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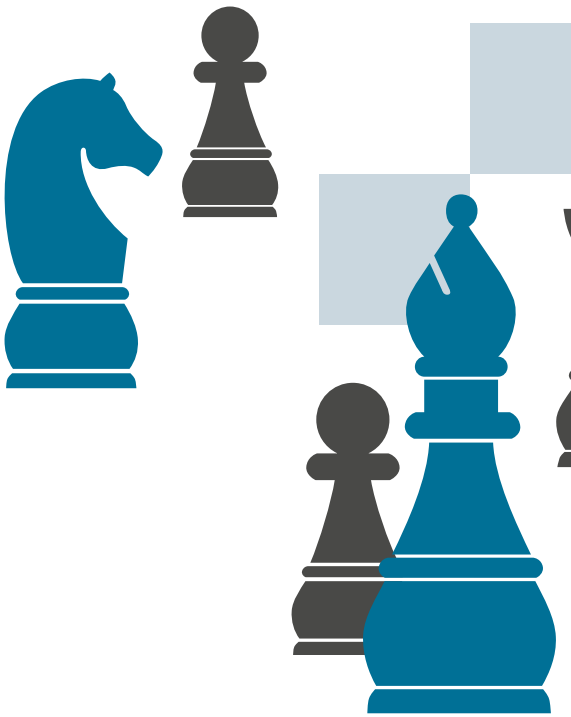
SKILLS SUPPLY AND DEMAND IN EUROPE



MEDIUM-TERM FORECAST UP TO 2020

CEDEFOP

Skills supply and demand in Europe

Medium-term forecast up to 2020

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is available on the Internet.
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The **European Centre for the Development of Vocational Training** (Cedefop) is the European Union's reference centre for vocational education and training. We provide information on and analyses of vocational education and training systems, policies, research and practice. Cedefop was established in 1975 by Council Regulation (EEC) No 337/75.

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Foreword

Europe's citizens and businesses have been hit severely by the economic slump. To recover speedily and tackle long-term challenges, we must unleash Europe's potential. But Europe's youth unemployment is soaring and its share of low-qualified people, who have fewer chances to develop their skills than others, is high.

To compete in the global market, Europe needs to generate higher quality and more innovative products and services. Higher productivity is essential to maintain our social model. New jobs and new skills are emerging, as technology, innovation, demographic change and climate strategies generate new demands. Downturn and exit strategies are accelerating economic restructuring. This will affect the type of skills needed.

Europe is devising its strategy for the next decade. It aims to stop further setbacks and to create a smart, green, sustainable, inclusive and high-employment economy. Skills to adapt and to shape the jobs of tomorrow are essential for Europe's citizens.

But which skills does Europe need to thrive? Which skills will Europe's citizens have? More than ever policy-makers, employers, skills providers, employment services and individual learners need clearer information. Clarity can lead to better informed decisions on skills development and career choice.

This need for clarity has made anticipating change central to the EU's new skills for new jobs initiative. Cedefop has been entrusted with providing regular European skill forecasts. This project to anticipate future developments and to promote a coordinated approach has been supported by the European Commission. Cedefop's new forecast is very timely. Taking account of the downturn effect, it projects skill demand and supply up to 2020 at a time when Europe is readjusting its policies.

While forecasts cannot predict the future precisely and in great detail, they can signal trends and complement other labour market information. Their forward-looking dimension is key to inform policy which needs to devise long-term and proactive strategies. Forecast results also have an early warning function as they can point to areas that may need more attention and highlight areas where we need to know more.

Forecast results do not only benefit policy-makers. They also benefit people who choose or need to change education and training or career paths,

education and training providers, guidance and placement services and enterprises. The better they are informed, the more effective their decisions on skills investment will be.

This forecast confirms earlier trends, even though job opportunity estimates for the next decade are lower than previously projected. Europe is on its way to an economy where services and knowledge- and skill-intensive occupations will prevail. Total job opportunities, which also include the need to replace those who retire, will still be high, even in occupations which are decreasing. We can see that jobs will mainly require medium- and high-level qualified people. At aggregate level, the forecast suggests that demand and supply trends across countries are converging.

But if we take a closer look, we can identify areas of potential tension and these we need to understand better. We certainly need to know more about how jobs are changing and tasks are developing, what knowledge, skills and competences people really have apart from their specific formal qualification and which skill mix they need to develop. We also need to have a clearer idea of how supply and demand match. This information is crucial to understand if there is a risk of skill mismatches and overskilling in certain occupations, as the forecast seems to suggest.

What becomes evident from the forecast results is the need for continued investment in education and training, as jobs are generally becoming more 'knowledge and skills-intensive'. If people lack the right skills, or cannot make use of them, they are more vulnerable to labour market change. This also calls on employers to use better the skills and talent of their staff to foster innovation and people's development. And we need to tap the potential of the inactive, in particular women whose qualifications are surpassing those of men. In view of ageing populations we cannot afford to waste any human resources. Recognising the skills people acquire at work for education and training and job mobility is crucial.

To support a Europe where people can develop the right skill mix to perform in and shape jobs, we need stronger bridges between the worlds of work and education and training. And we need an improved capacity to anticipate change, as the expert group report *New skills for new jobs: action now* (European Commission, 2010a) ([1]) and Europe's strategy for 2020 emphasise.

