifth of its over-qualification rate can be classified as severe, given that most of the mismatch in that country arises because of university graduates (ISCED 5) and post-secondary non-tertiary graduates (ISCED 4) taking up jobs requiring a qualification level that is only one step below their own (ISCED 4 and 3, respectively)[9].

Considering the evolution of the EU-wide rate of qualification mismatch over time (Chart 8), it is apparent that both types of vertical mismatch (over- and under-qualification) exhibit a relatively stable time series. However, in the period in which the economic crisis unfolded (2007-09), the under-qualification rate fell by about 1%, whereas the over-qualification rate has risen consistently by about 1% in total.

The relative stability of the over-qualification rate, as estimated by the empirical method employed in this chapter, is an outcome of two underlying forces. First, as argued in section 2.3, almost 59% of the increase in employment of high-educated workers in recent years has taken place in managerial and professional occupations,

(6) Although aggregated data files including information on all EU-27 countries for the years 2000-11 were provided to Cedefop by Eurostat, at the time of writing Cedefop only had access to the anonymised micro data files of the EU-LFS survey up to the year 2009 (excluding MT and DE). For the purposes of the empirical analysis the final sample includes six years of data (2003-08), due to the need to retain homogeneity in the empirical specification for all countries and in order to respect Eurostat guidelines on several key variables.

(7) Chart 7 reports the average incidence of qualification mismatch over the past decade, instead of the most recent annual estimate, as the former provides an indication of the 'natural' rate of mismatch characterising the EU Member States. The average incidence of mismatch over several years is also unaffected by any measurement error related to yearly fluctuations in the modal qualification of specific two-digit occupations.

(8) According to the Bologna process for higher education (http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=EC-30-12-534) roughly one fifth (20.6%) of young people (aged 25-34) with tertiary education can be regarded as over-qualified for the job they occupy, thus are employed in occupations not requiring tertiary qualifications. This percentage remained quite stable between 2000 and 2010, despite the growing participation rates and the 'massification' of higher education. This suggests that over-qualification rates are influenced more by labour market structures and innovation than by the growing number of students. The median over-qualification rate is 18.1%. A similar cross-country pattern of vertical mismatch is found, as there are six countires with an over-qualification rate around or above 30%: Bulgaria (30%), Greece (30.1%), Italy (30.4%), Ireland (37%), Cyprus (37.6%) and Spain (38%). The seven countries with over-qualification rates under 15% are Slovenia (14.1%), Iceland (13.9%), Romania (13.2%), Slovakia (11.6%), Croatia (11%), Czech Republic (9.2%) and Luxembourg (5.1%).

(9) The very small over-qualification rate in Finland is an outcome of the fact that about 87% of its population has an educational qualification that exceeds upper secondary level (ISCED 3 and above), while the mode educational requirement even of low-skilled occupations corresponds to an upper secondary qualification (ISCED 3).

Box 3: Methods of measuring vertical mismatch

The underlying rationale behind measuring vertical mismatch is to compare individuals' attained years of schooling/level of educational qualifications and the educational requirement of their job or occupation.

Three alternative methods have been used in the literature:

(*i*) the *systematic job evaluation method*, which is an objective measure. The job evaluation method is based on information that is included in formal job descriptions (e.g. the Dictionary of Occupational Titles). Although the required level of education in this case is calculated using a more objective approach, updates are infrequent and sometimes are not so accurate (Hartog, 2000);

(*ii*) the *worker self-assessment method*, which is a subjective measure. The worker self-assessment method relies on the subjective response of workers about the educational requirement of their job. However, differences in the phrasing and framing of the question can cause differences in the measured level of required education. It can also be ambiguous with respect to whether the question captures the required level of formal, non-formal or informal learning for being hired for a job or for adequately performing the job;

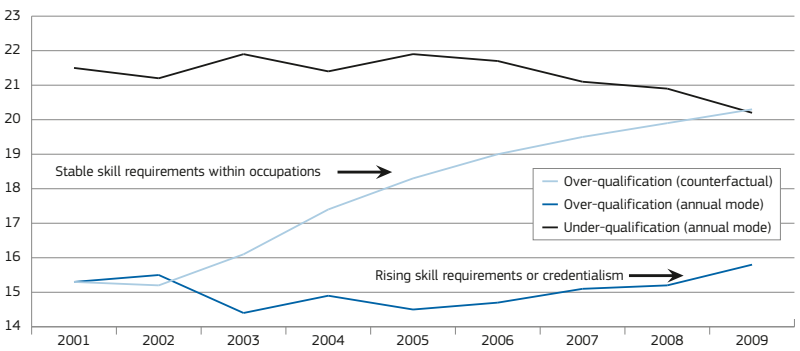
(*iii*) the *empirical method*, which constitutes an indirect method of calculating vertical mismatch when data sets do not contain a direct question on mismatch. The empirical method acknowledges that there is a distribution of schooling levels across a given occupation and calculates the required educational level on the basis of the mean or modal qualification possessed by workers in each occupational group. Comparing this estimated required education level to the worker's actual qualification level yields an indicator of skill mismatch. The major critique of the empirical method is that the required education level within an occupation is an outcome of supply and demand forces, and thus is likely to change over time.

Each method has its own virtues and weaknesses, but data on the incidence of vertical mismatch should always be considered in relation to the respective method used. Subjective measures of the incidence of over-qualification are typically found to exceed those obtained via objective (e.g. dictionary-based or empirical method) measures (Groot and van den Brink, 2000). Nevertheless, the various approaches to estimating the incidence and returns to over-qualification tend to yield broadly consistent conclusions (McGuinness, 2006).

Other less popular methods have also been suggested. Gottschalk and Hansen (2003) classified occupations in the US as graduate and non-graduate on a different basis: whether 90% or more of workers in a given occupation are graduates or, failing that, if there is a significant graduate pay premium of 10% or more in that occupation. They found that the probability of a graduate being employed in a non-graduate job in the US actually fell between 1983 and 1996, a result 'which stands in stark contrast to those in previous studies' (Gottschalk and Hansen, p. 450). Similar findings were obtained by Cardoso (2007) for Portugal and by Grazier et al. (2008) for the UK, while Boheim et al. (2008) performed a related exercise at European level using data from Eurostat's Structure of Earnings Survey (a data source that, unfortunately, only allows for infrequent calculations of mismatch using this particular methodology).

From the above it is apparent that conventional data on the incidence of skill mismatch should always be treated with caution and in relation to the selected measure of skill mismatch. Given the data sources used in this chapter (EU-LFS and the EWCS), which do not contain direct questions on the educational requirement of jobs or on the respondent's perceived level of vertical mismatch, the empirical method has been adopted.

Chart 8: Incidence of vertical mismatch over time (2001-09), % of employees, EU-25



Source: Cedefop, based on EU-LFS data (data for MT and DE not available).

Notes: The dark blue blue and black lines depict the average EU-25 rates of over-qualification and under-qualification where the modal educational requirement is derived using the annual EU-LFS population within each 2-digit ISCO occupation. The light blue line is derived using the counterfactual hypothesis that the educational requirement within each 2-digit ISCO occupation has not changed since 2001.

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so a significant share of high-skilled workers has potentially found employment in jobs that demand qualifications commensurate with their own. Second, the increasing share of higher-educated workers in the total pool of employment has contributed to an increase in the modal educational requirement in some occupations, and hence in a declining tendency of over-qualification over time. This is particularly evident in some technician and associate professional occupations (where the mode has generally risen from upper secondary level in 2001 to university diploma in 2009) and in elementary jobs (where the mode has increased from primary/lower secondary level to upper secondary level).

If it is assumed that the process of rising skill requirements and/or of credentialism did not take place in the past decade, so

that the modal educational requirement of occupations remained the same throughout the years as in 2001, it is possible to envisage an upper bound estimate of the extent of over-qualification in Europe. If indeed the 'true' nature of skill demand within occupations did not change over the years, the light blue line illustrating the counterfactual over-qualification rate in Chart 8 indicates that there has been a substantial increase of about 5% in over-qualification during this time period (rising from 15% in 2001 to over 20% in 2009). This corresponds to about 6.4 million employees in Europe who have taken up jobs in the past decade where the demand for skills is potentially lower than the level that would be expected on the basis of their qualifications.

Similar time trends are also evident when comparing the rates of vertical mismatch using the European social surveys (ESS). The ESS data reveals that while the level of education of workers has markedly increased between the years 2004/5 and 2010/11, qualification requirements (based on the subjective evaluations of respondents about the education required by their job) have increased only a little. This has implied that over this time period the rate of under-qualification has declined from 24% to 18% of the employed population, whereas the rate of over-qualification has risen from 11% to 16%.

Moreover, an examination of the composition of the EU-wide vertical mismatch (see Annex 3) reveals further that in the period 2001-09 there was a large increase in the share of severe over-qualification. Whereas in 2001 the phenomenon of university graduates taking up jobs that require upper secondary graduates accounted for 38% of the entire incidence of over-qualification in Europe, by 2009 it had risen to more than a half (53%).

Finally, it needs to be pointed out that the EU vertical mismatch rates disguise significant country variations over time. For instance, an upward trend in over-qualification can be observed not only in Greece and Portugal, the two countries with the highest rates of mismatch, but also in countries with the lowest mismatch, such as the Czech Republic and Slovakia. In some Member States (e.g. Finland, Italy, Slovenia) there has also been a decline in under-qualification rates over time.

3.3. Horizontal mismatch reflects heterogeneity of skills within education levels

Another form of qualification mismatch, namely horizontal mismatch, occurs when there are discrepancies between the number of workers within a given field of study and the available jobs to accommodate graduates from that field. Horizontal mismatch may lead to vertical mismatch, while vertically mismatched workers may or may not be horizontally mismatched (OECD, 2011). Measurement of horizontal mismatch depends on the identification of occupations that are considered to correspond to each field of study. For example, individuals with a science degree may be judged to be perfectly matched if they find a science-related job, but they may also be sufficiently matched in engineering posts. In a recent analysis along these lines, commissioned by Randstat (2012), some 23% of workers in the EU-27 are found to have been affected by horizontal mismatch in 2009 (Chart 9), with Ireland having the lowest level of horizontal mismatch, and Poland the highest.

3.4. Qualification and skill mismatch are weakly related

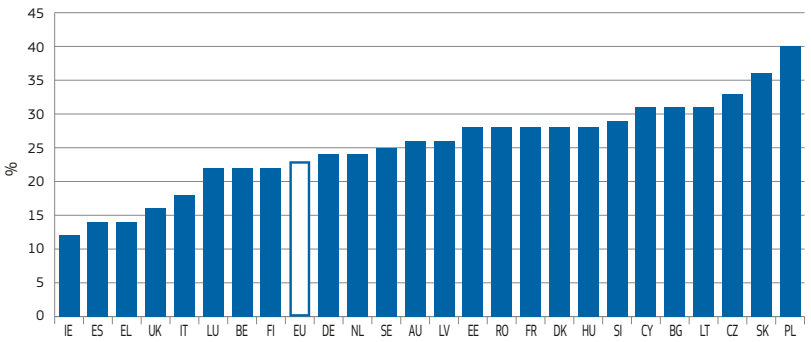
Educational qualifications are an imperfect proxy of the skills and competences possessed by individuals and supplied in the workplace. Qualifications fail to account for the dynamic process of skill gains and losses over the working lifetime (Desjardins and Rubenson, 2011) or for the differential quality and orientation of different education and training systems (OECD, 2012). For this reason, a new strand of the literature has questioned the validity of using *qualification mismatch* as an indicator of *skill mismatch* (e.g. Allen and van der Velden, 2001; Green and McIntosh, 2007; Mavromaras et al. 2009).

Ideally it would be good to know the extent of (objectively-measured) mismatches in various types of skills and their trend over time, but suitable datasets allowing for such measurements are scarce[10]. The 5th wave of the European Working Conditions Survey (2010) provides a recent, yet broad, picture of (self-reported) mismatch in skills, by asking a question about current skills and job matching. In this respect, only 56% of workers declare that '*their duties correspond well to their present skills*'; 13% '*need further training to cope well with their duties*' while 31% estimate that they '*have the skills to cope with more demanding duties*'.

As with the incidence of qualification mismatch, important differences between countries are observed (Chart 10). Romania, Greece, Cyprus, Slovenia and the UK are ranked highest in terms of skill mismatch with about 40% over-skilling rates, while Austria, Lithuania, the Czech Republic, Finland and Portugal are at the other end of the spectrum. Austria, Germany, Estonia, Lithuania and Slovakia record the highest rates of under-skilling while Ireland, Portugal, Bulgaria, UK and Romania have the lowest.

Further evidence of mismatch in skills is available from recent studies that use surveys of graduates (e.g. the REFLEX survey). Some 10% of higher education graduates in European countries indicate that their own competence level is lower than that required in their job (*under-skilled*) and around 15% report that it exceeds it (*over-skilled*). Desjardins and Rubenson (2011) also use direct measures of individuals' cognitive foundation skills (such as literacy and numeracy skills) and compare these to the level of

Chart 9: Incidence of horizontal mismatch in Europe, % of employed, 2009, EU-27



Source: SEO calculations based on Eurostat, Randstat (2012).

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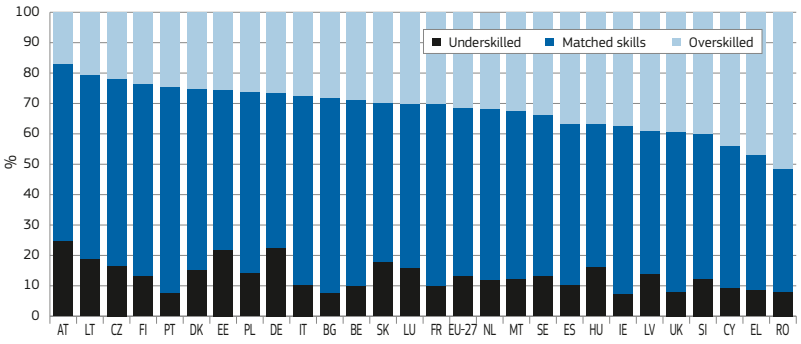
(10) New surveys currently undertaken by international organisations such as the OECD, the European Commission and Cedefop, including PIACC, the first European Employer survey and the pan-European skill mismatch and obsolescence survey, constitute promising attempts to provide insight into the nature of skill supply and demand in advanced economies.

Chart 10: Incidence of self-reported skill mismatch in Europe, % of employees, 2010, EU-27



Source: EWCS (2010).

Notes: Responses to the question 'Which of the following alternatives would best describe your skills in your own work? The over-skilled are the share of the employed who replied affirmatively to the option 'I have the skills to cope with more demanding duties'; Under-skilled are those who replied affirmatively to the option 'I need further training to cope well with my duties'; Matched in skills are those who replied affirmatively to the option 'My present skills correspond well with my duties'.

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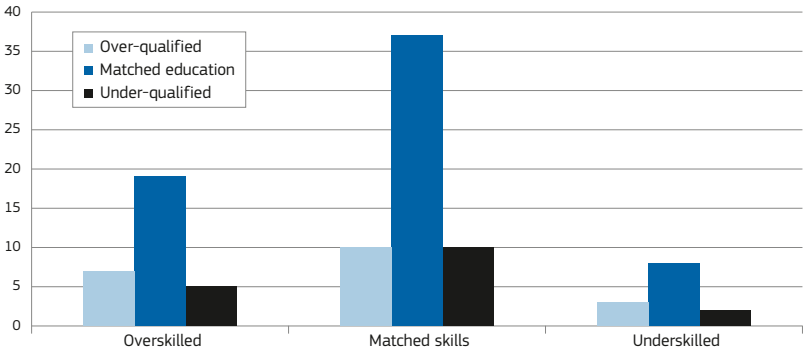
Chart 11: Qualification mismatch versus skill mismatch, % of employees, 2010, EU-27



Source: EWCS (2010).

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the same skills required within the job. They find that literacy and numeracy mismatch, manifested either as skill deficits or as skill surpluses, is a widespread phenomenon, affecting around a third to a half of workers in different countries.

Although a good match in terms of educational qualifications is expected to improve the likelihood of a worker having a good match in skills, this relation can be relatively weak (see Chart 11). Among the entire sample of employees in the EU-27, only 37 % of workers are matched in terms of both qualifications and skills[11]. For only 7 % of workers in the sample, the incidence of over-qualification is also accompanied by over-skilling, while only 2 % are both under-qualified and under-skilled. Some 10 % of workers are over-qualified but feel that their skills are well-matched despite their educational mismatch. 3 % of the European workforce comprises of over-qualified workers who are nonetheless under-skilled, while 15 % of employees have skills that are matched to, or exceed, the requirements of their job despite being under-qualified[12].

(11) As before, vertical mismatch using the EWCS dataset has been defined as deviations from the country-specific modal level of education in a respondent's occupational group. However, due to the limited number of observations per country within the cells of two-digit occupational groups, vertical mismatch has been calculated with reference to the 1-digit ISCO grouping in this case.

(12) This supports the idea that under-qualified workers may have acquired further skills outside formal education allowing them to hold more complex jobs than their qualifications would suggest. It also highlights the importance of recognition of the non-formal learning of such workers as a means of enhancing their careers and facilitating mobility within the job market, in line with the recent *Proposal for a Council Recommendation on the validation of non-formal and informal learning* (European Commission, 2012e).