To this end, Cedefop will continue to provide regular and systematic skills forecasts, pilot an employer survey and reinforce research on the content of

([1]) http://ec.europa.eu/social/main.jsp?catId=568&langId=en

skills and competences as well as skill mismatch. To improve the database, DG Employment, DG Education and Culture and Cedefop have also embarked on a joint initiative to develop a common language that better captures available skills and those required. These initiatives aim to support a better match of skills and jobs, which is not a luxury, but one of the keys to economic success and social cohesion.

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Executive summary

Anticipation of changing skill needs lies at the heart of the new skills for new jobs agenda. The new Cedefop forecast of changing skill demand and supply in Europe ([2]) up to 2020 updates the forecasts carried out in 2007-08 by applying improved data and methods. It also attempts to estimate the medium-term impact of the financial crisis of 2008, and the subsequent recession, based on the available data.

Impact of the recession: fewer jobs overall and only modest job creation

The crisis has had a dramatic impact on economies and labour markets worldwide. Despite indications that the world economy is now emerging from recession, it is likely that employment growth in Europe will only gradually recover in the next decade.

There are probably around 10 million fewer jobs now and over the next few years than would have been expected without the crisis. In the central baseline scenario, which assumes a modest recovery, employment in 2020 is likely to be higher than in 2010 but will not reach the peak of 2008. In total, around seven million jobs are expected to be created in the period 2010-20.

Developments in skill supply: towards a more highly qualified workforce

The future number of people and the qualifications they hold (supply) is largely predetermined by demographic development and education and training decisions already made, although most young people, aged 15-24, are still in the process of acquiring qualifications.

The overall supply trends measured by the number of economically active people (labour force aged 15+) with high- and medium-level qualifications remain positive. Substantial increases are projected for those who are qualified

([2]) The new forecast covers 29 European countries (EU-27, Norway and Switzerland); it is referred to in the text as EU-27+.

at the higher level, holding a university degree or equivalent (16 million). Although the supply of those with medium-level qualifications, mainly vocational, is expected to increase to a lesser extent (one million), they will still form the majority of the European labour force (50%). The labour force with low-level qualifications is projected to fall by around 15 million. This reflects strong cohort effects, as young people entering the labour market are higher qualified and lower-qualified older people are leaving the active workforce.

A closer look at individual countries confirms this overall picture. The results show that for nearly all countries the share of the labour force qualified at high level is projected to be greater in 2020 than in 2010. In contrast, the shares of people with low (or no) qualifications are generally projected to fall. The picture at medium level is more complex. In some countries shares are rising, in others they are projected to decline. In general, shares of medium- and highly-skilled people are clearly converging across European countries.

On average, women are projected to be formally higher qualified than men, except at medium qualification level, where the rates of increase are higher for men than women. The proportion of the labour force with low-level qualifications is projected to decline across Europe, and this decline will be sharper for women than for men. These general trends are observed in almost all countries.

For the age groups 25 and older the increase in numbers of high-level qualifications is rather sharp. The age group 25-34 is projected to experience the biggest increase in high-level qualifications. The number of people with a qualification at medium level is projected to decline for all age groups up to 34, but to increase for groups aged 35+. This is again an indication of cohort effects as the labour force is ageing, and the fact that younger people are nowadays generally higher qualified than older people. Consequently, the qualification structure of those aged 55 and over is also projected to change substantially over time, as more and more younger cohorts with medium- and high-level qualifications move into this group. Labour market participation rates among some older age groups are expected to increase as general health and fitness improves, their qualification levels are higher than those of today's older generation, and their ability, need and desire to work in later years increases.

Sectoral change: continued trend towards jobs in services

Recessions tend to accelerate sectoral change. However, sectoral employment trends post-recession are projected to be broadly similar to those pre-crisis, namely towards a service economy and away from primary and some manufacturing activities, albeit at lower absolute levels.

In the period 2010-20, further substantial decline in employment in primary industries is projected (with a loss of around 2.5 million jobs, especially in agriculture). Job losses (around two million) are also expected in manufacturing and production industries. The main areas of employment growth are in services, especially marketed services. Business and other services are projected to see a growth of around seven million jobs. Significant increases are also expected in distribution and transport. The projected moderate growth of employment in non-marketed services results from considerable job creation in healthcare and education which will, however, be partly offset by reduced labour demand in public administration due to expected budgetary constraints.

Occupational prospects: knowledge- and skills-intensive jobs dominating

For occupations, the main trends of recent years are expected to continue in the next decade, reflecting employers' decisions made in the past. Almost 40% of people are currently employed in higher level (knowledge- and skills-intensive) jobs such as managers, professionals and technicians. All these jobs are expected to increase over the next decade and, in 2020, have a share of more than 42% of total employment. In contrast, jobs requiring traditional agricultural skilled workers, several other craft and related skills and clerical skills will decline. This is linked to sectoral structural change, globalisation and technological progress which may displace many routine jobs. However, significant expansion is expected for many service occupations (retail and distribution) and also for elementary occupations. These changes in occupational structures with increased demand at the upper and lower ends of occupations, and decreases or stagnation in the middle, can signal a risk of job polarisation and bring concerns about quality of jobs. However, the situation for Europe as a whole is not very dramatic, as the share of ele-

mentary jobs in total employment is expected to be below 11% in 2020 (increase by only 1% since 2000). Job polarisation could be more pronounced in countries still in transition to service-based economies.

Net employment change for particular occupational groups (expansion demand) can be positive (job creation) but also negative (job losses). Most additional jobs expected are in knowledge- and skill-intensive occupations, mainly high-level managerial, professional and technical jobs (8.5 million). Demand for service-related occupations such as sales, security, catering and caring will increase by more than two million. Demand for office clerks will decrease by around a million and other job losses (over four million) are projected for skilled manual workers. At the lower end, an increased demand for elementary occupations (around two million) is projected. Altogether, net employment change adds up to more than seven million in the 2010-20 decade.

The importance of replacement demand needs to be emphasised as it is a substantial part of all total job openings. This means that even occupations which will face net job losses will still remain viable sources of employment resulting from the need to replace workers leaving for various reasons (mainly due to retirement). Replacement demand (around 73 million jobs) is projected to be positive for all occupations. Consequently, the total number of job openings – the sum of replacement demand and expansion demand – is projected to be around 80 million over the next decade; it is positive for all occupations.

Future skill needs: high- and medium-level qualified in demand

In terms of formal skills, changes in industrial structure will combine with skill-biased technological change to increase the demand for people with (formal) high and medium qualifications, at the expense of the low-qualified group.

In practice, observed future patterns of employment will reflect both demand and supply factors. The projections of employment by qualification are based on assuming that many features of historical employment and unemployment patterns among the qualified categories will continue. The implications are likely to be: increases in effective demand for those with high and medium qualifications in some occupations that used to require lower-level skills; and decline of the number of people in employment with low (or no) formal qualifications.

As a result, demand for highly-qualified people is projected to rise by almost 16 million. Demand for people with medium-level qualifications is projected to rise by more than 3.5 million. Conversely, demand for low-skilled workers is expected to decrease by around 12 million. The share of highly-qualified jobs will increase from 29% in 2010 to about 35% in 2020. The share of jobs employing those with medium-level qualifications will remain very significant (around 50%). In the same time period the share of jobs employing those with low qualifications will decrease from 20% to less than 15%.

The right skills for the right jobs?

Overall, the main trends of rising demand are paralleled by rising supply. However, the skill requirements of many jobs will not remain unchanged and it is key to understand how they are evolving not only in terms of formal qualifications but also in terms of detailed skills and competences. To ensure the best match of skills, individuals should acquire a combination of transversal core skills with the specific skills needed for a job as soon as possible and develop them further throughout life (European Commission, 2010a).

It is important not to interpret the results on imbalances too literally. Trends, both in supply (towards a more highly-qualified workforce) and in demand (towards increased need for such people in employment), are hard to predict precisely. They also interact: supply can to some extent generate and shape demand, and vice versa.

The recession might exacerbate structural differences in skill demand and supply. The results as well as lessons from past recessions suggest that it might be more difficult for some of those qualified at medium and higher levels to find the jobs they would like. There are indications that the positive trends in demand are less strong than expected before the recession and there are some concerns about whether future job opportunities will match the qualifications – and expectations – of younger people. The results also suggest increased deployment of higher- and medium-qualified people in jobs that used to require lower level skills. Despite these developments high- and medium-qualified workers will still have relatively better chances of getting better jobs than those with low formal qualifications. This may be a temporary phenomenon for some individuals, but the longer it lasts the more frustration it may cause to those affected, not to speak of losses of prior investment in time and money. None the less, it can also open up opportunities for individuals to shape and enrich their jobs in ways that employers may not have

thought of. It may also reflect increasing job requirements for many occupations which are not (yet) captured in traditional classifications.

In any case, research by Cedefop and others suggests that overqualification is not a problem per se. But underutilisation of skills and competences is certainly a potential problem not only for individuals but also for employers and society as a whole (Cedefop, 2010a).

Reflections on the core outcomes

The forecast results point to areas that require more research into jobs and their tasks, how they are changing, how employers match supply and demand and how they use the skills of their staff. Skill needs and supply also need to be contextualised, as they are embedded in dynamic interactions between the broader economic and social context and development of human resources. Complementary qualitative information that gives a clearer picture of the skills available and those required could improve the data based on the traditional ISCO and ISCED qualifications in the medium to longer term.

To ensure that people are fit for occupational mobility and further learning, education and training policies should provide occupational skills combined with key competences and transversal skills in initial, as well as continuing training. Sound labour market information and less linear approaches to learning and work combined with effective guidance and recognition of non-formally and informally acquired skills could help people to adapt more quickly to structural changes. Complementary policies for education and training, employment and social welfare could ease integration of those currently outside the labour market and promote better use of women's potential. But it is also important that employers take the lead by making more effective use of existing skills and encouraging skills development.

In short, Europe should give greater emphasis to bring the world of education and work together, increase use of skills and stimulate employer demand. A look beyond the fence at developments in the BRIC countries (Brazil, Russia, India, China) and other fast developing nations suggests that Europe has no room for complacency if it wants to stay competitive.

This is not the end ...

A few years ago, Europe did not have a comprehensive system to carry out consistent skills projections across countries. Cedefop has now set in place a firm foundation for undertaking such forecasts regularly which will be updated every two years.

The analysis would benefit greatly from complementary data on skill demand on what people should know and be able to do in particular jobs; likewise data on skill supply should not simply reflect formal qualifications but outcomes of all types of learning, including non-formal and informal learning. The new initiative by DG Employment, DG Education and Culture and Cedefop to complement traditional classification systems of occupations and qualifications by related competences expressed in a standardised language could help improve the data and foster a better match of supply and demand.