4. The economic and welfare cost of skill mismatch

It is unrealistic to assume that labour markets can ever operate without any temporary imbalances, but persistent skill mismatch implies real economic and social losses. In the long term any imbalances between labour demand and supply might be expected to be addressed through market force mechanisms such as changing wage premiums, geographical and/or job mobility, and the adjustment of firms' production technologies and training policies. For this reason it has been argued that skill mismatch, and particularly over-qualification, 'can only be a serious, long-run problem, if changes in the relative supplies of different types of education have little or no effect on the skill composition of labour demand, implying production technologies with fixed skill requirements. Production is not redesigned, jobs are not upgraded, and some workers end up in a job below their skill level...producing and earning the same as workers with less schooling in the same job' (Leuven and Oosterbeek, 2011, p.7). However, even though automatic adjustment mechanisms in the labour market play an important role, labour market mismatches may still persist or remain unresolved due to significant market failures[13].

Table 3 and the discussion below distinguish the economic and welfare cost of skill mismatch for the aggregate macroeconomy and society and also for enterprises and individuals.

4.1. Skill mismatch is costly for economies and societies

Imbalances between skill supply and demand across different territories and sectors may hinder a country's long-term growth prospects (Sianesi and van Reenen, 2003). At the macroeconomic level, skill mismatch is seen to increase equilibrium unemployment and reduces GDP growth via the loss of human capital and/or productivity-related skill bottlenecks (Manacorda

(13) Such market failures include the lagged nature of skill supply relative to demand; positive spillovers ('externalities') in human capital outcomes; disincentives to investment in training by enterprises and recruitment deficiencies; missing insurance markets for skills investment; intergenerational transmission of education and training.

Table 3: **Costs and consequences of skill mismatch**

	Individuals	Employers	Society
Direct costs	loss of earnings	higher recruitment costs	unemployment benefits
	higher turnover and absenteeism	lower productivity	public expenses for training and other ALMPs
		lower product quality	
		higher-skilled workers' wages	
		higher turnover costs	
Indirect, long-run and non-monetary costs	loss of skills/skill obsolescence	lower innovation capacity	under-investment in training
	loss of self-confidence	lower competitiveness	low-skills-bad jobs-low wages equilibrium
	lower levels of trust in government		higher equilibrium/structural unemployment
	lower job satisfaction		loss of potential output and employment
	lower participation in training		lower long-run growth

Source: Cedefop review of available literature on skill mismatch.

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and Petrongolo, 1998). Skill shortages in particular may be conducive to the perpetuation of a low-skills equilibrium in the labour market, particularly if firms react to the shortage of skills by investing in low-skill cost-cutting strategies (Finegold and Soskice, 1988; Haskel and Martin, 1996). Skill mismatch has also been identified as a potential explanation of higher wage dispersion and inequality among groups of workers with similar qualifications (Ingram and Neumann, 2006). For society as a whole skill mismatch entails a potential waste and misallocation of scarce public funds, particularly those spent on initial education and training. Society loses the output that could have been generated by reallocating genuinely mismatched workers to higher productivity jobs.

4.2. Skill mismatch can lower enterprise productivity

Skill gaps and shortages can lead to a loss of competitiveness and hamper enterprise productivity. Particularly in growing economic sectors, skill shortages can result in rising wage costs. Firms facing skill pressures might also be forced to employ or place lower-skilled workers in skilled positions, at a cost of lower productivity. For example, Haskel and Martin (1996) suggested that skill shortages reduced annual productivity growth in the UK by 0.4 percentage points over the period 1983-99, while Bennett and McGuinness (2009) reported that output per worker was lower in high-tech firms experiencing both hard-to-fill and unfilled vacancies.

Skill mismatch has been linked to a number of adverse outcomes related to productivity at the firm level, such as a higher level of absenteeism and turnover of the workforce (Tsang and Levin, 1985; Tsang, 1987; Sicherman, 1991; Robst, 1995; Sloane et al., 1999). Yet despite the negative effects of skill mismatch outlined above, the implications for firm productivity are somewhat ambiguous. Over-qualified workers are found to enjoy a wage premium relative to matched colleagues, suggesting that (in a competitive labour market) this might be a reward for their higher productivity within the firm. Over-qualified workers may also have beneficial (spillover) effects in the workplace, as their excess knowledge and skills may allow them to enrich not only their own jobs but also those of colleagues in ways that employers may not have anticipated (Battu et al., 2003). It has also been suggested that the recruitment of over-qualified workers sometimes constitutes a deliberate strategy on behalf of firms, as they exploit cyclical downturns to improve the average skills level of their workforce, and thereby ensure an uninterrupted supply of high skills in times of tight labour markets (Bulmahn and Krakel, 2002). Indeed, recent studies using firm-level data have shown that there is a positive relationship between the proportion of over-qualified/over-skilled workers within the workforce and the productivity of the firm (Jones et al., 2009; Kampelmann and Rycx, 2012). On the other hand, if these positive outcomes are outweighed by the lower productivity of mismatched workers due to de-motivation or higher quit rates, the under-utilisation of skills can result in an overall waste of talent and lower than potential rates of productivity growth.

4.3. Qualification mismatches entail economic and welfare costs for individuals

It is well-documented that those individuals possessing superior qualifications and skills in the labour market are recipients of greater economic returns, are better shielded from joblessness than the low-skilled, and are more likely to enjoy significant non-material benefits such as better health outcomes, life satisfaction and social capital (OECD, 2012). However, individuals suffering from qualification mismatch, particularly the over-qualified, are more likely to endure wage penalties, lower job satisfaction and higher turnover than individuals with similar qualifications who are well-matched. Over-qualification can be a manifestation of lower individual ability, one's own preferences or a firm's recruitment policies, but it can also result from a lack of availability of suitable jobs or family or other mobility constraints. It can be persistent as it sends a negative signal to future employers and/or induces skills obsolescence, thus increasing job insecurity and reducing the long-term employability of individuals concerned.

The over-qualified (e.g. tertiary graduates in non-graduate jobs) are typically found to suffer from an average wage penalty of 15 % relative to those with the same qualifications who are well-matched (e.g. tertiary graduates in graduate jobs),

ranging from -8% to -27% (Cedefop, 2010a). However, they are usually paid more than their matched colleagues in the same job (e.g. non-tertiary graduates in non-graduate jobs) despite the fact that both face similar working conditions. The reverse is observed for the under-qualified, who suffer from a pay penalty relative to their matched colleagues in the same job, but earn more than if they were properly matched to a lower-level job (McGuinness, 2006). Wage differentials are also found in the case of horizontal mismatch (Nordin et al., 2008; Kelly et al., 2008), and are accentuated if an individual's job is only partially or completely unrelated to the field of study (Robst, 2008).

The over-qualified are also typically found to be less satisfied with their jobs relative to matched workers with the same qualifications, as well as in relation to colleagues in the same job (Tsang et al., 1991; Battu et al., 2000; Verhaest and Omey, 2006). Moreover, their participation in on-the-job-training tends to be lower compared to well-matched, similarly-qualified workers (Büchel and Mertens, 2004), but the effect is positive in comparison to well-matched colleagues in the same job (Büchel and Battu, 2003).

Overall, the evidence suggests that the over-qualified work below their potential in their current jobs due to some form of productivity ceiling. Nonetheless, there is still some benefit to be enjoyed from the extra years of education (Rumberger, 1987), provided that the wage premium of over-qualified workers relative to their matched colleagues reflects a higher level of productivity and not 'sheepskin effects' (McGuinness, 2003)[14]. Similarly, there is scope for upskilling under-qualified workers, despite their generally favourable labour market situation, as their productivity is found to lag behind that of matched colleagues in the same job. The wage effects are usually found to vary depending on different individual and job characteristics, such as age, level of education (e.g. VET vs. general education), labour market experience and ethnicity (Battu et al., 1999; Dolton and Vignoles, 2000; Battu and Sloane, 2004).

(14) Sheepskin effects are defined as a situation where the initial pay of workers is determined solely on the basis of their educational certificate, which may turn out to be an imperfect signal of productivity.

4.4. Skill mismatch can be more costly than qualification mismatch

A key concern regarding the cost of educational mismatch is that the consequences of such mismatch have been mostly inferred from cross-sectional household datasets or from short time-series of graduate cohorts. It has been argued that qualification mismatches obtained on the basis of such data are partly a statistical artefact that may reflect any of the following three mechanisms:

- the sorting of individuals with the same academic credentials into jobs according to differences in their abilities or skills (Bauer, 2002; McGuinness, 2003);
- variation of their human capital across different fields of study (Wolbers, 2003);
- heterogeneity in task requirements within the same broad occupational or job title (OECD, 2011).

Over-qualification may therefore not be genuinely related to the under-utilisation of skills within jobs (i.e. ***over-skilling***), but may simply reflect the lower ability or preferences of individuals who appear to be mismatched.

In order to examine the above hypothesis, researchers have disaggregated the proportion of individuals who are over-qualified according to their level of job satisfaction or their concurrent under-utilisation of skills. In particular, Chevalier (2003) has distinguished between *apparently* and *genuinely overeducated graduates* in the UK based on their answers to questions on job satisfaction. Graduates in graduate jobs are defined as 'matched', whatever their level of satisfaction. Those individuals who are in non-graduate jobs but satisfied are described as 'apparently mismatched' (comprising of 10% of the sample) and those in non-graduate jobs who are also dissatisfied are classified as 'genuinely mismatched' (6% of the sample). Within the over-qualified group, the apparently over-qualified are found to have better capabilities than the genuinely over-qualified, a finding which is also consistent with Chevalier and Lindley's (2009) recent evidence that workers in the latter group lack graduate skills such as management and leadership.

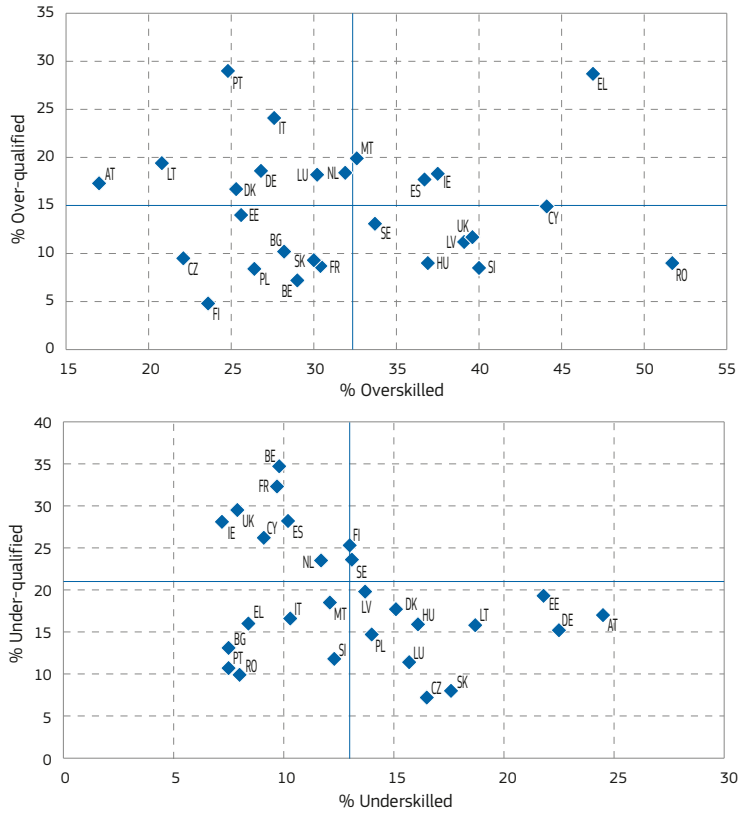
Allen and van der Velden (2001) and Green and Zhu (2010) have argued further that the 'true' cost of over-qualification hinges critically on whether it is accompanied by under-utilisation of skills and abilities, in which case it constitutes a *real mismatch* as opposed to a *formal mismatch*. Focusing on a cohort of young Dutch graduates, the former authors found that about 15% of their sample experienced skills under-utilisation, where their current job offered sufficient scope to use their acquired knowledge and skills. About half of the graduates also had skills deficits that were weakly related to their educational mismatch, as they believed that they would perform better in their current job if additional knowledge and skills had been acquired.

In terms of the impact of skill mismatch rather than qualification mismatch on labour market outcomes, a wage penalty of 26% for *genuinely over-qualified* graduates is found, in contrast to 7% among those who are *apparently over-qualified* (Chevalier, 2003). Allen and van der Velden (2001) and Cedefop (2010a) have showed that skill mismatches are much better predictors of job satisfaction than qualification mismatches, although the effect of over-qualification on wages is only slightly reduced when skill under-utilisation is also taken into account.

In a similar spirit, examination of the 2010 wave of the EWCS data reveals that about 35% of over-qualified workers in the EU-27 are also over-skilled, so that about a third of the overall incidence of over-qualification can be classified as *real skill mismatch*. Similarly, only about 11% of the individuals in the sample of under-qualified workers are simultaneously under-skilled. Less than a fifth (16-18%) of both over-qualified and under-qualified workers state that they are not very, or at all, satisfied with the working conditions in their main job. This implies a genuine skill mismatch that affects about 3% of all employees in the EU-27 area.

Plotting the average incidence of qualification and of skill mismatch at the country level reveals further that employees in some countries (e.g. Greece, Spain, Ireland, Cyprus, Malta) are more likely

Chart 12: Average qualification mismatch vs. skill mismatch, EU-27, % of employees, 2010



Source: EU-LFS; EWCS (2010).

Notes: The average incidence of qualification mismatch by country has been derived using 2010 EU-LFS data, while the mean rates of skill mismatch are derived from the 2010 wave of the EWCS dataset. The blue lines correspond to the mean levels of qualification or skill mismatch, respectively.

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to suffer from a double cost of mismatch (see Chart 12). In this group of countries not only is there a weak correspondence between the qualifications of employees and the demands of the job market, but a considerable proportion of the workforce also feels that their skills are under-utilised, presumably because of the poor quality of their jobs. Furthermore, there is a strong negative correlation between the incidence of under-qualification and of under-skilling in the data.

Cedefop (forthcoming[a]) confirms that the magnitude of many empirical estimates that have used qualifications as proxies of skills, and which are based on cross-sectional data, may be questionable. Using panel data methods that control for the unobserved heterogeneity of individuals among different educational categories, it is found that the adverse effects of over-qualification on some labour market outcomes are, in many instances, a statistical fallacy. Taken together, these results imply that the label of over-qualification partly masks unmeasured skills or ability traits of individuals, and/or other compensating factors (e.g. geographical barriers or preferences for specific job amenities). Far from implying inefficiencies in the labour market, this evidence suggests that it is functioning effectively in allocating workers to jobs that match their skills, abilities and preferences.

4.5. Skill mismatch can have lasting effects on welfare

The previous section highlights the importance for policymaking to focus on skills rather than qualification mismatch, given that the former affects a much broader proportion of the labour force than over-qualification, which is typically concentrated among tertiary graduates (Quintini, 2011). However, the cost of skill mismatch largely depends on the extent to which it is temporary or permanent. Several researchers have stressed the so-called *career mobility hypothesis*, according to which skill mismatch is a temporary phenomenon that gradually dissipates as workers' labour market prospects improve with age and experience or as a result of career or occupational mobility (Sicherman, 1991; Alba-Ramirez, 1993; Robst, 1995).

Nevertheless, using longitudinal data that enables individual work histories to be traced, Cedefop (forthcoming, [a]), Mavromaras and McGuiness (2012) and Mavromaras et al. (2012) find strong evidence of persistence in the mismatch of different types including those categorised as real (over-qualified and over-skilled) or genuine (over-qualified and

Table 4: Persistence of different types of skill mismatch among university degree holders, employed individuals, 2001-10

Mismatch status in previous 3 years	Over-skilled	Over-qualified	Real mismatch (Over-skilled & over-qualified)	Genuine mismatch (Over-qualified & dissatisfied)
Not mismatched in previous 3 years	0.05	0.03	0.006	0.01
Mismatched in the previous year, but not in previous two years	0.20	0.26	0.05	0.07
Mismatched in previous 2 years but not 3 years ago	0.34	0.54	0.14	0.16
Mismatched in previous 3 years	0.45	0.68	0.24	0.36

Source: Mavromaras et al. (2012) and Cedefop (forthcoming[a]).

Notes: The figures are predicted probabilities that an individual employee experiences a particular status of skill mismatch in the present period given several possible patterns of mismatch in the last three years. They follow from the estimation of a dynamic random effects probit model with the inclusion of Mundlak correction terms on a sample of employees from the Australian Household Income and Labour Dynamics (HILDA) survey.

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dissatisfied)[15]. Table 4 illustrates that the lagged mismatch status in previous years is invariably and strongly related to the probability of present mismatch. University degree holders who spent the last three years mismatched in terms of education have a quite high probability (0.68) of also being mismatched in the current year. This is in contrast to those who were never mismatched in the last three years, who are only 3% more likely to be mismatched in the present year.

Similar patterns are observed for those who are over-skilled, indicating that workers who have been mismatched for a long time are not very likely to escape from that situation. However, the probability of a current mismatch falls by about a half when focusing only on the portion of workers who suffer from real or genuine mismatch. This tends to confirm that workers who are the most likely to be harmed by mismatch will respond by doing whatever is necessary to quit their job. Nevertheless, even those workers who are affected by real mismatch have a significantly high probability (0.24-0.36) of remaining mismatched if they had been in that position in previous years.

5. Drivers and determinants of skill mismatch in Europe

5.1. Sectoral restructuring and job quality affect skill shortages

As shown in section 2.2 skill and labour shortages even when the labour market is slack are a common feature in European economies and tend to be more prevalent in certain regions and economic sectors.