Among the many other areas that need further refinement and improvement, are the urgent need to improve existing data sources, to develop new surveys, to harmonise related work at national level and to devote more attention to fields of study and occupational requirements. These improvements are also a prerequisite to assess prospective employment opportunities and skills requirements for different sectors and regions within and across national boundaries.

Cedefop will continue its work on improving the regular forecasts, researching various forms of skill mismatch and developing and piloting a new European employer survey on skill needs. It will also continue to investigate sectoral skill needs, in particular for green jobs.

As with education more generally, this is a costly business, but the private and social costs of insufficient labour market information and intelligence are even greater. There is an urgent need to make the necessary investments in data and methods to bring Europe generally up to levels of best practice worldwide.

The more so as the audience for the results is not just policy-makers. It is crucial that people who choose education and career paths, education providers, guidance personnel as well as enterprises that invest in education and training make informed decisions. The lessons from other countries such as the US (with its O*NET) demonstrate the value of such information.

1. Introduction

1.1. Background and rationale

Cedefop's work on early identification and anticipation of skill needs started in 2001-02. In 2008, the first pan-European forecast of skill needs (demand) was published and provided for the first time consistent and comprehensive projections of employment and skill needs across Europe until 2015. In 2009, Cedefop presented a complementary forecast of skill supply in Europe until 2020.

The new Cedefop forecast brings the supply and demand projections together ([3]) applying improved data and methods, considering all information available so far about the impact of the crisis. This publication provides a synthesis of the new results of Cedefop's forecast of skill supply and demand in Europe.

The overall aim of the project is to develop a system of regular, detailed and consistent projections of future skill demand and supply across Europe. Although many countries are already undertaking this kind of work, Cedefop offers a unique pan-European perspective. Such pan-European projections do not intend to substitute what is being done nationally, but rather to complement them. Pan-European projections should not compete with forecasting work of individual countries, which draws on many years investment in data, systems and knowledge, but offer a common framework and a consistent set of underlying assumptions. They therefore can provide a context for more detailed national analyses and forecasts.

The rationale for regular, coherent and systematic skill demand and supply forecasts in Europe is now well established. The Lisbon agenda, followed by several related policy initiatives, has given high priority to anticipation of changing skill needs. Globalisation, technological and organisational change combined with demographic developments (including ageing populations and migration) are posing huge challenges, offering both risks and opportunities.

([3]) The two pilot projects developed the basic database and tools required to produce a comprehensive and consistent set of skill demand and supply projections for all countries in the EU. Building on the skill demand forecast (Cedefop, 2008), the skill supply forecast (Cedefop, 2009) extended the modular approach adopted there to anticipation of Europe's future skills supply. The current projections build on the results of these pilot projects.

The need for regular forward-looking assessments has received further impetus following the setting of employment targets and related policy documents such as the integrated guidelines for growth and jobs (2008-10) ([4]), the Council resolution on new skills for new jobs ([5]), and the Spring 2008 Council conclusions ([6]) where EU Member States asked the European Commission to report on future skills requirements in Europe up to 2020. As a response, the European Commission launched the new skills for new jobs initiative in December 2008 ([7]). *New skills for new jobs: action now* (European Commission, 2010a), a report recently prepared by an expert group set up by the European Commission also emphasised the need for an overall coordinated approach to improve Europe's capacity to anticipate change. After wide consultation among stakeholders, the Commission included the new skills for new jobs agenda as a flagship initiative in its new EU 2020 strategy (European Commission, 2010b) ([8]).

Cedefop supports the European Commission and Member States by providing regular skill supply and demand projections. They can help inform education and training, active labour market and other related policies to guide the decisions of all those investing in human capital and initial and continuing education and training, to retrain the unemployed or reintegrate the economically inactive.

Regular and detailed qualitative projections can help to fill existing information deficits and prevent future labour market imbalances (early warning); inform various actors on future labour market needs, as an aid to their choices and decision-making; support policy-making at national and European levels in employment and social protection, lifelong learning, guidance and counselling and migration; and answer key questions such as:

- in which sectors will employment be growing;
- which occupations and qualifications will be in demand;
- what about replacement needs;
- how will this compare with supply;
- what potential labour market imbalances may occur.

([4]) http://ec.europa.eu/growthandjobs/pdf/european-dimension-200712-annual-progress-report/200712-annual-report-integrated-guidelines_en.pdf

([5]) http://ec.europa.eu/social/BlobServlet?mode=redirLinks&url=http://eur-lex.europa.eu/ChangeLang.do?lexlang=en&URL=/JOHtml.do?uri%3DOJ%3AC%3A2007%3A290%3ASOM%3ADE%3AHTML.

([6]) http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/ec/99410.pdf

([7]) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52008DC0868:EN:NOT

([8]) http://ec.europa.eu/eu2020/

It is generally accepted that, in a market economy, it is neither possible to predict the future precisely nor to go back to a kind of manpower planning. But policy-makers need to devise strategies and related investments which can influence the future path of the economy and the labour market. Such choices need to be guided by robust labour market information and intelligence (LMII), including a forward looking element. The role of labour market information and intelligence is twofold: to assess existing skill needs and to provide a longer-term perspective, so that we not only anticipate future requirements but can also actively shape them (European Commission, 2010a). This needs to be based on regular, systematic early warning systems using forecasting, scenario development and other approaches. Skills are a key part of the economy's infrastructure, and right choices made by policy-makers, enterprises and individuals on investment in education and skills can help drive economic development.

A range of approaches to assess future skill needs is required. They need to encompass both quantitative and qualitative methods and serve a broad range of audiences, including policy-makers, education and training providers, other stakeholders such as public employment and guidance services, social partners, sectoral organisations, practitioners in education and training institutions and enterprises and analysts. The results should be useful to all these audiences, across all countries covered.

All this has been given additional impetus by the financial crisis of 2008 and the subsequent worldwide recession. The crisis has increased uncertainty about ongoing and possible future developments. These issues are addressed explicitly in this project, which builds on previously published results (Cedefop, 2008 and 2009) and information available up to end-2009. The results presented here cover all Member States of the EU plus Norway and Switzerland (hereafter EU-27+) ([9]).

It is important to recognise what such forecasts can and cannot do. They can help inform labour market participants and actors and help labour markets work better. But they cannot provide detailed data to guide investment decisions at grassroots' level, for example the future number of jobs in very specific occupations or the wide range of competences, skills and knowledge required in a particular job.

([9]) Previous projections excluded some countries because of data limitations. Care needs to be taken in comparing current results with earlier ones for this reason and for different data vintages.

1.2. Objectives and approach

The general aim of this project is to build capacity and improve the capability to anticipate changing skill needs across Europe, and to understand better the main drivers of change. The need to improve labour market information and intelligence to inform decision-making of all actors is crucial. This can help to identify possible new jobs for Europe, as well as highlight those threatened by structural change.

The main objective of this project is to develop a robust system for producing medium-term forecasts of skill needs (demand and supply), at pan-European level, based on readily available, comparative data and advanced methods. Such forecasts will be carried out and disseminated regularly.

This publication highlights the key results emerging from the project. For the first time these include detailed, comprehensive and consistent quantitative projections on both skill supply and demand covering the whole of Europe (EU-27+). The focus in this publication is on the period 2010-20 ([10]). The publication sets out the general approach adopted, the limitations of this work, and priorities for future research. Of course, there are many data and technical problems with which the research team has had to grapple. Therefore the research done so far should be seen as part of an ongoing programme of work.

The project focuses on skills needed (demand) in sectors and occupations and on (formal) qualifications of individuals (supply), using comparable data across all countries. A key focus was creation of a general conceptual framework and a modular approach which together form the foundation for further development. The method has involved encouraging systematic dialogue and discussion with individual country experts.

The demand side (skill needs) focuses on employment – number of jobs to be expected in sectors and occupations, and the qualification required. The supply side focuses on the numbers of people economically active and, in particular, the qualifications they hold. By comparing both it is possible to infer first indications of possible imbalances. In reality, of course both employment and the labour force – and the qualifications they need and hold – are the results of both demand and supply factors and decisions taken by the various actors. In the medium to longer term, supply can influence demand and vice versa.

([10]) However, 2009 is partly estimated as not all data were available when the forecast was carried out.

Use of common models and assumptions does not always allow incorporation of local data and knowledge on detailed policies and other factors that may affect skills supply and demand. But they do present a consistent overview across all countries, using common data sets and the same methodology as in the two preceding forecasts (Cedefop, 2008 and 2009). The results have benefited from scrutiny by and comments from many country experts (members of Cedefop Skillsnet ([11]) expert network). In addition the project team was strengthened by other country group experts ([12]) engaged to scrutinise the results for groups of countries in more detail and ease discussion of the results. The results presented here need to be seen in that context. They should be supplemented by other country-specific and qualitative information before reaching firm conclusions. They should be seen as just one of several important building blocks in developing a consistent pan-European view of current and possible future developments.

Given the difficulties faced, a certain amount of pragmatism was required, but the results provide an important contribution to the debate on the changing patterns of skills demand and supply in Europe. In principle, the projections of future supply allow comparison with likely future demands. However, such comparisons are sometimes fraught with difficulty and not always straightforward. The report explores some of these issues and draws out the implications of balancing the demand for and supply of skills over the longer term.

This publication focuses on reviewing the main results of the demand and supply projections in Europe. In addition, there are several more technical documents available which explain in more detail how these have been produced, including technical information on data sources and methods ([13]). Further, the project has included a number of other elements that complement the core research. This includes work to explore the possible links between skills, technological change and productivity performance, as well as research to develop a more detailed picture of occupational skill profiles. The latter has explored the potential benefits from exploiting existing work such as the US

([11]) Skillsnet is a network of experts from across the world with an interest in skills anticipation, established and coordinated by Cedefop (http://www.cedefop.europa.eu/EN/about-cedefop/networks/skillsnet/index.aspx).

([12]) The country group experts consist of Pekka Tiainen, Catalin Ghinararu, Tim Grebe, Matthias Kirbach, Simonas Gaušas and Haroldas Brožaitis, in addition to other members of the core research team.

([13]) These include the following papers and reports: Stehrer and Ward (2010); Pollitt and Chewpreecha (2010); Livanos and Wilson (2010a and b); Kriechel and Sauermann (2010); and Kriechel and Wilson (2010) (available from Cedefop on request).

O*NET system from a European perspective. It demonstrates that much of the information in the US system has more general relevance. Many countries throughout the world are already using it in combination with their own databases. With some effort it can also be exploited in a European context to provide a richer picture of changing skill needs. These and other elements will be explored further in the near future, to improve the next round of projections to be carried out in 2011.