Table 5 examines the effects of several characteristics of EU-27 firms on the probability that they will experience a shortage of either skilled or low-skilled/unskilled labour. It is evident that a significant contributing factor to the possibility of firms encountering skill shortages is the dynamic changes and restructuring that takes place over time within firms. Firms that increased in size in previous years, or which experienced changes in their remuneration system, organisation of work processes or working time arrangements, are found to be more likely to face skill or labour shortages.

Table 5: Determinants of skill shortages in European firms, 2009, EU-27
Probit regression, marginal effects of independent variables

Establishment characteristics	High-skill shortages (1)	Low-skill or unskilled shortages (2)
Private sector	0.072***	0.025**
Firm has temporary agency workers in last year	0.023*	0.037**
% of employees who worked overtime in last year	0.001***	0.000***
% of employees covered by collective wage agreement	-0.000	-0.000***
Employees regularly required to work on Sundays	0.037***	0.028***
Training: - Training offered for vocational adjustment of new employees	0.033**	0.014*
- Training offered to prepare employees for new tasks	0.034***	-0.005
- Training offered after long absence	-0.016	-0.012*
(reference: no training offered in last year)		
Major changes in past 3 years: - Remuneration system	0.049	0.016***
- Organisation of work processes	0.033***	0.017**
- Working time arrangements	0.020	0.018**
Rating of general work climate in firm: - Quite good	0.076***	0.013
- Somewhat strained	0.149***	-0.003
- Very strained	0.164***	0.012
(reference: very good)		
Sector: - Construction	0.012	0.018**
- Wholesale and retail trade	-0.074***	-0.006
- Hotels and restaurants	0.043	0.057*
- Transport	-0.087*	-0.032***
- Finance	-0.165***	-0.018
- Real estate	-0.022	-0.022**
- Public administration	-0.103***	-0.005
- Education	-0.042	0.006
- Health	0.068***	-0.010
- Other	-0.074***	0.021
(reference: manufacturing)		
Observations	16 543	16 411

Source: European Company Survey (2009); Cedefop's estimations.

Notes: (a) ***, **, *; statistically significant at 1%, 5% and 10%, respectively;

(b) Robust standard errors (not shown here but available upon request), adjusted for clustering of establishments within countries.

(c) The dependent variable is the probability that an establishment faces difficulties in finding staff for skilled (column 1) or low-skilled/unskilled jobs (column 2).

(d) Marginal effects at the variable mean for continuous variables and for discrete changes of categorical variables.

(e) Other control variables include country dummies, firm size (smaller-sized firms +effect on both high- and low-skill shortages); if the firm has employees with fixed-term contracts or freelancers (insignificant); if profit sharing scheme (insignificant); needs for further training periodically checked at irregular intervals (insignificant); subjective rating of labour productivity compared to firms in same sector (firms with below average productivity +effect on high-skill shortage); subjective rating of comparison of labour productivity to three years ago (considerable rise in productivity +effect on low-skill shortages).

[15] A number of studies from the UK, Germany, Belgium and Australia have also shown that over-qualification is likely to be persistent, that the wage and job satisfaction penalties suffered by over-qualified workers relative to those in matched jobs remain stable over time and that the over-qualified experience less upward mobility relative to those who are well-matched (Sloane et al., 1999; Dolton and Vignoles, 2000; Battu et al., 2000; Büchel and Mertens, 2004). Verhaest and van der Velden (2010) find important country differences in the persistence of over-qualification among university graduates.

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Box 4: Investigating skill needs and mismatches in European enterprises

The pilot *Employer survey on skills needs in Europe*, a project launched in 2009 by Cedefop with financial support from the European Commission, aims to investigate the current and future skill needs of enterprises in countries and sectors and within different occupations in Europe. The survey provides a unique view of the dynamics of the importance of tasks and the preparedness of the workforce for emerging tasks.

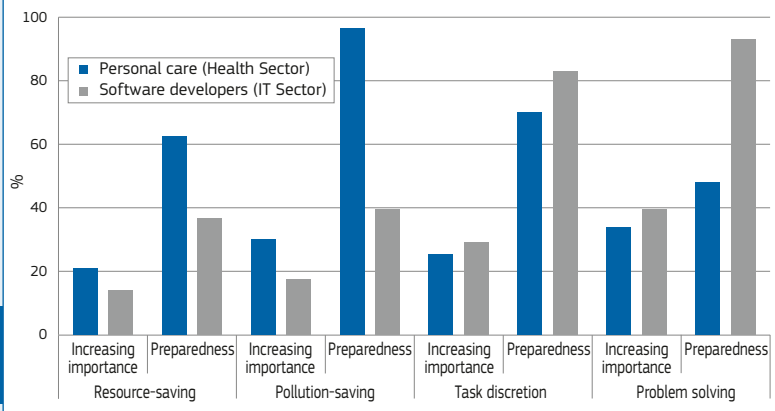
Questions on 17 generic tasks are asked, as well as on occupation-specific tasks. Further, a number of open-ended items on newly emerging tasks address future skills needs and possibly related training needs. Drivers of change questions explore differences among employers with respect to innovation and the adaptation of products, processes and services due to environmental awareness or standards/regulations. Further background questions look at establishments' review of skill and training needs, training establishments, hard-to-fill vacancies, as well as establishment size.

A pilot data collection took place in nine European countries (Czech Republic, Germany, Ireland, Spain, France, Italy, Hungary, Poland, Finland) in 2012. About 1 000 local establishments per country (IE 500) were surveyed. Chart B4 uses pilot survey results to provide an example of anticipated skill needs and mismatches (as given by the increase in importance and preparedness of the workforce) of selected generic tasks for two particular occupational groups of interest: Personal care workers in health services (in sector 86 Human health services), and software and applications developers and analysts (in Sector 62 IT and other information services).

Green skills are found to be more important for personal care workers and their importance is increasing at a faster pace when compared to software developers (in the IT sector). A reverse pattern is observed for 'problem solving' and 'task discretion'. For software developers, the percentage of employers reporting that the workforce is prepared for the increasingly important tasks of 'task discretion' is 83 %, as opposed to below 40 % for 'resource saving' and 'limiting pollution'. So it appears that there are skills gaps in green skills among software developers, while personal care workers are not well prepared for the increasingly important task of problem solving.

The project has received financial support from the European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities.

Chart B4: Percentage of establishments reporting that selected tasks are increasing in importance and preparedness of the workforce, two occupations from two different sectors



Source: Cedefop pilot Employer survey (2011).

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The sectoral dimension of skill shortages is also very important. Firms operating in the health and social care sector are more likely to experience shortages of skilled workers relative to firms in the manufacturing sector once other differences in the characteristics of firms in the two different industries are taken into account. On average firms that operate in the finance, wholesale and retail trade and in the public administration industries in the EU-27 have a lower probability of facing a high-skill bottleneck. Firms in the hotels and restaurants sector, on the other hand, have a 6 % greater likelihood of facing a shortage of low-skilled or unskilled workers than manufacturing establishments, as is also the case for construction firms.

The significant impact of collective wage bargaining in mitigating the chances of firms facing low-skill shortages is also evident. By setting a lower threshold of pay and by widening the coverage of compensation particularly of lower-paid jobs, the chances that companies will face a shortage of labour in low-skilled or unskilled positions decrease[16]. Inferior working conditions (working on Sundays, shifts, overtime) are also conducive to difficulties in hiring low-skilled staff. This supports the argument that low wages and poor job quality lie behind the labour shortages that employers face in particular sectors.

Firms with a strained or difficult working climate are found to be 16 % more likely to face shortages of skilled workers. Private sector firms and those that rely more heavily on temporary agency workers are also faced more often with difficulties in finding suitably skilled staff. Furthermore, the coefficients on some of the variables in Table 5 are indicative of the optimal responses that some firms adopt as a means of avoiding or tackling the incidence of skill shortages. For instance, those affected by high-skill shortages are more likely to use the option of overtime work to overcome production constraints, to offer various job amenities (e.g. time flexibility, employee representation) and to utilise performance-related pay as a sorting device that will attract skilled workers

(16) This significant effect arises particularly when the collective wage agreement is negotiated at a higher level than the company (not shown in the estimates of Table 5).

to the company. The important role of continuing training is also apparent, since firms that face skill shortages are more likely to engage in appropriate vocational training measures.

Finally, a positive association is found between firms that face a negative economic situation and the likelihood of high-skill shortages. It is plausible that this finding reflects a self-reinforcing cycle; on the one hand firms with bad economic performance are more likely to have difficulties in attracting skilled workers. On the other hand, the lack of a suitably skilled workforce is also more likely to contribute to an inferior overall economic outlook for the firm.

5.2. Different demographic and socioeconomic factors explain vertical mismatch

A number of demographic and socioeconomic characteristics have been identified as potential determinants of the likelihood of vertical mismatch, with age, gender, marital status, ethnicity, work experience, type of contract, economic sector and occupation all having been found to be significantly correlated with qualification mismatch. However, their impact tends to vary depending on the type of vertical mismatch, the country examined, and the particular sample of interest.

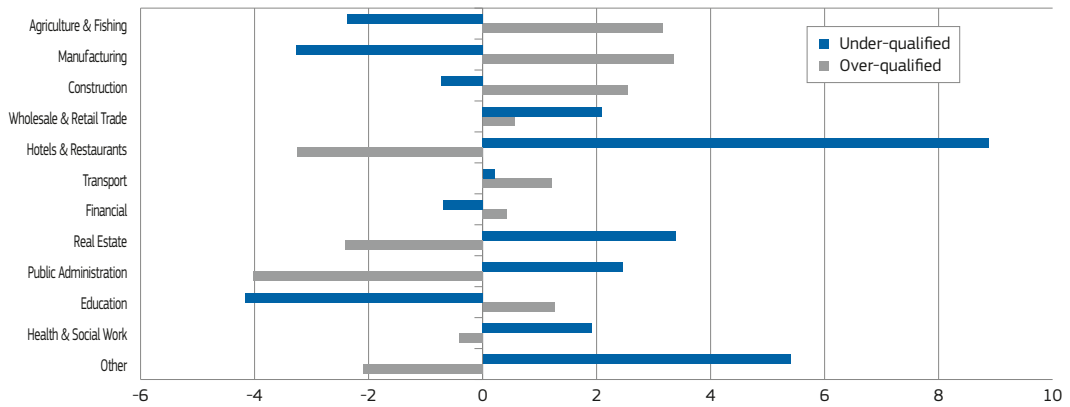
Chart 13 illustrates that there are differences in the incidence of vertical mismatch between sectors and that important sectoral changes in mismatch took place over time. Overall, non-marketed services (public administration, education, health and social work) are found to have a lower average rate of over-qualification relative to other sectors in the economy. In these industries and in the real estate and hotels and restaurants sectors there was a decrease in over-qualification during the period 2001-08. A positive trend is observed instead in the sectors of agriculture and fishing, construction and manufacturing. In these industries their approximately 2-3 % rise in mismatch over the previous decade can be explained mainly by upper secondary graduates taking up jobs requiring lower secondary diplomas but also because of university graduates increasingly accepting jobs that would typically need graduates at upper or lower secondary level.

Similarly, marked changes over time in the incidence of under-qualification can be observed across the sectors, with a notable fall in education and manufacturing and significant increases in the hotels and restaurants, real estate, public administration and 'other' sectors. However, the underlying reason for the increase in under-qualification in these latter sectors differs. Whereas in hotels and restaurants the increasing rate is mostly driven by a growing share of lower secondary graduates taking up jobs requiring upper secondary diplomas, in the real estate industry the rise is mostly underpinned by a greater proportion of upper secondary graduates finding jobs that would normally require a university degree.

Chart 14 illustrates how the incidence of vertical mismatch varies across occupational groups (also see Annex 5 for a detailed breakdown at the two-digit occupational level). The incidence of over-qualification is higher among technicians and associate professionals, clerks and elementary occupations (though in this latter group the over-qualification rate dropped considerably over time). A sizeable 23 % of managers of small enterprises are also over-qualified. Over the past decade, and particularly during the years of the economic recession, there has been an increase in the share of over-qualified workers in skilled non-manual occupations (technicians and associate professionals and clerks), which is indicative of the unfolding of the crowding out effect.

With around 43 % of those employed in legislative, senior official or managerial positions not having a tertiary education qualification, a significant rate of under-qualification (38 %) is observed given that, in this broad occupational group, the educational requirement tends to be a university diploma or above. High rates of under-qualification are also evident in skilled agriculture and fishery and elementary occupations, while it was only in these latter occupations that the incidence of under-qualification has risen during the past decade. This is consistent with the robust growth in employment that took place at the lower end of the occupational spectrum during the last decade in Europe, as it encouraged an increasing share of lower secondary graduates finding jobs that require upper secondary degrees (see Annex 3). During the years of the crisis, the incidence of under-qualification fell mostly in high-skill and skilled non-manual occupations.

Chart 13: Change (%) in incidence of vertical mismatch by economic sector, 2001-08, EU-25



Source: Cedefop, based on EU-LFS data (data for MT and DE not available).

Notes: Data up to the year 2008 are displayed as this is the last year before the change in the official definition of the industrial classification (from NACE Rev. 1.1 to NACE Rev. 2). Appropriate weights used (COEFF).

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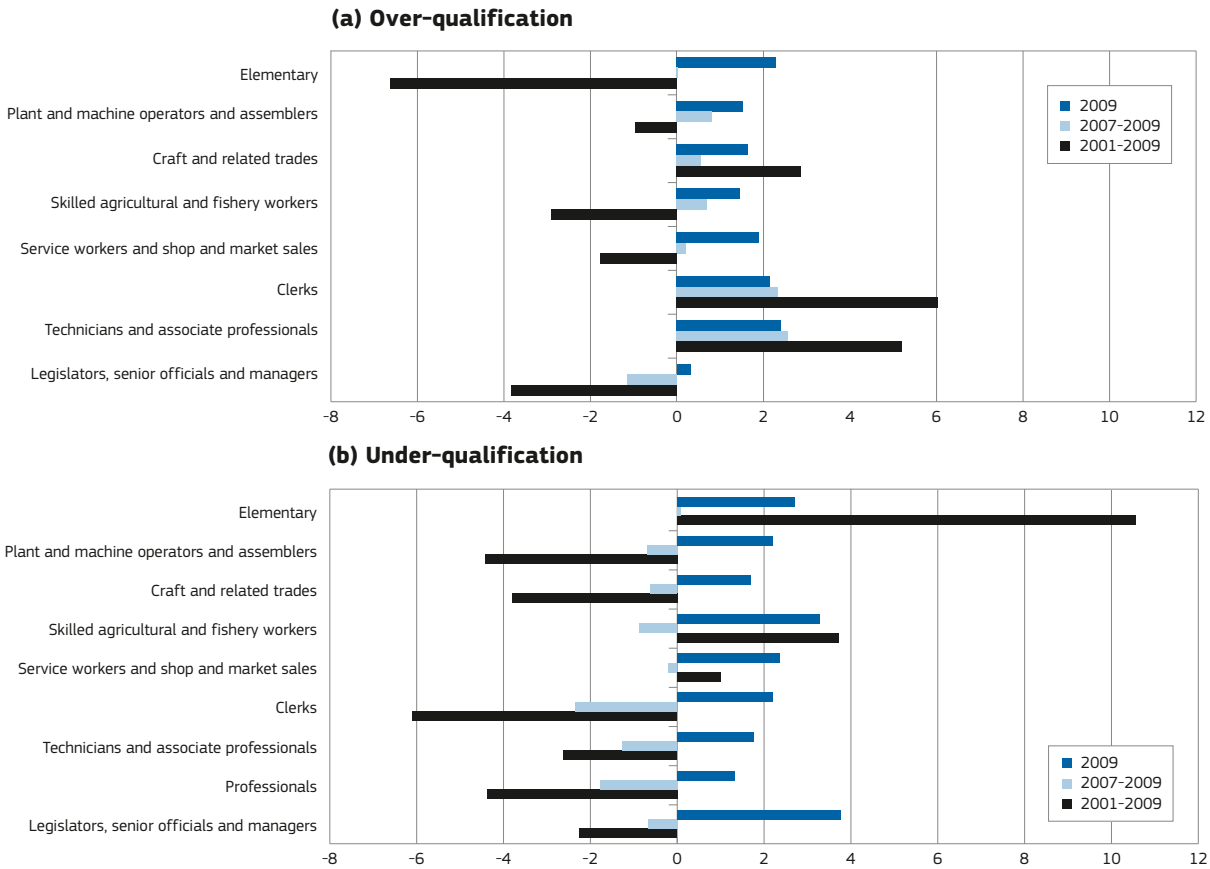
Chart 14: Incidence and change (%) in vertical mismatch by occupation, 2001-09, EU-25



Source: Cedefop, based on EU-LFS data (data for MT and DE not available).

Notes: The bars for 2009 depict the average incidence of mismatch per occupation (for illustration purposes the figures have been divided by 10 e.g. the average over-qualification for technicians and associate professional is 24%, shown in the graph as 2.4). Appropriate weights used (COEFF).