Quantitative projections should not be seen as deterministic or prescriptive. Structural change, and its implications for changing skill needs, should not be mechanistically predicted. Neither qualitative scenarios nor quantitative projections should be seen as precise predictions of future reality. They are more about preparing for future opportunities or serving as an early warning system by indicating potential future problems. Cedefop's work aims to help move Europe towards a world class infrastructure for anticipation of changing skill needs. It builds on:

- existing strengths, networks and capacity, by identifying and helping to fill gaps and deal with problems in basic data;
- improving model building and technical capability;
- developing capacity and capability across Europe;
- strengthening and developing networks;
- improving strategic thinking and policy-making relating to skills at European level.

Extensive previous reviews (see for example Wilson et al., 2004), confirm that best practice in quantitative skills forecasting requires a multisectoral macro model. The changing demand for labour and skills is derived from the demand for goods and services and related economic parameters. Similarly, the supply of skills needs to be seen in the broader context of demographic and socioeconomic change that a macroeconomic model can provide. The conceptual framework developed for the two previous Cedefop forecasts provides such a foundation. This is described in detail in Section 2. However, there is an urgent need to work further towards improving Europe's technical capability and the models used for this work.

While there have been significant methodological improvements in recent years, as identified by the two previous Cedefop forecasts, some concerns about data quality remain. In some areas, not all Eurostat data are fully sufficient, especially on detailed trends in skill demand within sectors and occupations and some other aspects of skill. There is also a lack of consistency both over time and across countries. The project has helped to identify where the main problems are, and begin to develop a more consistent

and robust database. However, in many cases the data used are still subject to some uncertainty. This refers not only to data reflecting the economic crisis, but also to general problems of pushing the European labour force data (LFS) and other data to the limits in terms of the amount of detail they can reveal. By presenting such results for further expert scrutiny, it is hoped that the dialogue that has already begun at Cedefop Skillsnet expert workshops and other events can be used to improve the results in subsequent projections.

In addition to the results reported here, a set of Excel workbooks has been produced containing the detailed data for each country. They represent the most comprehensive and consistent set of skill demand and supply projections ever produced for Europe. These are available to Skillsnet members on request (contact: skills-analysis@cedefop.europa.eu).

As mentioned above, a multifaceted approach is required, involving both quantitative and qualitative approaches. Although the main focus of Cedefop in the last years was on development of quantitative projections, based on econometric analysis and using well-established models and techniques, Cedefop is continuing in parallel its work to develop a European employer survey on skill needs. It aims to complement, in the medium to longer term, the quantitative forecasts with other information. Cedefop also continues to identify new and emerging skill needs in selected sectors, currently with particular focus on skills for green jobs (in cooperation with ILO), and works on complementary research that aims to provide a comprehensive assessment and analysis of skill mismatch in Europe.

1.3. Structure of the publication

Section 2 explains briefly how the results have been produced. For those readers requiring more detailed explanation of the methodology, data sources and methods, further details are available in background papers which can be requested from Cedefop. Section 3 sets out the general economic and employment prospects, including alternative scenarios calculated in this project. Sections 4, 5 and 6 present the main findings of the research, also highlighting key messages for policy-makers and others. While Section 4 focuses on skill supply in Europe, Section 5 provides the main results on future skill demand in Europe by sector, occupation and level of qualification. Section 6 discusses potential labour market imbalances between skill supply and demand. Section 7 concludes with some implications for policy and priorities for further research.

2. Methodology

The methods used to forecast Europe's future skill needs and supply are quite complex and technical. The basic methodology is econometric modelling using time series data. This methodology combines and develops research made in previous Cedefop projects – *Future skills needs in Europe* (Cedefop, 2008) and *Future skill supply in Europe* (Cedefop, 2009). The adopted modular approach supports independent development and improvement of the different parts of the system.

The framework was designed to promote further development and customisation. In particular, it allows for refinement of modelling approaches used for projecting occupational and qualification structures, and replacement demand. It also allows for improvement or replacement of data for particular countries or sectors where there are concerns about data quality and robustness. The present results are intended to continue a process of dialogue with experts from European countries who are likely to have much greater knowledge of employment trends and data in their own countries. This framework provides an opportunity for this knowledge to be built in to future assessments efficiently and transparently, as it makes it easy to incorporate new data and alternative or additional assumptions.

The project involved developing consistent databases and related tools to produce a comprehensive and consistent set of skill projections for all countries in the EU plus Norway and Switzerland (EU-27^{+}). It adopts common data, methods and models for all countries. Together, the demand and supply databases, and the related models and modules, constitute a conceptual framework for analysis of future developments in skills demand and supply across Europe (see Figure 1). Full details of the methodology are given in various technical reports that have been produced as project background papers. These include:

- refinement of the LFS data used to measure skills (Stehrer and Ward, 2010);
- description of the multisectoral macroeconomic scenarios developed to underpin the projections (Pollitt and Chewpreecha, 2010);
- analysis of trends in the demand for and supply of skills based on the LFS data and how this has been linked to E3ME (Livanos and Wilson, 2010a and b);
- the treatment of replacement demand (Kriechel and Sauermann, 2010);

- the treatment of imbalances, mismatches and the reconciliation of demand and supply estimates (Kriechel and Wilson, 2010).

The forecast presented is based on official data sources. The database draws primarily on Eurostat sources, in particular Eurostat demographic data, national accounts (NA), the European labour force survey (LFS), and additional data on flows of those acquiring and attaining qualifications (UOE). The LFS data in particular have been subject to considerable scrutiny and analysis to avoid discontinuities and other problems.