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Box 5: Empirical methodology of a micro-econometric model of vertical mismatch

Probit regressions are estimated to identify the determinants of the probability that an individual employee is affected by a particular type of vertical mismatch (a binary outcome e.g. the individual is either mismatched or not). The probability of an individual being either over- or under-qualified is modelled on the basis of a latent variable model, where it is assumed that an individual's unobserved propensity to be in a particular state of qualification mismatch is determined by the equation:

$$m_{it}^* = \beta_0 + \mathbf{x}_{it}\boldsymbol{\beta} + T_t + C_i + u_{it},\ m = 1[m^* > 0]\ (1)$$

where m, individual i's mismatch status in time period t, takes the value one if $m^* > 0$ and zero if $m^* \leq 0$. $\mathbf{x}$ is a vector of explanatory variables, including demographic, socioeconomic and job-related characteristics of the respondents, while u, the disturbance term, is assumed to follow a normal distribution and to be independent of $\mathbf{x}$. The estimated parameters, β, denote the effect of each explanatory variable on the probability of a positive response i.e. P(m = 1/$\mathbf{x}$). In all regressions, country- and time-specific conditions (e.g. differences in labour market institutions and the business cycle) are taken into account via the inclusion in the empirical specification of country (C) and time (T) dummies. The reported marginal effects *mfx* can be interpreted in the following way: an increase in variable x_1 by one unit (similarly, if x_1 is a dummy/indicator variable, then if x_1 changes from 0 to 1) leads to an increase of *mfx* units of the outcome variable. So the values of the estimated coefficients in Table 6 can be interpreted as the change in the probability of an individual being vertically mismatched in relation to a particular characteristic (e.g. gender).

To identify the impact of observable individual and job-related factors on vertical mismatch (either over- or under-qualification), estimates have been obtained from an econometric model using European Labour Force Survey (EU-LFS) micro data for a sample of 25 EU countries spanning six years (2003-08) (Box 5). Table 6 illustrates the marginal effects of these variables.

On average, male employees are found to be slightly more likely to be over-qualified relative to females in Europe, though this effect is statistically weak and there is a significant degree of underlying country heterogeneity[17]. The chances of over-qualification are also lower for married individuals. As predicted by the career mobility and search hypotheses, the incidence of over-qualification is significantly lower among older age groups, as well as for employees who have longer job tenure. No significant association is found between non-standard employment contracts and over-qualification, which may be due to the various factors affecting the individual choice of part-time and/or temporary contracts. Further analysis of the data reveals that, relative to full-time/permanent employees, the propensity for over-qualification is significantly greater for those workers who voluntarily take up atypical contracts (e.g. because of training in an apprenticeship or internship, own illness, child-care and/or other family or personal reasons).

Over-qualification is also found to be significantly higher in larger-sized firms, while the important differences in mismatch between sectors, even after keeping constant a host of important demographic and socioeconomic determinants, are confirmed. Specifically, individuals who are employed in the financial services, real estate and public administration sectors are more likely to be over-qualified relative to those employed in the mining, manufacturing and electricity sector. The reverse is true for employees working in agriculture and fishing, and less so for the wholesale and retail and hotels and restaurants sectors.

Consistent with the rising pattern displayed in Chart 8 and Annex 3, the empirical evidence also confirms that there was a statistically significant increase in the likelihood of severe over-qualification taking place within the EU in the years preceding the economic crisis.

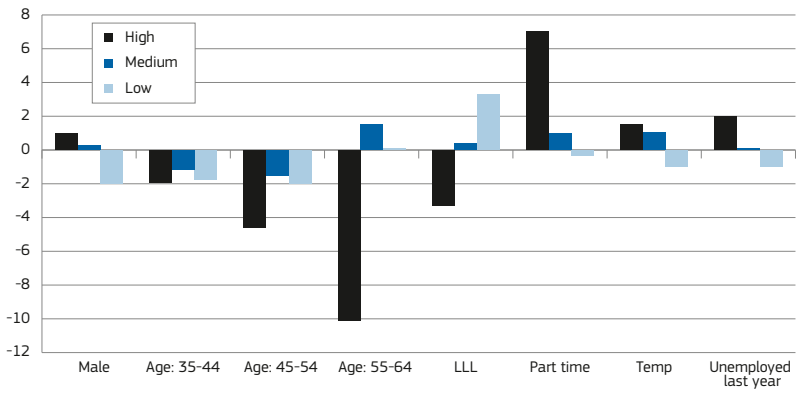
In contrast to the positive effect of age on over-qualification, column (2) of Table 6 shows that under-qualification is more likely to be observed among older age groups, possibly because workers who are under-qualified for their jobs compensate for this mismatch with additional years of work experience and the skills acquired during their working life. It may also be a reflection of rising educational requirements in certain occupations such that workers of older cohorts may now appear to be under-qualified for these jobs. Important sectoral differences are again detected, with employees in the manufacturing sector more likely to be under-qualified than those in transport, financial services, real estate, public administration and education.

A notable difference between the correlates of over- and under-qualification is that while there is a positive relation between over-qualification and participation in lifelong learning, there is a negative relation with respect to under-qualification. Indeed, the inverse relation of under-qualification and lifelong learning participation may reflect the superior job experience and work-based skills of under-qualified workers. However, to the extent that under-qualified employees are found to be generally less productive than their matched colleagues in the same job (McGuinness, 2006), their lower likelihood of participation in lifelong learning can be seen as an issue of concern.

5.3. Over-qualification is a reflection of segmented labour markets

The estimated effects shown in Table 6 conceal important country differences concerning the impact of the explanatory variables on qualification mismatch. Chart 15 displays the effect of the most important factors on the likelihood of over-qualification across three aggregated clusters of countries (characterised by high, medium and low mismatch). These clusters have been defined on the

Chart 15: Probability of over-qualification by cluster of countries, EU-25, 2003-08



Source: Cedefop, based on EU-LFS data (data for MT and DE not available).

Notes: The reported probabilities represent marginal effects of each explanatory variable on the status of over-qualification (obtained via probit regressions). The reported effects are the median of the individual country-specific effects of the countries belonging to each cluster, as obtained via separate country regressions. The effects of Age are relative to the reference category (25-34). The estimates for those Unemployed last year (but employed in the current year) have been obtained from a sample of new job finders only (i.e. those with less than 1 year of tenure), so that the reference category is individuals who were employed but changed job in the preceding year.

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(17) The overall empirical evidence on the differences in qualification mismatch by gender has been mixed (Quintini, 2011). Theoretically, it has been argued that women face a greater chance of mismatch than men since they tend to be 'tied movers or stayers', they regularly experience intermittent labour-force participation because of child-breeding/rearing, they tend to choose fields of studies that are more loosely tied to the job market and because of historical reasons related to discrimination which might have affected female perceptions regarding the extent of feeling under-skilled for a job. The gender gap in the probability of qualification mismatch varies markedly across EU Member States too. According to a country-specific empirical analysis of the EU-LFS data (Box 5), males in AT, CZ, DK, ES, EL, IT, LU, NL, PT, RO, SE and SK are found to have a greater chance of over-qualification than women, whereas the opposite holds in BE, BG, CY, EE, FI, FR, HU, IE, LV, PL and SI. Similarly, a positive chance of under-qualification is detected for males in BE, CY, DK, FR, EL, IE, IT, LV and SE, in contrast to those in AT, BG, CZ, EE, ES, FI, HU, LT, PL, RO, SI, SK and UK. In some countries there is a statistically insignificant difference in the chance of vertical mismatch by gender.

Table 6: Determinants of vertical mismatch, employees (aged 25-64), EU-25, 2003-08
Probit regression, marginal effects of independent variables

	Over-qualification	Under-qualification	Severe Over-qualification	Severe Under-qualification
Explanatory variables	(1)	(2)	(3)	(4)
Male	0.010*	-0.013	0.006*	0.005
Age group: - 35-44	-0.020***	0.049***	-0.009***	0.008**
- 45-54	-0.026***	0.138***	-0.013***	0.031***
- 55-64	-0.023***	0.212***	-0.008***	0.083***
(reference: 25-34)				
Married	-0.006***	-0.007	-0.004***	0.001
Tenure	-0.002***	-0.003***	-0.002***	-0.000
Participation in LLL	0.023***	-0.050***	0.014***	-0.003
Part time	-0.007	0.000	-0.005	0.001
Temporary contract	0.005	0.026***	0.003	0.003
Ln (hours)	0.000	-0.010	-0.001	-0.003
Firm size: - 11-49	-0.001	0.002	0.000	0.002
- 50+	0.010**	-0.008	0.007**	-0.003
(reference: 0-10)				
Industry: - Agriculture & fishing	-0.017***	0.018	-0.004	-0.009**
- Construction	-0.014*	0.004	-0.005	0.004
- Wholesale & retail trade	-0.009*	-0.013	-0.007***	0.005
- Hotels & restaurants	-0.007*	0.021	-0.004	0.022**
- Transport, storage & communications	0.005	-0.038**	0.001	-0.002
- Financial intermediation	0.033***	-0.087***	0.027***	-0.003
- Real estate, renting and business	0.016***	-0.030**	0.010***	-0.000
- Public administration	0.023***	-0.058***	0.018***	-0.006
- Education	0.008	-0.078**	0.009	-0.004
- Health & social work	-0.011	-0.009	-0.007	0.006
- Other community activities	0.010	-0.014	0.014***	0.008
(reference: Mining, manufacturing & electricity)				
Observations	4 416 480	3 697 764	4 416 480	3 697 764
Pseudo R^2	0.15	0.20	0.16	0.44

Source: Cedefop, based on EU-LFS data (data for MT and DE not available).

Notes: (a) ***, **, *; statistically significant at 1%, 5% and 10%, respectively;

(b) Robust standard errors (not shown in table, but available upon request), adjusted for clustering of individuals within countries.

(c) The dependent variable is the probability that an employee faces a particular type of skill mismatch. The omitted category is well-matched individuals. Columns (1) and (3) exclude under-qualified workers; columns (2) and (4) exclude the over-qualified and those with tertiary education attainment (who cannot be under-qualified).

(d) Marginal effects calculated at the variable mean for continuous variables and for discrete changes of categorical variables.

(e) Other control variables not reported here include 25 country dummies, 6 time dummies, 8 1-digit occupational dummies (managers and professionals are aggregated together as the reference category), a quadratic tenure term (insignificant) and if the individual holds an additional/second job (positively related with severe over-qualification).

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Box 6: Empirical methodology of macro-economic panel model of vertical mismatch

A fixed effects panel econometric technique is employed to relate the deviation of each country's over-qualification rate from its average mismatch throughout the years (i.e. the dependent variable = [$\dot{OQ} = OQ_{ct} - \overline{OQ}_c$]) to the within-country variation observed in several explanatory variables ([$\dot{x}_{ct} = x_{ct} - \overline{x}_c$]). A parsimonious set of explanatory variables is chosen to reflect the interplay between market forces (labour demand and supply of different skill types), labour market regulations (e.g. percentage of GDP invested in labour market programmes, strictness of employment protection legislation) and attitudes towards skills within countries (e.g. whether attracting and retaining talent is a priority in companies). Their independent effect on the incidence of over-qualification is estimated taking into account the different levels and rates of economic growth between the countries and after holding constant any unobserved time-invariant factors within countries (e.g. infrastructure) and other macro-economic shocks that have commonly affected EU countries over time. Specifically, the following equation has been estimated:

$$OQ_{ct} = \beta_0 + \mathbf{x}_{ct}\boldsymbol{\beta} + T_t + \varepsilon_c + u_{ct} \quad (2)$$

where *OQ*, the average rate of over-qualification of country *c* in time period *t*, is explained by a vector **x** of explanatory variables, while u_{ct} is assumed to be a random error term. The specification also allows for a number of country-specific, time-invariant unobserved factors to be taken into account, in the form of the error term ε_c in equation (2). The estimated parameters, β, capture the impact of an increase in each explanatory variable on the average incidence of over-qualification, holding constant any country-specific fixed effects and other observed determinants. In the regressions, time dummies are included to account for aggregate time effects.

basis of the countries' over-qualification rates. The high-mismatch group (which exhibits over-qualification rates of over 20%) mostly includes the countries of the Southern Mediterranean basin. The low-mismatch group (with over-qualification rates between 7 and 11%) include countries from Eastern and Central Europe. The medium-mismatch group (characterised by over-qualification rates between 12 and 18%) is mostly made up of Western and Northern European Member States[18].

Based on this classification, important differences exist between the country clusters with respect to the estimated effect of the explanatory variables on over-qualification. In high-mismatch countries, the chance of over-qualification is higher for males and for employees on part-time/temporary contracts than it is in the medium- and low-mismatch clusters. The likelihood of over-qualification is also markedly greater for younger age groups and for new job-finders (those with less than 1 year of job tenure) who were unemployed in the previous year. Furthermore, while over-qualified workers are positively inclined to invest in lifelong learning in medium- and low-mismatch countries, the relationship is negative in the high-mismatch group.

These patterns suggest that a significant part of the qualification mismatch observed in specific countries may be attributable to the segmented nature of their labour markets (European Commission, 2010b). In the high-mismatch countries, for example, young male workers, particularly those who are unemployed, appear to be inclined to take up part-time and/or temporary jobs which demand lower qualifications than the ones they possess. In these labour markets, workers taking up lower-level jobs are also less likely to invest in lifelong learning. This is again an issue of concern as adult learning can potentially lead to a closer alignment of a worker's skills with job demands as well as foster job and occupational mobility.

5.4. Lowering over-qualification depends on high-skilled job creation

Differences in the macro-economic environment, nature of labour market institutions and regulations across the Member States are not taken into account in the above analysis, but they may help explain the different patterns of vertical mismatch. Furthermore, it is not possible on the basis of the pooled cross-sectional estimates reported in Table 6 to draw robust conclusions regarding the causal relations between the various determinants and the incidence of vertical mismatch.

To address the above issues, a longitudinal econometric analysis is undertaken in order to explain the average incidence of vertical mismatch in European countries (see Box 6)[19]. A macro-economic panel database was compiled by aggregating the EU-LFS micro data to summarise time series information of the average rate of vertical mismatch per country over the nine years 2001-09. Important macro-economic variables, labour market institutions and regulatory factors were also incorporated into the database. Moreover, in order to capture elements of each country's infrastructure and attitudes towards skills, subjective indicators of the availability of skills within their labour markets and of their orientation towards skills development and utilisation were also taken into account (see Box 7)[20].

As indicated by the coefficients of the explanatory variables in Table 7, economies with increasing levels of GDP and those which exhibited robust demand for high-skilled labour (as shown by an increasing share of employment of tertiary education graduates within a country over time) have experienced falling rates of over-qualification. In fact an increase of 1% in the share of employment of high-skilled individuals within a country has led to a fall in the average over-qualification

(18) The country clusters are defined as follows: High over-qualification cluster = (EL, IT, PT, CY, LT, IE, ES); Medium = (AT, BE, DK, EE, FR, LU, LV, NL, SE, UK); Low = (BG, CZ, HU, PL, RO, SI, SK). FI is not included in the low mismatch cluster as it is an outlier relative to the remaining Eastern/Central European countries in the group.

(19) Although the analysis has also been done for under-qualification, the output for over-qualification only is presented in this section due to space limitations but also because of the seemingly larger cost of the latter type of vertical mismatch for individual and societal welfare. Nine years of data (2001-09) are used for the analysis.

(20) These indicators are obtained from the IMD World Competitiveness Yearbook (http://www.imd.org/research/publications/wcy/index.cfm), and are based on the subjective opinions of a panel of 5 000 executives, who comprise a representative cross-section of the business community in each country analysed. No information is available for LV and CY, so the analysis in this section has been constrained to 23 EU countries.

Table 7: Relationship of macroeconomic indicators with incidence of over-qualification, EU-23, 2001-09

Explanatory variables	Fixed effects: Simple	Fixed effects: Augmented
	(1)	(2)
Economic level and growth		
GDP (PPP) per capita (000s)	-0.162**	-0.144**
Real GDP growth (% change p.a.)	0.182***	0.174***
Labour/skill supply		
Share of high-educated (ISCED 5-6) labour (% of active workforce)	0.093	0.309
Share of medium-educated (ISCED 3-4) labour (% of active workforce)	-0.174	-0.284
Labour/skill demand		
Share of employment of medium-educated (ISCED 3-4) graduates (% of all employees)	-0.181	-0.204
Share of employment of high-educated (ISCED 5-6) graduates (% of all employees)	-0.454**	-0.819***
Dynamics of labour market		
Job mobility (% of employees < 1 year of job tenure)		0.116*
Youth unemployment rate		0.087**
Attitudes and labour regulations affecting skill supply/demand		
Index: Labour regulations		-0.431**
Attractive and retaining talents is a priority in companies		-0.686***
Constant	44.254***	53.498***
Observations	206	206
R^2 within	0.230	0.322
R^2 between	0.174	0.175
R^2 overall	0.175	0.177
corr(u_i, Xb)	-0.3901	-0.6193

Source: Cedefop, based on EU-LFS, Eurostat, OECD and IMD World Competitiveness yearbook data.

Notes: (a) ***, **, *; statistically significant at 1%, 5% and 10%, respectively; standard errors available upon request.

(b) The dependent variable is the average proportion of over-qualified employees as a share of all employees.

(c) Estimates of fixed effects (within-country) regressions. Cronbach's alpha measure is used to generate an index from a subset of subjective variables obtained from the World Competitiveness yearbook describing the state of labour regulations within countries as follows: (i) Labour regulations (hiring, firing, minimum wages, etc.) do not hinder business activities; (ii) Unemployment legislation provides an incentive to look for work; (iii) Immigration laws do not prevent your company from employing foreign labour. 9 time dummies are also included (coefficients indicate a significant positive trend of qualification mismatch over time).

(d) Countries not included: DE, MT, LV and CY.

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rate of between 0.5 and 0.8 percentage points, a sizeable effect. In contrast, there is no evidence that an increasing supply of higher-educated labour is associated with greater vertical mismatch, provided that this greater supply is also met by a corresponding demand in the form of high-skilled jobs.