One important task of the project is finding the best data for measuring employment. Historically, most countries have invested considerable resources in developing data for their NA. In many respects estimates of employment on this basis are to be preferred as they are consistent with other key economic indicators such as output and productivity. On the other hand, the European LFS has the considerable advantage of providing measures of employment structures by skills (occupation and qualification), as well as gender and age, that are not available from NA-based estimates.

The numbers presented by sectors, as used in the multisectoral macroeconomic model, are based on NA, rather than LFS estimates. There are some significant discrepancies between these two sources which remain unresolved. These reflect sampling errors as well as other differences arising from different methods used to collect different data sets. The framework developed does, however, allow for alternative data and assumptions to be incorporated with relative ease. Users should however understand that for these reasons, although the LFS is a prime input, the final results will not match estimates for individual countries based solely on LFS.

The initial results, once completed, were validated by various country experts from Cedefop's Skillsnet network. In some cases this suggests the need to make changes to the results to take account of local knowledge. Procedures have been developed to adjust the results in response to such suggestions. This includes:

- amendments to E3ME sectoral results;
- amendments to labour supply results in E3ME;
- adjustments to skill demand results, including occupational and qualification shares;
- adjustments to skill supply results (qualification shares).

The last two procedures are built into the respective country workbooks. The first two are dealt with by making changes to E3ME scenarios.

2.1. Demand for skills

The demand side involves four main elements or modules. These include:

- Module 1: a set of multisectoral macroeconomic forecasts of employment, based on the E3ME macroeconomic model;
- Module 2: an occupational model, focused on explaining expansion demand within sectors adopting common classifications and data sources – LFS (EDMOD);
- Module 3: a qualifications module (QMOD), based on similar data sources, focusing initially on the implications for qualification intensities within occupations (demand) and without interaction with the supply side;
- Module 4: a replacement demand module, based on similar data sources, recognising the crucial importance of considering not just changing occupational employment levels but also the need to replace those leaving the workforce because of retirement, migration and occupational mobility (RDMOD).

Each module contains a database and models. With the corresponding skill supply elements they constitute the conceptual framework described in Figure 1.

- The results focus on future demand trends at pan-European level (EU-27+):
- by sector (up to 41 industries based on NACE classification);
- by occupation (up to 27 occupations based on ISCO classification);
- by qualification (three broad levels based on ISCED classification);
- plus replacement demands by occupation and qualification.

Together these produce estimates of the numbers of job openings (net employment change plus replacement demand) by skills (as measured by occupation and by qualification).

Detailed classifications and aggregations used are provided in Annex III.

Module 1: **Multisectoral macroeconomic model (E3ME)**

This module is based on the existing pan-European multisectoral macroeconomic model (E3ME) ([14]). This model delivers a set of consistent sectoral employment projections, which are transparent in the assumptions made about the main external influences on the various countries (including technological change and the impact of global competition).

E3ME combines the features of an annual short- and medium-term sectoral

([14]) Detailed model description is available at: http://www.camecon.com/ModellingTraining/suite_economic_models/E3ME.aspx

model, estimated by formal econometric methods, with the detail and some of the methods of the computable general equilibrium (CGE) models that provide analysis of the movement of the long-term outcomes. It can also be used for dynamic policy simulation and for forecasting and projecting over the medium and long terms.

The detailed nature of the model allows the representation of fairly complex scenarios, especially those differentiated according to sector and country. Similarly, the impact of various policy measures can be represented in detail.

The econometric grounding of the model makes it better able to represent and forecast performance in the short to medium term, while simultaneously addressing long-term outcomes. It therefore provides information closer to the time horizon of many policy-makers than pure CGE models.

An interaction (two-way feedback) between the economy and labour markets, energy demand/supply and environmental emissions is an undoubted advantage over other models, which may either ignore the interaction completely or only assume a one-way causation.

Like its predecessors, E3ME is an estimated model based on empirical relationships. The primary source of data provided by Eurostat (NA) is supplemented by the OECD Stan database and other more aggregate international databases.

E3ME is a detailed model of 42 product/industrial sectors, compatible with ESA95 (gross national income inventory) accounting classifications. It also has a linked set of 19 fuel-using sectors, including the energy branch, the energy-intensive sectors and four transport sectors. Labour supply is split by gender and into five-year age bands.

Module 2: **Expansion demand by occupation (EDMOD)**

The LFSs conducted in all countries, provide a source for employment by industry and occupation matrices. They have the advantage of being regularly conducted. They also adopt standardised sets of questions and systems of classification. While there are still some differences across countries, LFSs provide a broadly consistent set of data which can be used for producing occupational employment projections within the industries identified in macroeconomic models such as E3ME.

The forecasting model (EDMOD) based on these data, works out the implications for occupational employment of the projected sectoral employment levels developed from Module 1 using quite basic models (fixed coefficients, or extrapolations). The current approach also includes results based on development of more sophisticated econometric models.

Module 3: **Expansion demand by qualification (QMOD)**

Occupational employment patterns are only one way of measuring skills. Occupation can be understood as describing a particular job (related tasks, requirements, position, etc.). Qualifications represent the characteristics of people filling these jobs as well as one of the selection criteria when filling a particular job. From the education and training policy and planning point of view, the types of qualifications typically required are very important.

Even with only weak data for (formal) qualifications it has been possible to develop an extension to the EDMOD module, which allows inferences to be made about implications for qualifications.