The rate of over-qualification is also found to rise in response to increasing rates of youth unemployment. This is indicative of the greater pressure exerted on individuals' job search efforts during an economic downturn, leading them to accept jobs with lower educational requirements relative to their own qualifications. Job creation of high-skill jobs (i.e. stimulating the growth in demand) therefore seems to be the most relevant response to mitigating the prevalence of over-qualification within EU economies. This is an important finding in view of the high current rates of youth unemployment experienced in Europe and the growth in the supply of high-skilled labour that is anticipated to take place in most Member States in the next decade (in line with the Europe 2020 education targets).

However, the positive impact on over-qualification of increasing real GDP growth rates and of increased job mobility (defined as the percentage of employees with less than one year's employment in the same job), as shown by the coefficients of the respective variables in Table 7, underlines that, in dynamic labour markets, a certain degree of qualification mismatch may occur because of restructuring and turmoil within the job market. In this case, higher rates of job creation and job destruction facilitate greater churning and labour turnover. At the same time, while a flexible and dynamic labour market is important in enabling an efficient allocation of productive human capital, excessive job mobility can be conducive to qualification mismatch if it is associated with non-stable and short-term employment relationships.

Finally, the empirical evidence highlights the influential role that labour regulations and talent management can play in terms of moderating the incidence of over-qualification in European labour markets. Countries where employment protection regulations do not hinder business activities, and those that have instituted greater incentives to nurture the supply and utilisation of skills and talent (including the supply of foreign labour), are found to have lower rates of over-qualification over time.

5.5. Challenging jobs are needed to mitigate skill mismatch

As highlighted by the OECD (2011), a potential explanation for the weak

Box 7: Explaining differences in mismatch status between countries using economic indicators

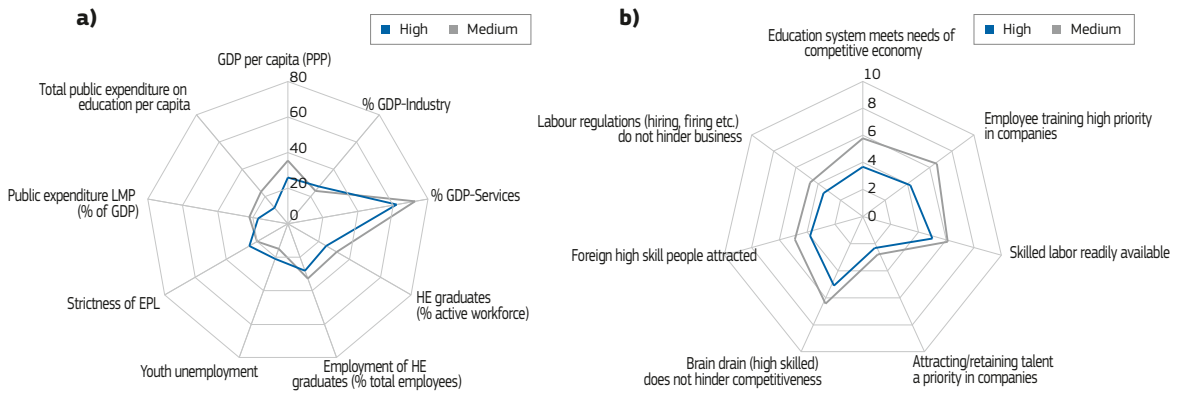
A number of factors describing the macro-economic and institutional conditions of countries may potentially account for the differences in the incidence of vertical mismatch between EU Member States. However, drawing comparisons across a diverse set of countries on the basis of indicators of macro-economic, labour market and skills performance is potentially misleading. The level of qualification/skill mismatch within an economy is likely to be highly influenced by the differential degree of economic development between economies, as well as by their long-term education and training infrastructure and their regulatory structure.

With this caveat in mind, Charts B7(a) and B7(b) compare the performance of the high- and the medium-mismatch clusters of countries, as defined in section 5.3, on the basis of selected economic indicators. Contrasting these two similar groups of countries in terms of historical stages of economic advancement and common exposure to market and regulatory forces, allows for more reliable inferences to be drawn regarding the relation between the selected indicators and observed country differences in vertical mismatch. The low-mismatch group is instead omitted from this particular analysis, as it is populated by Eastern/Central European countries that have faced markedly different trajectories of economic growth in the past decade.

From the spider diagrams below it is evident that countries with high levels of over-qualification tend to be less wealthy, whilst a greater exposure of the economy to the services sector does not necessarily imply higher levels of vertical mismatch. An important observation is that a greater supply of higher education (HE) graduates in the economy is also not necessarily conducive to higher mismatch, provided that this greater supply is also met by a corresponding demand in the form of graduate employment and available high-skilled jobs. The higher levels of youth unemployment consistently encountered by the high-mismatch group of countries during the last decade may also be a factor accounting for their greater mismatch, given that in slack labour markets many young graduates are forced into over-qualification (Randstat, 2012). Moreover, the high-mismatch countries are found to have lower expenditure in labour market programmes and more rigid labour markets (as approximated by the strictness of employment protection legislation, but also by a subjective assessment of the negative impact of labour regulations on business activities). Their lower levels of public investment in education and training might also hinder the quality and ability of their education systems to respond to the ever-changing needs of economies and societies. Indeed, business executives in the high-mismatch countries believe that the educational systems of their countries are failing to adequately meet the needs of a competitive economy.

As with the greater supply of HE graduates, a greater availability of skilled labour in the job market is not necessarily correlated with higher mismatch. Instead, countries which are more geared towards the attraction and retention of skilled individuals (including the attraction of foreign high-skilled labour) are likely to benefit from lower over-qualification rates. Finally, the countries in which a brain-drain of their well-educated and high-skilled workforce hinders competitiveness are more likely to exhibit higher rates of over-qualification. This correlation potentially reflects the lower rate of creation of innovative and high-skilled jobs within the economies that experience a flight of their brightest minds, which can subsequently foster their regression to a low skill-low productivity equilibrium.

Chart B7: Comparison of economic (a) and skills (b) indicators between clusters of countries with high vs. medium over-qualification rates, mean value of indicators within each cluster (2001-09)



Source: Cedefop, based on Eurostat, OECD and IMD World Competitiveness yearbook data.

Notes: High over-qualification cluster = (EL, IT, PT, CY, LT, IE, ES); Medium = (AT, BE, DK, EE, FR, LU, LV, NL, SE, UK).

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relationship between qualification and skill mismatch is the variation in job tasks that are required within occupations. Individuals who take up jobs that demand a lower qualification than the one they possess may still hold challenging and skill-intensive jobs, which may use a significant part of their skill set and yield job satisfaction. Though no such information is available in the EU-LFS, the EWCS dataset contains a wealth of job-related variables pertaining to the tasks performed by workers in their jobs.

Table 8 presents the empirical estimates of the impact of several important characteristics of the job, such as the nature of working conditions, the extent of job discretion and complexity, the degree of job latitude and job training and the extent to which this is likely to affect the likelihood of an individual facing qualification or skill mismatch.

The important role of task heterogeneity for both educational and skill mismatch, even after taking account of differences between individuals in their occupational groups, is clearly shown. Over-qualified workers are found to be more likely to work in jobs with better working conditions, complex tasks, frequent demand for IT skills, and offering greater ability to apply one's own ideas and to learn new things. Under-qualified workers are, instead, less likely to be in task-challenging jobs, which may also be related to their lower propensity to participate in training. Furthermore, over-skilled workers are found to be in less demanding jobs, in contrast to those who are under-skilled – all of which is reasonable enough given that the skill mismatch of individuals is based on the subjective opinion of individuals regarding the correspondence between their skills and the requirements of their jobs.

6. Skill mismatch among specific population groups

6.1. Young individuals: difficult integration into the job market

Many EU economies, particularly those with segmented labour markets, experience difficulties in successfully integrating young people into the labour market, not only in terms of getting them out of unemployment but also in terms of matching their qualifications and skills with suitable jobs. There is extensive evidence indicating that younger workers, as new entrants into the labour market, tend to experience a higher degree of skill mismatch. Typically, younger employees are more likely to be formally over-qualified (as shown in Table 6), yet their skills are less likely to be matched to their jobs

Table 8: Determinants of skill mismatch among employees (aged 25-64), 2010, EU-27
Probit regression, marginal effects of independent variables

Explanatory variables	Over-qualified (1)	Under-qualified (2)	Over-skilled (3)	Under-skilled (4)
Over-skilled	0.033***	-0.024		
Under-skilled	0.020	-0.014		
Over-qualified			0.035**	0.043***
Under-qualified			-0.028	-0.001
Male	0.024*	0.014	0.024***	-0.001
Tenure	-0.007***	0.000	-0.002	-0.006***
Training paid by employer	0.019*	-0.023	-0.001	0.101***
Training paid by self	-0.003	-0.035*	0.100***	0.123***
On the job training	0.002	-0.020**	-0.033**	0.042***
Substantial restructuring at workplace in last 3 years	0.021***	0.024***	0.050***	-0.006
Index: Bad working conditions – exposure	-0.017	0.012	0.016	0.032***
Index: Bad working conditions – ergonomics	-0.051***	0.021**	0.031**	-0.014
Working with computers	0.041***	-0.052***	0.030***	0.040***
Job involves: complex tasks	0.029***	-0.027*	0.037**	0.028**
Job involves: Learning new things	0.032**	-0.022	-0.027**	0.073***
Always able to apply own ideas	0.045***	0.009	0.029**	-0.013
Index: Bad hours	0.005	0.018	0.014**	0.011
Index: Inflexible hours	-0.019***	0.007	0.009	-0.011
Index: Job latitude	-0.008	-0.009	0.016**	0.008
Observations	17546	12515	19277	15025

Source: Cedefop, based on EWCS (2010) data.

Notes: (a) ***, **, *; statistically significant at 1%, 5% and 10%, respectively;

(b) Robust standard errors (not shown but available upon request), adjusted for clustering of individuals within countries.

(c) The dependent variable is the probability that an employee faces a particular type of skill mismatch. The omitted category is well-matched individuals. Column (1) excludes under-qualified workers; column (2) excludes over-qualified and tertiary education graduates; column (3) excludes the under-skilled; column (4) excludes the over-skilled.

(d) Marginal effects calculated at the variable mean for continuous variables and for discrete changes of categorical variables.

(e) Other control variables not reported here include country dummies, 1-digit occupation dummies, NACE Rev.2 economic sectors, firm size dummies, hours of work, if born in the country, past employment status, type of contract, private sector, supervisory duties, work with people, work in teams. Cronbach's alpha measure is used to generate indices of a large number of similar variables (see Annex 4).

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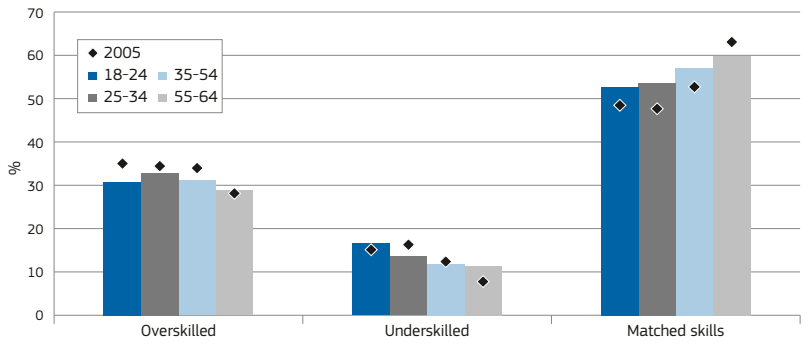
Chart 16: **Skill mismatch by age groups, employees (aged 18-64), EU-27 (2005, 2010)**



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Source: EWCS (2005 & 2010).

compared to older workers (Chart 16). Young workers lack experience or relevant information about the opportunities available in the labour market. For this reason, it is often argued that any qualification and skill mismatch tends to become eroded as they become older (Alba-Ramirez, 1993).

Nevertheless, Cedefop (forthcoming[a]) finds that a scarring effect is likely to be associated with skill mismatch. Being over-qualified in the first job may send a negative productivity signal to employers, making it difficult for younger over-qualified workers to achieve a substantial improvement in job quality when they change jobs. A long job tenure in a non-challenging job, in which those concerned lack the possibility of fully utilising or further advancing their skills, is also likely to lead to skills obsolescence. Young people who come from a poor or disadvantaged background (especially if they lack upper secondary education, are early school leavers, or are not in either education or training) are particularly susceptible to underskilling, and need vocational training if they are to improve their prospects during the initial phases of their working lives.

Vocational education and training (VET) programmes that are work-based (as opposed to school-based), and closer to the needs of the job market, can play a crucial role in facilitating the transition from school to work (Cedefop, 2012e, Cedefop forthcoming [b]). The European Commission has stressed the need to reinforce the attractiveness of VET as a learning option, and as a strategy for ensuring a closer link between people's skills and their relevance to labour market needs[21],[22]. Almost three quarters of young VET graduates aged 18-24 – in particular those graduating from a workplace-based VET programme[23] – leave formal education in order to seek entry into the labour market. This contrasts with individuals with a general education, who are more likely to continue studying.

The decision to continue studying at tertiary education level is obviously a rational choice for young people who have the opportunity to do so considering that a higher education degree carries a clear employability and wage premium over medium-educated individuals. However, when comparing young graduates with medium-level qualifications (ISCED 3-4) against a different education orientation (general vs. VET), it is apparent that VET is more successful at getting individuals into work in the short to medium-term (Cedefop, 2012e)[24]. In fact VET graduates from the youngest age groups (18-24) are more likely to be employed (63% vs. 34%, respectively), to be actively seeking work (12% vs. 7%, respectively) and to be enjoying a relative wage premium than medium-level general education graduates.

However, the type of VET programme is also found to have a significant influence on the probability of successful entry into the job market, as the share of employed graduates from workplace-based (or combined with school-based activities) medium-level education is noticeably higher (78% vs. 53%, respectively) than VET that is mainly school-based (see Chart 17). Thus, VET with higher workplace content leads to stronger labour market outcomes in the youngest age group.

(21) Several EC initiatives refer to the important role that VET can have in this regard, including the Europe 2020 flagship initiative *New Skills and Jobs*, the Bruges communiqué and *A new impetus for European cooperation in education and training to support the EU2020 strategy* (European Commission, 2010a; 2010d).

(22) Around 35.2 million people (60%) of the 58.5 million people holding a medium-level qualification have a VET-oriented education in Europe. Significant variability exists among EU Member States with respect to VET intensity and different types of VET programmes (e.g. mainly or solely school-based, workplace-based or a combination of the two), which reflects historical VET traditions but is also related to different demand and supply factors. VET systems are more popular in the Czech Republic, Austria and Slovakia but less popular in Iceland, Ireland and Portugal.

(23) General education is defined as a programme with less than 25% of its content as vocational, whereas vocational (and pre-vocational) education and training refers to programmes where at least 25% of the content is oriented towards a specific category of occupations or trades leading to a relevant qualification. Mainly workplace-based VET is when at least 75% of the education/training hours are spent in a working environment and the balance in a school, college or training centre.

(24) These findings are based on data from the 2009 ad hoc module of the EU-LFS, which focused on young individuals' (aged 15-34) transition from education to work. They hold even after considering differences in gender (males are more likely to enter into a VET stream than women) and in years of work experience, while they are robust even when restricting the analysis to young adults who are no longer in education or to 25-34 years olds who have completed their education.

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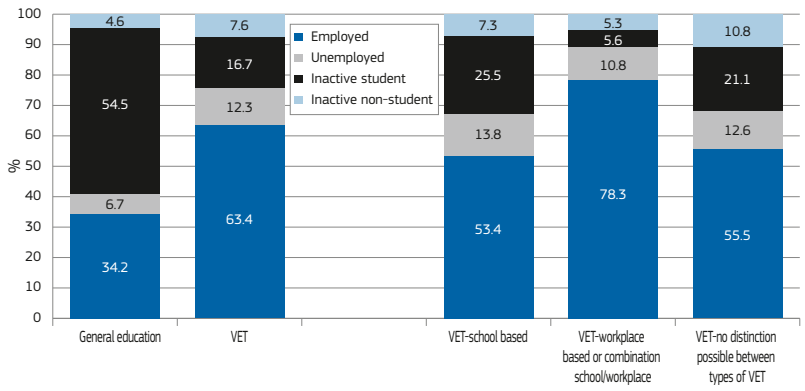
Table 9: Effect of level of education and type of academic orientation on indicators of labour market matching, 20-34 year olds, 2009, EU-27

	Job search duration	Job duration	Skilled manual job	Skilled non-manual job	High-skilled job	Over-qualification	Under-qualification	Job search duration	Job duration	Skilled manual job	Skilled non-manual job	High-skilled job	Over-qualification	Under-qualification
	First job							Current job						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Secondary - VET premium	-0.16**	0.13	0.93**	0.03	-0.07	-0.27**	-0.83**	-0.10	4.10**	0.74**	-0.09	-0.27**	-0.01	-0.98**
Secondary - VET	-0.60**	0.34	0.99**	1.13**	1.69**	1.80**	-4.01**	-0.39**	1.44*	0.66**	0.94**	1.48**	1.73**	-3.69**
Secondary - General	-0.44**	0.21	0.06	1.10**	1.76**	2.07**	-3.17**	-0.29**	-2.66**	-0.08	1.03**	1.76**	1.74**	-2.71**
Tertiary - VET premium	0.29**	3.50**	0.94**	-0.14	-0.93**	0.83**	-0.21**	0.05	12.31**	0.92**	-0.11	-1.09**	1.15**	-0.33**
Tertiary - VET	-0.92**	-0.55	0.90**	1.71**	3.68**	4.19**	-6.89**	-0.57**	-3.60**	1.03**	1.84**	3.60**	3.98**	-7.02**
Tertiary - General	-1.21**	-4.05**	-0.04	1.84**	4.61**	3.36**	-6.68**	-0.62**	-15.91**	0.11	1.95**	4.69**	2.82**	-6.69**
Observations	97743	75609	75317	75317	75317	73983	73983	24444	131144	130172	130172	130172	123438	123438

Source: 2009 AHM EU-LFS; Cedefop (forthcoming[c]).

Notes: * p<0.05, ** p<0.01; Duration measured in months; Columns: 1, 2, 9: OLS estimates; Column 8: Ordered logit estimates; Columns 3-7, 10-14: Multinomial logit estimates; all regressions include country-specific dummies and individual-level control variables; robust standard errors (not shown in table, but available upon request); High skilled job: ISCO 1-3; Skilled non-manual job: ISCO 4-5; Skilled manual job: ISCO 6-8. The reference (omitted) education level is 'no secondary education'. The reference group for the dependent variable is 'unskilled' in columns 3-5 and 10-12, and 'matched' in columns 6-7 and 13-14.

Chart 17: Labour market status (%) of medium level graduates by orientation, 18-24 year olds, 2009, EU-27



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Source: 2009 Ad Hoc module, EU-LFS.

Note: Medium level education means upper secondary and post secondary (non tertiary) (ISCED 3-4).

Looking more closely at the nature of the school-to-work transition of young adults, and the quality of their first job match, several indicators suggest that VET is more successful than general education programmes in this respect. The empirical estimates of Table 9 compare the effects of different levels of education (e.g. secondary vs. tertiary) according to their academic orientation (VET vs. General) on the basis of various indicators of labour market outcomes. Examining the difference between the coefficients of VET and general education (the so-called 'VET premium'), it is clear that the speed of transition (the length of time that elapses between completing formal education and starting a first significant job) is generally faster for secondary (but not tertiary) VET graduates.

The duration of the first job is also significantly greater for graduates from VET tertiary education programmes. As these programmes tend to develop job-specific skills, the probability of finding a more suitable match in terms of skills is potentially higher, even though VET tertiary graduates are more likely to find employment in skilled manual jobs and, hence, have a greater likelihood of being over-qualified. In contrast, the probability of job separation tends to be higher for tertiary general education graduates who, having more generic skills, tend to be in a better position to exploit the option of job mobility in search of a better job.

VET programmes can make the transition to a first job fast and effective, yet graduates of VET programmes are also likely to have significantly longer job tenure in their current employment than those from general education. Although this may reflect a lower capability of VET graduates to engage in job mobility, their greater job tenure might also arise because their job-specific skills are matched to the requirements of their current job and since they are more likely to enjoy stable employment relationships in so far as they work in full-time jobs with permanent contracts (not shown in Table 9). Both secondary and tertiary VET graduates are more likely to be employed in skilled manual jobs, decreasing the chances of the former being over-qualified as opposed to the greater propensity of over-qualification among the latter. In contrast, both secondary and tertiary general education graduates are employed mostly in high-skilled occupations. This is consistent with the lower relative propensity of VET graduates being under-qualified in both first and current jobs. Efficient matching therefore seems to be taking place within the labour market with respect to the skill profiles of young VET graduates.

Blending learning and work as part of initial vocational education and training (IVET) and by using the workplace as a learning place (via schemes such as job shadowing, internships, voluntary work and apprenticeships) may thus facilitate the school-to-work transition of younger-aged medium-qualified workers by placing them in jobs that match their skills. However, as VET graduates are more likely to be employed in medium-skilled occupations (mainly craft and related trades), they are also at greater risk of exposure to declining future labour demand (Cedefop, 2012b).

Apprenticeship programmes in which the quality of provision and social security is not guaranteed can also degenerate into cheap labour schemes involving narrow/menial skills (European Commission, 2012c). General programmes may also contribute to a better matching of skills with job needs beyond the first entry into the labour market, as the greater adaptability and mobility of graduates from general orientation programmes are conducive to finding a better job match over time (Verhaest and van der Velden, 2010). In other words there may be a trade-off for VET systems, with the short-term benefits of easy entry to the labour market being outweighed in the longer run by the fact that specific skills may be at greater risk of becoming obsolete at a faster pace (Hanushek et al., 2011).

6.2. Ageing workers face the risk of skills obsolescence

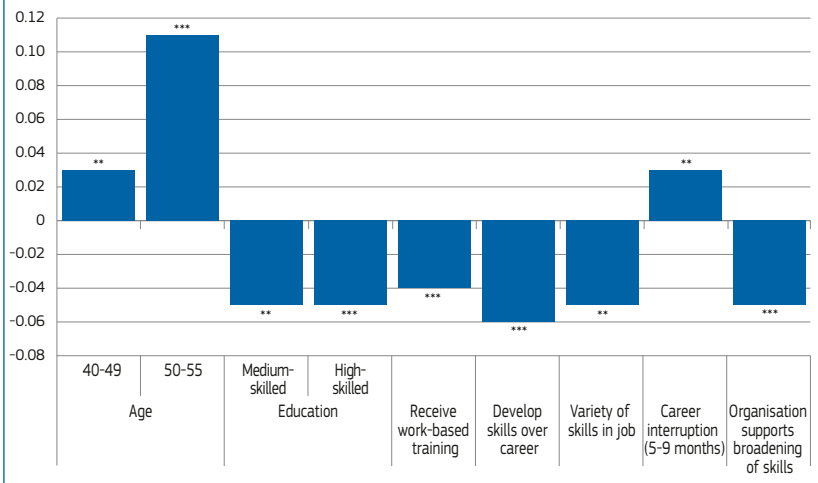
The continued employment of older workers has become a major issue in most European countries given their generally ageing populations. Raising the activity rates for older people is one way of addressing the challenge, but this is dependent on being able to exploit their skills and experience and preventing the obsolescence of their skills as technological progress and the ageing process unfold (OECD, 2011). In this respect, older workers are generally believed to have greater difficulty in assimilating new skills following technological and organisational innovations (e.g. computerisation) and therefore need more retraining. However, as Eurofound (2008) has pointed out, ageing workers are generally less involved in new organisational work arrangements, training and acquiring new skills, all of which may be associated with a higher degree of obsolescence and skill mismatch.

In 2011 Cedefop carried out a pilot survey (see Box 8) that showed that a significant share of workers is affected by skills obsolescence. About 12% of the respondents believe that the current match of their skills to the requirements of their job is worse than what it was when they first started their current line of work[25]. Skills obsolescence affects not only older individuals, but also prime-age workers, many of whom still have many years of working life ahead.

(25) According to a Dutch survey, 30% of the skills of individuals in their sample had become obsolete with a half-life for competences in the range of 10 to 15 years (Allen and van der Velden, 2007).

Chart 18: Probability of skills obsolescence by groups of workers, 4 EU countries, 2011

Probit regression, marginal effects of significant variables



Source: Cedefop pilot skills obsolescence survey (2011).

Notes: ***, **; statistically significant at 1% and 5%, respectively; Omitted groups: *Age:* 30-39; *Education:* Low-skilled; *Receive work-based training:* No; *Chances to develop his/her skills over his/her career:* No; *Use of variety of skills in job:* No; *Career interruption:* less than 1 month; *Organisation supports me to broaden my skills:* No. Marginal probabilities that an individual's skills necessary to optimally perform his/her job are currently lower than or equal to when they started their current line of work.

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Specific groups of the population are found to face a greater risk of skills obsolescence, such as lower-skilled workers, older individuals, those without opportunities to develop their skills throughout their careers, and individuals who have had lengthy career interruptions (e.g. because of unemployment, child rearing or other responsibilities) (Chart 18). Even highly skilled workers are not immune, with 9% of tertiary education graduates reported as facing skills obsolescence. 15% of workers who did not receive any work-based training in the previous year were affected by skill obsolescence, in contrast to 10% of those who participated in training. Likewise some 15% facing such challenges are employed by organisations that do not encourage them to broaden their skills compared to 9% where the enterprise does do so. The findings of the pilot survey thus underline the importance of fostering a learning culture within the workplace, and of providing training and good working conditions as appropriate policy tools to combat skills obsolescence.

6.3. Third-country nationals are susceptible to skill mismatch

Migration of both third-country nationals and of mobile EU citizens can influence a country's skill mismatch in several ways. Emigration may result in shortages of highly skilled labour in the countries of origin (brain-drain), while immigration can sometimes create labour surpluses (particularly in lower-skilled occupations) in host countries. Cedefop (2011b) examined the issue of skill mismatch among migrants and ethnic minorities and their labour market performance in 15 European countries based on data from the European social surveys. Third-country nationals, as opposed to mobile EU citizens and ethnic minorities, were found to have a 5% greater probability of being over-qualified relative to their native counterparts. Those educated in the country of origin are more likely to suffer from vertical mismatch than those educated in the host country. They tend to be employed in both jobs requiring tertiary education, which match their skills, and, in large numbers, elementary occupations, consistent with job polarisation. The under-utilisation of the human capital potential of third-country nationals, in particular of migrant women who suffer from a higher incidence of over-qualification[26], tends to be a persistent phenomenon in many countries, particularly since the qualifications obtained in their own country tend not to be recognised in the host country and because of insufficient language skills. Studies of skill mismatch among ethnic minorities in the UK have also confirmed that over-qualification tends to be higher for non-whites than for whites, with more severe consequences in terms of the wage and welfare outcomes of the former (Battu and Sloane, 2004; Lindley, 2009).

7. Future trends in skill mismatch in the European labour market

Anticipating and matching skill needs and supply is at the forefront of the European Commission's strategy *New Skills for New Jobs* and the *Agenda for New Skills and Jobs* (European Commission, 2008a;

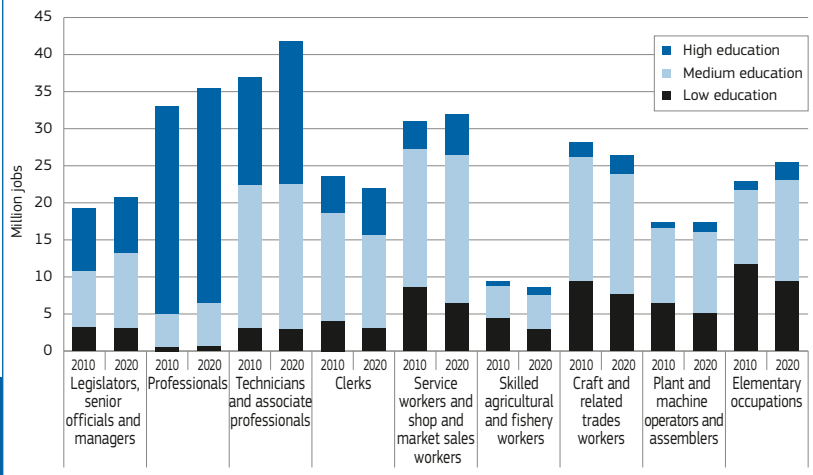
Box 8: Exploring new terrain - Cedefop's pilot survey on skills obsolescence

Cedefop carried out a pilot survey on skills obsolescence in four EU Member States in 2011: Finland, Germany, Hungary and the Netherlands. The target population of the study was employed persons, aged 30 to 55 years and working 30 hours per week or more. Existing panels were used and the data was collected by online interviewing. Data for around 4 000 employed persons was eventually collected. The survey allows for the construction of subjective measures of skills obsolescence and contains information on the employment situation of respondents, their demographic characteristics and the development of their skills and knowledge over time. The survey helps to identify appropriate policy measures aimed at mitigating the diminishing capability of individuals to remain up to date in an ever-changing workplace.

Skills obsolescence can be measured in several ways, but little consensus exists on which method is the most appropriate. Few data sets in general contain appropriate questions that can be used to assess skills obsolescence. To address this deficiency, Cedefop is launching in 2013 a skills obsolescence and skill mismatch survey that will cover all EU-27 Member States.

[26] According to the Eurostat (2011) indicator of over-qualification, 36% of migrant women are found to be over-qualified as compared to 30% of males.

Chart 19: Changing skill composition of the occupational structure of employment, EU-27, 2010-20



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Source: Cedefop country workbooks (2012).

2010a). Significant initiatives have been undertaken both at the international and at the national level in an attempt to identify the sectors, occupations and countries that are most likely to experience skill shortages in coming years, including the pan-European forecasting model of labour demand and labour supply developed by Cedefop (see Box 9).

According to the Cedefop forecasting model, the ongoing trend towards rising 'skill intensity' of jobs is likely to continue in the next decade. Although a substantial number of jobs that will be available in the future job market do not yet exist, the proliferation of new path-breaking technologies (e.g. mechatronics, nanotechnology, biotechnology) across a wide variety of sectors and jobs, even those that were in the past reliant on medium- or lower-skilled labour, is indicative of a universal trend towards rising skill requirements within jobs (see Chart 19). Even in 'declining', relatively medium-skilled occupational groups, the trend is towards increasing skill demands as customer expectations rise, as technology accelerates (e.g. 'digitalisation' of the manufacturing sector), and as more complex forms of work organisation become more commonplace.

Despite the increasing share of high-skilled jobs in total employment, almost 70% of jobs will continue to be those requiring workers possessing only medium or lower level qualifications. An estimated 75 million job openings are predicted in all types of occupations in order to replace workers who retire or leave the workforce (*replacement demand*). In recent years, lower-skilled occupations have accounted for the largest share of job-finders in the European labour market, despite the fact that the fastest growing occupational groups depend on high-skilled labour (European Commission, 2012b).

Although the demand for more elementary occupations, especially in personal and household services and in care, is expected to remain strong, many of the traditional manual or routine jobs that can most easily be replaced by new technologies (such as craft and related trades workers, clerks, plant and machine operators) are likely to decline. Such changes indicate a continued risk of job polarisation in the future European job market, with increased demand at both the upper and lower ends of occupations, and decreases or stagnation in the middle.

On the supply side, EU Member States have seen educational upgrading as the best way of addressing current and anticipated needs in the labour market. However, some have also been investing strongly in lifelong learning (notably Denmark, Sweden, UK, Norway, Iceland)

Box 9: The Cedefop Pan-European forecasting model of skill demand and supply

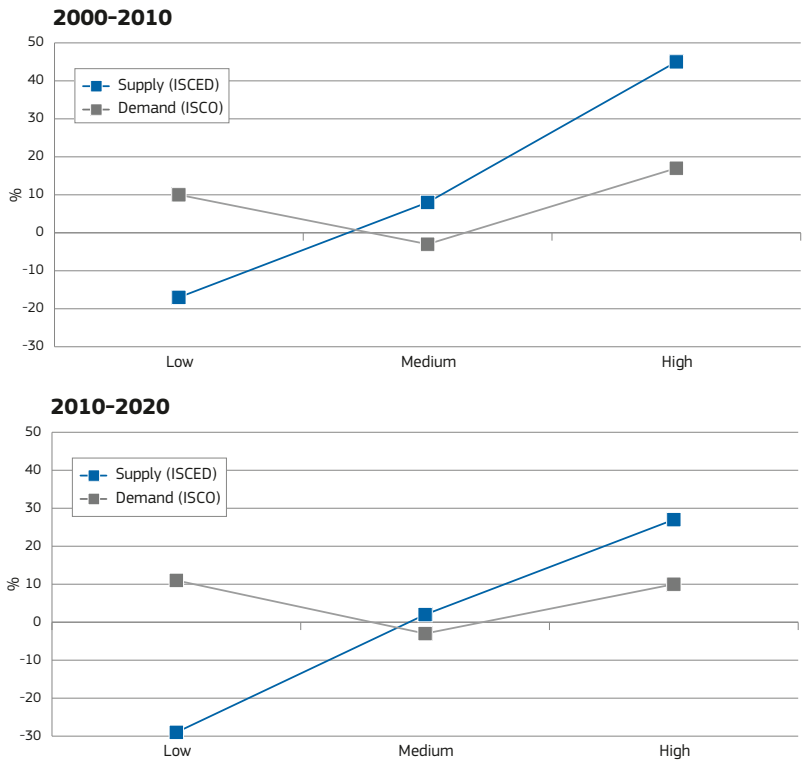
Regular and comparable skill supply and demand forecasts are produced and published by Cedefop on a bi-annual basis using harmonised data for 33 countries (EU-27 + Norway, Switzerland, Croatia, Turkey, the former Yugoslav Republic of Macedonia, and Iceland) (Cedefop, 2010c; 2012b). The model uses a modular approach in generating skill supply and demand estimates. On the basis of a long time-series of macro-economic data spanning back to the 1970s, an augmented version of an existing multi-sectoral macro-economic model is used to produce country-specific estimates of employment by 41 economic sectors. Within two separate modules, occupational and education qualification distributions within sectors are then exploited to break down the industrial level of employment into predictions of labour demand by 27 occupational groups and 3 broad levels of educational attainment (low, medium and high). The replacement demand by occupation and qualification level, the number of job openings due to the need to replace the workforce that will retire or leave the labour market, are both integral components of the model. Together, the level of expansion and replacement demand provides an estimate of the total number of job openings by skill level (as approximated by occupational groups and education qualifications).

The model also provides medium-term projections of overall labour and skill supply broken down by 5 year age bands, gender and 3 educational qualification levels, derived on the basis of a historical analysis of demographic and labour supply trends in European countries. In particular, an analysis of EU-LFS micro data is used to predict the probabilities of the labour force achieving different levels of educational attainment. Together these country-specific skill supply and demand forecasts provide estimations of trends that are anticipated to prevail in the next decade. They constitute a powerful tool of labour market intelligence and are offered as a publicly available good at a web-interface maintained by Cedefop, which can be assessed at the following address:

http://www.cedefop.europa.eu/EN/about-cedefop/projects/forecasting-skill-demand-and-supply/skills-forecasts.aspx

The project has received financial support from the Progress Programme managed by the European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities. Cedefop's skill supply and demand forecasts form one of the key building blocks of the EU Skills Panorama.

Chart 20: Historical and anticipated change in demand and supply of labour of different skill types, EU-27, 2000-20



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Source: Cedefop country workbooks (2012).

Notes: Figures on supply represent the % change in supply between workers with different qualifications (Low: ISCED 0-2; Medium: ISCED 3-4; High: ISCED 5-6); Figures on demand show the % change in demand for workers of different occupational types (High-skilled: ISCO 1-3; Medium-skilled: ISCO 4-8; Low-skilled: ISCO 9).

in order to upgrade skills within their existing workforce. Assuming that these trends will continue, the Cedefop forecast model projects a clear rise in the proportion of people with medium- and high-level qualifications in the next decade as younger cohorts with higher qualifications replace older workers with lower qualifications.

The proportion of people with high-level qualifications is predicted to rise to more than a third of the workforce in the next decade, while people with medium-level qualifications will continue to account for about half of the workforce. The relatively high proportion of low-qualified individuals in Europe today – accounting for nearly a quarter of the working age population – will decline to about 16%, mainly as a result of the retirement of older, less qualified, cohorts. Also influencing these supply changes is the fact that a higher proportion of females are now obtaining higher education qualifications than men, which is expected to result in women increasing their share of employment within traditionally male-dominated jobs at the higher end of the skills distribution.

The forecasts also show that the share of workers possessing higher qualifications will increase among prime-aged workers, making them more highly qualified in 2020 than the same cohorts today. Higher levels of human capital among older age groups are likewise expected to increase their labour market participation rates, as the ability and desire to remain in employment tends to increase with higher skill levels.

Chart 20 uses the currently available data from the Cedefop model to illustrate the evolution of skill supply and demand in the EU-27 over the previous decade (2000-10) and next (2010-20). The potential for skill mismatch in Europe by 2020 appears to be substantial, as the well-documented labour market trends of past years – namely job polarisation on the demand side and upskilling on the supply side – are expected to continue unabated into the future. In the face of continuous demand for some elementary occupations, however, shortages of low-skilled workers may also unfold in the European economy by 2020. The predictions likewise suggest that the growth in the supply of high-skilled workers is expected to outpace the growth in demand, a trend that has become more pronounced since the economic crisis began[27].

Governments will thus need to consider how best to stimulate employers' skill demand and encourage innovation and the creation of high level jobs in order to absorb and fully utilise the human capital potential of Europe's increasingly talented workforce.

8. Policies to combat skill mismatch

When market failures result in structural labour market imbalances, appropriate policies are called for across relevant policy domains (education and training, employment and social security, migration, industrial and regional development) in order to prevent or mitigate the significant economic and social costs of skill mismatch. Investing in such policies at a time when fiscal consolidation and the economic slowdown are exerting strong pressures on public finances is nevertheless seen as a sound strategy, considering that improvements in the matching of skills can reduce structural levels of unemployment, promote the competitiveness of European enterprises, and prevent the waste of public resources invested in education and training systems. Forward-looking initial and continuing training, improvements in the efficiency of labour markets, the promotion of innovative and high performance workplaces, and labour mobility are all necessary ingredients for overcoming skill mismatch.

8.1. Enhancing the responsiveness of education and training to labour market needs

8.1.1. Education and training systems should cater to diversity

In the new world of work, increasing numbers of people are required to possess a range of skills that lie outside the narrow

(27) Although inferring the exact nature and magnitude of skill shortages or surpluses would require a comparison of the differences in the levels of demand and supply of individuals of different educational types, Chart 20 focuses on the underlying trends in the labour market. This is a reflection of the widely accepted view in the recent academic discourse that the value added of skill forecasting exercises lies in the identification of the underlying dynamics and changes within particular sectors, occupations and skill types, rather than in a direct comparison of the absolute numbers of employment demand and supply, which can be subject to measurement error.

occupational skill profiles of the past. Communication skills and a combination of problem-solving, analytical and linguistic abilities, along with the capacity to self-manage and work in teams, are just some examples of 'transversal' skills that have become increasingly valued in the labour market. Along with individuals' basic knowledge (numeracy, literacy) and attitudes ('soft skills'), these are seen to represent the type of key competences that are crucial to personal fulfilment and success in the knowledge economy and represent the foundation for 21st century skills (European Commission, 2007, 2012d).

Changing skill requirements highlight the need for more open, flexible, responsive and diverse education and training systems, focused on learning outcomes throughout the whole process. The evidence regarding the impact of different forms of academic orientation (general vs. VET) on skill mismatch does not yet allow for definitive conclusions to be drawn. It is clear that vocational streams contribute to the acquirement of occupation-specific skills, whereas general systems support the acquisition of generic skills. VET programmes with higher workplace content can also be more effective at getting the youngest age groups with medium-qualifications, who do not wish to or are unable to continue their studies, into work. Bringing workplace-based training into the education domain through apprenticeships can be particularly valuable (European Commission, 2012c), as workplace training provides skills that are difficult to replicate with traditional teaching methods[28].

In contrast to VET graduates, those graduating from a generally oriented programme are found to have a lower likelihood of finding a good match in their first job and of staying in that job. However, their education can provide the kinds of transferable skills that serve as stepping stones towards better matched and higher-skilled jobs in the long term. This underlines the necessity for education and training systems that avoid developing curricula that are overly specific and which are useful in only a limited range of occupations. The learning outcomes approach to curriculum design that is now being implemented across Europe is helping to reconcile the interests of those from the education and the labour market worlds, and identify pathways towards an accommodation of specific skills alongside more generic skills and key competences (European Commission, 2012d, Cedefop, forthcoming[d]).

Education and training policies have a particularly crucial role to play with respect to overcoming the skill mismatch problems of migrants and other vulnerable groups, who are more prone to unemployment, inactivity and mismatch relative to the native population. Two factors are particularly important here: the recognition of qualifications obtained abroad, and the role of domestic employers in providing migrants with greater training opportunities, including language training.

8.1.2. Who should bear the cost of further [continuing] training?

Striking the right balance in terms of sharing the cost of continuous education and training between institutions and individuals (who pays for what, when and where?) is a complex issue and a difficult one for policymakers to address. Both individuals and firms face disincentives with respect to investing in further education and training[29]. Companies are discouraged by the fear that they will not be able to benefit from the potential return from training due to turnover or poaching of employees by other competitors (who may be able to pay higher wages as they have not had to bear the costs of training) (Booth and Snower, 1996). Individuals may, likewise, under-invest due to a perceived threat of being fired and, thus, of losing any firm-specific capital, but also because of high perceived training costs, including foregone earnings and family or time constraints. Both parties of the employment relationship also tend to fail to recognise the (joint) benefits when deciding how much to invest in training (Redding, 1996)[30].

For older workers in particular, the incentive to upgrade skills is reduced because of higher opportunity costs, a shorter time period within which they can expect to recoup the benefits of their investment and lack of recognition of non-formal or informal learning. Workers on precarious employment contracts, migrants and those employed in the secondary sector are generally less involved in workplace learning, in stark contrast to high-skilled adults ('skills beget skills') (Cedefop, 2011c). Adult training therefore tends to reinforce existing educational inequalities, perpetuating the risk of a divided skills base of the workforce (Carneiro and Heckman, 2003; Desjardins and Rubenson, 2011). A key challenge for public policy therefore lies in better targeting the participation of low-qualified groups in in-company training and in other forms of adult learning.

The above constraints highlight the necessity for collective national training or apprenticeship schemes as a strategy for encouraging the provision of an efficient level of training in the labour market. Yet such policies have met with strong resistance in the past (e.g. the 1970 UK training levy scheme). In line with the influential theory of Gary Becker (1964), which drew a distinction between firm-specific and general training, employers have argued against the provision of transferable training on the grounds that workers can renege on their commitment once the firm has borne the cost. However, this line of thinking is at odds with the reality of firms providing a mix of both general and specific training (Lazear and Oyer, 2009). General training is sometimes in the interest of firms, as this can provide

(28) In particular, the use of up-to-date equipment as well as practical/soft skills such as customer relations, working in a team and complying with workplace requirements. Such schemes may also establish good relations between employer and employee, thereby improving a young employee's chances of being offered a matched job.

(29) As evidenced by the fact that nearly two thirds of the adult population in the EU did not participate in (formal or non-formal) learning in 2007 (Adult Education survey data). Similarly, a sizeable 38% of European companies (mostly smaller-sized firms and those in Southern European countries) did not provide any training at all in 2009. Cedefop's (2010d, p. 23) analysis of the results of the third Continuing Vocational Training Survey (CVTS) categorises EU Member States according to whether they are high , average or low performers in terms of CVT performance. The benchmarking exercise reveals that the countries which have high skill mismatch (e.g. EL, IT, PT, ES) also tend to perform poorly among the EU Member States in terms of the incidence of training enterprises, participation of employees in CVT courses, intensity of training (in relation to total hours of CVT courses attended by employees) and total costs of CVT courses as a share of the total labour costs of enterprises, a phenomenon closely related to the economic structure of these economies (e.g. higher concentration of small- and medium-sized enterprises). However, the association between CVT performance and skill mismatch is imperfect, as the low CVT performance group also contains Baltic and Central European countries with generally lower rates of skill mismatch than the Southern Mediterranean ones e.g. SI, LV, HU, BG, PL, LT, RO.

(30) Other important deterrents to the provision of training include: the preference of firms to provide only limited training if they operate in seasonal markets (such as tourism); and the fact that enterprises in decentralised or remote locations often face a shortage of suitable trainers as well as higher costs, which negatively impacts on the cost-effectiveness of courses.

them with an informational advantage over their competitors and serve a useful screening purpose (Autor, 2001). Given imperfectly competitive labour markets, employers may also benefit from general training (Acemoglu and Pischke, 1999).

Public policies and company training often serve contradictory goals, with governments wishing to aid the employability and mobility of workers in the labour market, while companies may be more inclined to narrowly invest in the careers of their most talented workers according to their specific production needs. Nevertheless, public policy has an important role to play with respect to reducing the risks of investment in training for companies. Instruments that promote investment in human capital within the firm include so-called 'payback clauses' (Cedefop, 2012c). By requesting that part of the cost of training is paid back to the employer in the case of employee turnover, such clauses may provide an incentive to firms to offer training (though the implications of such clauses for individual freedom and mobility are an issue of concern).

Given well-documented lags and/or errors in the recruitment and training practices of firms with respect to addressing skill needs (Freeman, 1971), public authorities can also assist enterprises in the assessment and elaboration of training plans, the accreditation of training providers and the evaluation of the outcomes of training. Furthermore, many countries lack the necessary public or joint public-private institutional arrangements, such as sector skills councils, which can act as mediators between the labour market and the education and training sector. The European Commission Communication *Re-thinking education* has strongly called for education and training partnerships between public and private institutions, not only concerning funding but also as an opportunity for mutual learning and joint policy action (European Commission, 2012d).

8.2. Promoting high performance workplaces

Analyses of patterns of skill mismatch within and between countries frequently reveal that a significant proportion of skill mismatch remains unexplained, even after taking account of different demographic and socioeconomic characteristics of individuals. This is mainly due to the limited availability of appropriate data sources which contain detailed information on individuals' job demands or task requirements within their occupations.

Recent research has started to focus on the important role of firms' human resource (HR) policies (e.g. recruitment, training, job design, compensation and competency development policies, etc.) in terms of fostering a better match between jobs and skills (Cedefop, 2012a). HR practices and the overall management strategy of firms can potentially account for the differences in skill mismatch observed between individuals working in similar jobs. Belfield (2010), for instance, has found that firm attributes are driving one quarter to one half of the over-qualification wage penalty in UK firms.

As shown in section 5.5, differences in job tasks can be an important factor in fostering skill mismatches between individuals[31], but this can be mitigated by adjusting organisational practices in ways that optimise the use of the skills that are available. Organisations that use high performance workplace practices, in particular, often have skill induction programmes and skill development policies that are tailored to both their business strategy and the personal development needs of their workforce. For policymakers this implies that more attention should be paid to improving workplace and job design rather than just focusing on the perceived inadequacies of the education and training systems (Weststar, 2009).

8.3. Anticipation and identification of skill needs and supply

Identifying emerging skill needs is key to achieving a better balance between skill supply and demand. European and national forecasting exercises can help align education and training with labour market needs, but enterprises also need cost-effective tools to anticipate their own skill needs[32]. Employers may fail to recognise productivity-related deficiencies among staff because of poor management or inadequate HR policies. Additionally, the formal education system is often relied upon too much as a means of addressing skill deficiencies, and this can explain the persistently low levels of continuous vocational training offered by firms in several EU countries. As a result there is scope for policy interventions that seek to inform labour market actors about the potential sectoral and occupational mismatches that may develop in the future job market.

In this respect, the EU Skills Panorama offers unique access to data on anticipated short- and medium-term skill needs and mismatches across different occupations and sectors in Europe and raises awareness about the benefits of skill needs identification. It is then the task of education and training systems to increase the levels, quality and relevance of skills supply, responding to identified skill needs – a challenge that is the main focus of the European Commission Communication *Re-thinking education* (European Commission, 2012d).

8.4. Targeting labour market institutions and regulations

Differences between countries in terms of skill mismatch can result both from structural differences in demand and supply and from cyclical fluctuations. However, the evidence available often fails to identify the current unemployment rate as a decisive factor affecting cross-country differences in skill mismatch. However, when focusing on graduates that first enter the labour market during a recession, and on individuals who are in search of a new job following a redundancy or business closure, it is observed that they are more likely to be over-qualified due to fierce competition from other highly educated individuals (Verhaest and van der Velden, 2010; OECD, 2011). Likewise those who experience a prolonged period of unemployment and/or labour market inactivity also face a greater risk of skills obsolescence (Cedefop, forthcoming[f]).

Tackling skill mismatch and skills atrophy through the provision of efficient job placement services and ALMPs targeted at unemployed individuals can thus be seen as a priority strategy for policymakers. There is also a need for policies that reduce labour market frictions associated with imperfect information

(31) Desjardins and Rubenson (2011) also show that the possession of skills by workers does not guarantee a reward in the labour market unless workers engage in tasks within their job that require those skills.

(32) The significance of this is seen in the latest Continuing Vocational Training Survey (CVTS 2005) which shows that the most common reason given by enterprises for not providing training is that they see no need, with only a quarter of firms actually assessing their future manpower/skill needs (Cedefop, 2010d).

on behalf of employees and employers, including the provision of better labour market information. Young people in particular need access to information about likely future job needs, the related qualifications that will be required and the risks they face in particular occupations. In these respects, current systems of career guidance in European countries are seen as poor and, even when labour market intelligence exists, labour market actors are not trained to use it in the most appropriate manner (OECD, 2011).

Institutional factors and labour market rigidity may also contribute to skill mismatch, as discussed in section 5.4. Collective wage bargaining systems may be unable to take account of sectoral or regionally-based changes in demand, although they may be useful in mitigating shortages of low-skilled labour (as shown in Table 5). Some authors argue that more stringent labour regulations and segmented labour markets can increase skill mismatch by making it harder for individuals to obtain their best matched job (Di Pietro (2002), Brunello et al. (2007)) while others have failed to find a significant association between employment protection legislation and the incidence of over-qualification (Verhaest and van der Velden, 2010).

8.5. Reaping the benefits of innovation

Innovation and skills development should go hand-in-hand and recent evidence on the relation between innovation, work-based learning and work organisation practices suggests that skill shortages in firms may hinder the introduction of new products and processes (Cedefop, forthcoming[c]). In countries and firms where traditional Tayloristic production practices are most common, performance on the European Innovation Scoreboard tends to be lower than in cases where more learning-intensive forms of work organisation exist. Task complexity, in particular, a key characteristic of learning-intensive forms of work organisation, is found to have a strong relation to innovation performance.

When there are under-utilised skills in the labour force, increasing the pace of innovative activity in the economy is expected to provide the right kind of market incentives for mismatched workers to find suitable job opportunities that utilise their skills. On the other hand, if there is a lack of skills in the economy, a fast pace of innovation might, in the short term at least, increase the frequency of skill shortages, and rapidly expanding firms may find it difficult to maintain an adequate skill base. However, evidence from the UK and Australia has suggested that skill shortages do not operate as constraints on product strategy (UKCES, 2011; Healy et al., 2012). Rather they appear to be indicators of a more dynamic approach to skills resourcing, with fast-growing firms more likely to be pursuing 'high-end' skill- and innovation-intensive product strategies.

Policy needs to support and encourage employers with high-skill product market strategies applying new methods of production, although the success of these policies is dependent on investment in skill formation. Recent case studies of high-value industries operating in European regional labour markets show that successful clusters can be developed around high-value added activities and high-performance work practices[33]. This can be achieved through the coordinated introduction of measures aimed at supporting innovation through research and development activities, ensuring at the same time that the vocational education and training systems (both public and private) provide the possibilities for the acquisition of the necessary skills, which calls for a partnership approach (Cedefop, 2012d, European Commission, 2012d). Hence, supporting the promotion of innovation and the adoption of technologies which correspond to the available skills base can be a beneficial strategy for tackling skill mismatch.

9. Conclusion – Europe has no room for complacency

The path to sustainable and socially inclusive growth in Europe is dependent on the availability of a skilled and talented workforce. High levels of education and skills are needed to meet the long-term challenges of the economy and to facilitate the necessary labour market and work process adaptations required by rapid technical change and fierce global competition. With the share of older workers in the European job market continuing to increase, it is essential to increase the available supply of labour by activation policies and to tackle skills obsolescence via continued investment in high-quality initial and continuing education. The recent European Commission Communication *Re-thinking education* has provided guidance on reforms of the education and training systems to tackle the skills challenge.

However, as Europe struggles to overcome the biggest economic crisis in its recent history, it has become ever more imperative to acknowledge that converting skills into job-rich growth is only attainable if effective use is made of the available talents. Along with a substantial pool of idle workers finding it difficult to get a job, the skills of about a third of the European workforce are under-utilised. At the same time, employers in Europe continually draw attention to skill gaps and shortages that constrain their productivity and competitiveness.

Skill mismatch affects economic productivity and growth, increases structural unemployment and generates significant economic and social costs. Skill mismatch takes the form of quantitative imbalances between aggregate labour demand and supply, thus resulting in shortages or surpluses in particular sectors or occupations in the economy (e.g. health and social care, hotels and restaurants), but it can also reflect an inadequate fit between individuals' skills and their jobs' requirements.

Though much of the early literature focused on education mismatch, recent evidence has highlighted that it can be weakly correlated with skill mismatch. Educational credentials cannot provide a full picture of the quality of individuals' human capital, in particular their skill gain and skill loss over their careers. Labour market persistence found in cases where there is real skill mismatch (i.e. workers mismatched in both their qualifications and skills) or genuine skill mismatch (i.e. mismatched employees who are simultaneously dissatisfied with their jobs) draws attention to the fact that employees can get trapped in non-challenging employment, leading to a continued under-use and obsolescence of their skills and competences.

(33) This conclusion is based on recent Cedefop research examining various case studies from European industries and regions, such as the textile sector in Flanders (BE), medical technologies in Baden-Württemberg (DE), wind power engineering in Jutland (DK) and hi-tech manufacturing in Brabant (NL) (Cedefop, 2012d).

Cedefop's most recent projections of skill needs and supply shows that as a result of the crisis the potential for skill mismatch, at least in the short- to medium-term, is considerable. The continued trend towards the upskilling of the European population raises significant concerns about the ability of European economies to use the available skills to create growth, as this requires improving the quality of jobs to match the available supply.

Exploiting the potential and talent of an increasingly higher-skilled workforce is inevitably linked to the creation and availability of high-skilled jobs, though important adjustment lags in labour demand often hinder the capacity of European economies to create high-skilled jobs. When no such jobs are available, those with higher qualifications may end up over-skilled. In times of high unemployment, they will tend to take up lower-skilled occupations, crowding out those with lower education and skills. Nonetheless, along with the important positive social benefits of having a highly educated population, employing workers with surplus skills has been found to sometimes entail significant (though not yet fully measured) positive spillover effects on the productivity of enterprises.

It is also argued that over-skilling will in the long run lead to innovation and growth, but organisational innovation and high-performance work practices are necessary for providing challenging employment to a higher-skilled workforce. When higher-educated workers are offered jobs that entail complex tasks, work autonomy and continuous learning, this will raise firm productivity, support innovation and provide job satisfaction even to those who are formally over-qualified. Given the significant variation in human resource practices observed across firms in the European economy, which is related to differences in production functions and adjustment costs faced in different labour and product markets, public policy has a key role to play in informing and in supporting the adoption of high-performance workplace practices by uncompetitive firms and in enabling firms to more rapidly overcome regulatory or other lags during the adjustment process.

Evidence indicates that under-qualified workers may be able to compensate for their labour market weakness through work experience and additional skills acquired on the job. This points to using work-based learning as a more widespread strategy in education and training to increase the match between young graduates' skills and workplace demand – not only in order to place the significant share of medium- and lower-skilled youth in matched jobs, but as an overall strategy to improve the responsiveness and relevance of labour supply to labour market needs.

Skill mismatch is an endemic feature of imperfectly competitive labour markets, yet public policies, in conjunction with the committed support of social partners, have a key role to play with respect to tackling long adjustment lags and failures in the market mechanism by:

- facilitating mobility in the labour market and strengthening active labour market policies and the role of public employment and guidance services in promoting efficient matching and qualification accessibility;
- providing early intervention in career guidance, assisting students with respect to having realistic labour market aspirations and making informed choices about learning pathways, skills development and careers;
- ensuring that education and training systems provide opportunities to develop high-quality transversal as well as vocational job-specific skills, which allow for easier adaptation to changing needs;
- stimulating employers' skill demand, spurring innovation and the creation of high-level jobs in order to absorb and fully utilise the human capital potential of Europe's increasingly talented workforce;
- promoting high-performance workplace practices and challenging job design and supporting firms that rely on high skill-high productivity product strategies;
- exploiting synergies between skills and high productivity firms by facilitating, in close cooperation with local authorities and social partners, the growth of industrial clusters (e.g. through publicly funded training agencies catering to the specific needs of the industrial cluster);
- emphasizing job quality as an instrument for the mitigation of labour shortages, particularly among low-skilled jobs and sectors;
- promoting diversity in education and training, by allowing for a variety of routes and fields for qualifications, by strengthening pathways between VET and general education systems and encouraging the institution of validation and recognition systems of informal and non-formal learning;
- providing efficient incentives to firms to increase the provision of work-based training and encouraging adult and lifelong learning, particularly targeted towards vulnerable and disadvantaged groups of the population;
- raising awareness of anticipated mismatches in different sectors and occupations in the European economy and focusing on skill mismatch in addition to qualification mismatch.

In modern economies, skills have become the key to labour market success (OECD, 2012), ensuring employability, higher wages and employment security. In the design of appropriate skill and employment policies it is important to bear in mind that when the skills of individuals are matched to the most appropriate job within the labour market, '*economic value is created of a magnitude that few other economic processes can*' (Lazear and Oyer, 2009).

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Annex 1

Chart A1(a): Shortages of staff for skilled jobs by broad economic sector, EU-27, 2009

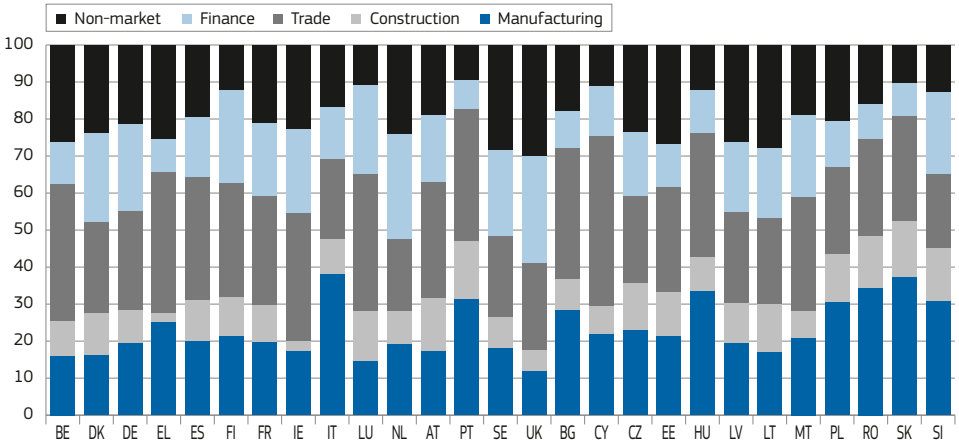
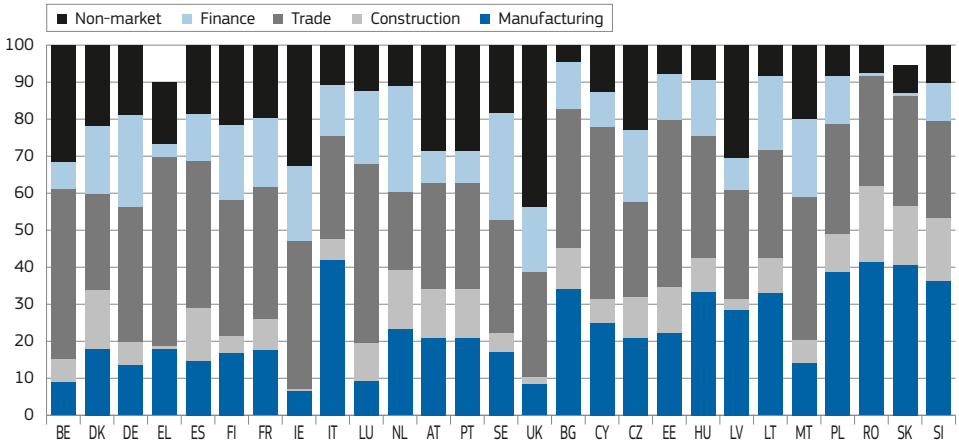


Chart A1(b): Shortages of staff for low-skilled/unskilled jobs by broad economic sector, EU-27, 2009



Source: ECS (2009).

Notes: The broad sector 'Trade' includes retail and wholesale trade, hotels and restaurants and transportation; 'Finance' includes financial and real estate services; 'Non-market services' include public administration, education and health care.

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Annex 2

Table A.2: Average incidence of vertical mismatch among 25-64 year olds, % of employees, 2001-11, EU-27

	Ordinary		Severe	
EU MS	Under-qualified	Over-qualified	Under-qualified	Over-qualified
AT	17%	18%	3%	8%
BE	29%	14%	14%	11%
BG	16%	9%	4%	9%
CY	22%	20%	15%	16%
CZ	10%	8%	3%	7%
DE	17%	18%	5%	11%
DK	18%	15%	7%	10%
EE	21%	16%	12%	10%
ES	26%	22%	13%	9%
FI	28%	5%	22%	4%
FR	32%	12%	16%	11%
EL	17%	26%	8%	15%
HU	14%	11%	4%	6%
IE	30%	21%	16%	11%
IT	20%	21%	4%	8%
LT	18%	23%	4%	5%
LU	14%	18%	5%	10%
LV	20%	17%	8%	8%
MT	20%	20%	6%	11%
NL	26%	17%	11%	11%
PL	12%	9%	4%	6%
PT	12%	21%	5%	10%
RO	10%	9%	2%	4%
SE	22%	13%	9%	9%
SI	13%	8%	3%	6%
SK	10%	7%	4%	7%
UK	28%	14%	15%	8%
EU	21%	15%	8%	9%

Source: Cedefop, based on EU-LFS data (2001-11).

Notes: Over-qualified (under-qualified) workers are those whose highest level of qualification attained is higher than (is lower than) the qualification requirement of their occupation. Individuals are classified as severely mismatched if their qualification level is more than one step away from the required qualification in their job on the five-point ISCED scale. The modal qualification in each occupational group at the two-digit level is used to measure qualification requirements.

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Annex 3

Chart A3(a): Distribution of over-qualification by underlying type of mismatch, EU-25, 2001-09

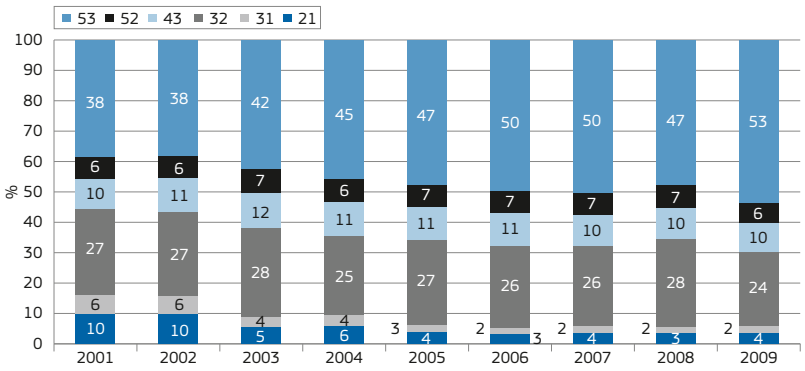
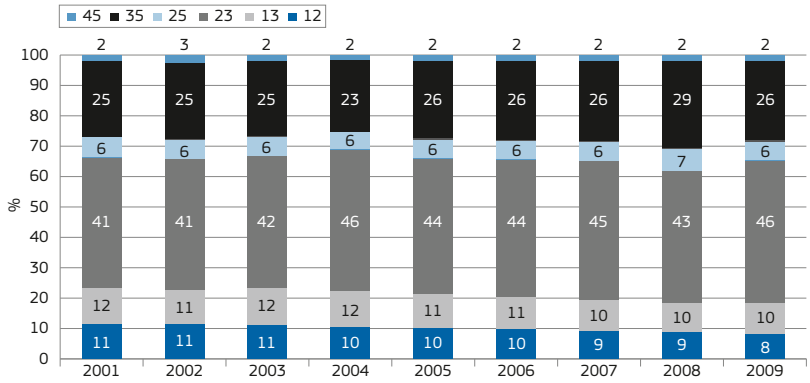


Chart A3(b): Distribution of under-qualification by underlying type of mismatch, EU-25, 2001-09



Source: Cedefop, based on EU-LFS data (data for MT and DE not available).

Notes: The incidence of vertical mismatch is decomposed in each year according to the underlying type of the mismatch as follows: [Education level of individual (ISCED level), Modal educational requirement of occupation] e.g. 53 denotes over-qualification caused by individuals with an education level ISCED 5 or above (higher education graduates) who are employed in jobs requiring upper secondary graduates (ISCED 3). The figures within the bars denote the % contribution of each category to the total annual level of mismatch e.g. 53% of the total level of EU over-qualification in 2009 can be attributed to the type of mismatch '53'. Appropriate weights used (COEFF).

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Annex 4

In the empirical estimations shown in Table 8, Cronbach's alpha measure is used to generate indices of a large number of similar variables that are contained within the EWCS (2010) dataset. The various indices are defined as follows: *Bad working conditions - exposure*: whether the individual is exposed at work to vibrations, loud noise, high and low temperatures, breathing in fumes and vapours such as solvents, handling or being in direct contact with chemical products and/or infectious material, tobacco smoke from other people. *Bad working conditions – ergonomics*: whether the main job involves tiring or painful positions, carrying or moving heavy loads, standing, repetitive hand or arm movements, working at very high speed and working to tight deadlines. *Bad hours:* How many times a month do you work at night, in the evening for at least two hours from 6-10pm, on Sundays, on Saturdays, shifts and more than 10 hours a day. *Inflexible hours:* Do you work the same number of hours per day, the same number of days per week, the same number of hours per week, fixed starting and finishing times. *Job latitude*: Are you able to choose your order of tasks, your methods of work, your speed or rate of work.

Annex 5

Table A5: Incidence of vertical mismatch by occupational group (1 and 2-digit), 2009, EU-25

Occupational group	Over-qualification	Under-qualification	Educational requirement
	(1)	(2)	(3)
LEGISLATORS, SENIOR OFFICIALS AND MANAGERS	**3%**	**38%**	**5 (1-5)**
Legislator and senior officials	5.4%	32.8%	5 (3,5)
Corporate managers	0%	39.5%	5
Managers of small enterprises	22.9%	27.1%	3 (1,3,5)
PROFESSIONALS	**0%**	**13%**	**5**
Physical, mathematical and engineering science professionals	0%	16.5%	5
Life science and health professionals	0%	12.5%	5
Teaching professionals	0%	6.9%	5
Other professionals	0%	18.8%	5
TECHNICIANS AND ASSOCIATE PROFESSIONALS	**24%**	**18%**	**5 (3-5)**
Physical and engineering science associate professionals	26.9%	15.2%	3 (3-5)
Life science and health associate professionals	13.7%	16.9%	5 (3-5)
Teaching associate professionals	17.3%	18.9%	5 (3,5)
Other associate professionals	27.3%	18.8%	3 (3,5)
CLERKS	**22%**	**22%**	**3 (3-5)**
Office clerks	21.5%	21.8%	3 (3,5)
Customer services clerks	22.3%	22.2%	3 (3,5)
SERVICE WORKERS AND SHOP AND MARKET SALES WORKERS	**19%**	**24%**	**3 (1-5)**
Personal and protective services workers	16.2%	27.8%	3 (1,3,5)
Models, salespersons and demonstrators	24.6%	15.6%	3 (2,3)
SKILLED AGRICULTURAL AND FISHERY WORKERS	**15%**	**33%**	**3 (1-3)**
Skilled agricultural and fishery workers	14.7%	32.9%	3 (1-3)
CRAFT AND RELATED TRADES WORKERS	**17%**	**17%**	**3 (1-4)**
Extraction and building trades workers	15.3%	21.2%	3 (1-4)
Metal, machinery and related trades workers	18.9%	13%	3 (1-4)
Precision, handicraft, craft printing and related trades workers	22%	13%	3 (1-3)
Other craft and related trades workers	13.3%	15%	3 (1-3)
PLANT AND MACHINE OPERATORS AND ASSEMBLERS	**15%**	**22%**	**3 (1-3)**
Stationary plant and related operators	19.2%	19%	3 (1-3)
Machine operators and assemblers	16%	22.4%	3 (1-3)
Drivers and mobile plant operators	14.3%	21.7%	3 (1-3)
ELEMENTARY OCCUPATIONS	**23%**	**27%**	**2 (1-3)**
Sales and services elementary occupations	24.6%	26.9%	2 (1-3)
Agricultural, fishery and related labourers	31.2%	17.5%	2 (1-3)
Labourers in mining, construction, manufacturing and transport	17%	29.6%	3 (1-3)

Source: Cedefop, based on EU-LFS data (data for MT and DE not available).

Notes: The EU-wide educational requirement (column 3) refers to the most frequently observed ISCED value within the range of modal qualifications for each occupational group observed across the EU-25 countries (range shown in parenthesis). Appropriate weights used (COEFF).

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