Module 4: **Replacement demand (RDMOD)**

In addition to changes in overall occupational employment levels it is important to consider replacement demand arising from outflows from a job/occupation, such as retirements/deaths, transition to non-employment, net migration, and interoccupational mobility. Estimating replacement demand is not straightforward and is quite sensitive to the data sources used. Ideally, detailed data on labour market outflows and transitions (mainly retirements and occupational mobility) would be required to analyse replacement demand more accurately. However, these are not currently available and therefore this forecast relies on methodology based on stocks of age cohorts by occupations and qualifications, and excludes transitions from one occupation to another.

In general terms there is however agreement on what it is about – that is job openings arising because people leave the workforce or a particular occupation, for whatever reason. Previous work tended to focus on 'permanent or semi-permanent' withdrawals from the employed workforce. This includes retirement (and other reasons for leaving the workforce, including family formation), emigration, deaths, etc.

Information on age and gender of the labour force is required because many of the flows, especially retirements and transitions to inactivity are age and/or gender specific. Age structures also vary significantly by occupation and bring differences in the labour market behaviour. While older workers are leaving the labour market mainly due to retirement, younger people are changing occupations, forming families or migrating within countries.

From the LFS, it is possible to analyse the demographic composition of each occupation. This makes it possible to estimate specific rates of retirement for each occupational class (but still considering interoccupational mobility). LFS data can also be used for making estimates of rates of outflow. The replacement demand model (RDMOD) has been developed based on similar

data sources to the occupational model. It is driven in part by the occupational and qualification employment levels projected from Modules 2 and 3, in combination with models and information on the probability of leaving employment due to retirements, migration and other reasons (such as transition to inactivity). This part is closely connected to the skill supply forecasts described further.

Essentially, replacement demand for a particular category (such as an occupation) depends on two issues:

(a) the size of the category;

(b) the rate of outflow (which can in principle be separated to distinguish the various components described above).

Replacement demand is the product of (a) and (b). The main database and EDMOD produce (a) for each country, sector, occupation and gender category; RDMOD produces (b).

2.2. Supply of skills

The medium-term projections of skill supply, as measured by highest qualification held by people:

- produce consistent pan-European projections, using existing data broken down by age, gender and formal qualifications ([15]);
- are compatible with the projections of skills demand (focusing on qualifications).

Ideally, modelling and forecasting the supply of qualifications requires a detailed and comprehensive stock-flow model, with behavioural links which can be used to predict the distribution of people in the total population and labour force (employed and unemployed people) by highest qualification held ([16]). In practice, this ideal cannot yet be realised, as a detailed demographic or educational and labour market accounting system is still lacking at EU level.

([15]) In this project skill supply is not measured by occupations as it is not possible to attribute people to different jobs after acquiring particular qualification: the occupational decisions of individuals vary significantly and cannot be predicted. Moreover, employment in occupations will change in the life course of individuals.

([16]) This kind of model is used in many national projections of skill supply – see, for example, Wilson and Bosworth (2006) for the UK.

Current treatment of supply has two main strands:

- focus on stocks of people by three broad qualification levels (high, medium and low);
- analysis of flows of those undertaking courses and acquiring qualifications into the labour market (however, this part is not yet fully operational).

The results provide the future skill supply by highest qualification held as well as by age group and gender for:

- the whole population aged 15 and over,
- the labour force aged 15 and over.

Treating skills supply involves three main modules:

(a) **Module 1* – E3ME*:** an augmented/extended version of the existing E3ME pan-European macroeconomic model (see Section 2.1), which incorporates a new demographic and labour-supply module. This provides historical analysis and projections of overall labour supply by age and gender;

(b) **Module 5 – StockMOD:** an analysis of LFS microdata from Eurostat to project the probabilities of the population and the labour force to achieve different levels of qualification;

(c) in future, these will be complemented by **Module 6 – FlowMOD**: an analysis of aggregate flow data published by Eurostat/OECD (on enrolment and graduation) to produce a complementary analysis of participation and qualification rates by broad age groups ([17]).

Module 1* – E3ME*

E3ME models labour supply as a function of economic activity, real wage rates, unemployment and benefit rates. At present, model parameters are estimated for labour market participation in each country by gender and separately for different age groups. This is of key importance for modelling educational participation and attainment since these are known to be gender and age specific. This expanded model framework is then used to create a detailed set of baseline projections for labour supply, disaggregated by country, age groups and gender and covering a 10 to 15 year period. This model is key input for analysing the supply of qualifications and provides the link between

([17]) The results from FlowMOD are currently not fully consistent with nor integrated into those from StockMOD. Supply projections are therefore based solely on results from the StockMOD module. In future it is hoped to integrate these more fully, but this is likely to continue to be constrained by data inadequacies.

economic activity and labour market supply. Finally, these links can be used to provide a range of projections of available skills through scenario-based analysis. In this way, a range of projections can be formed around the baseline forecast, indicating areas that are most sensitive to the economic climate and change.

Modules 5 and 6 – StockMOD/FlowMOD

Several methods for modelling the supply of qualifications have been developed in recent years. The most sophisticated involve complex stock-flow models, with strong behavioural elements ([18]). Such models are very demanding on data requirements, including detailed and consistent data on stocks and flows, as well as information on the factors that drive behavioural choices.

The methods developed for using modelling forecasts are less ambitious. They range from rather simple models, based on fitting trends of aggregate qualification patterns among the population and/or labour force, to more sophisticated approaches based on econometric analysis of micro data on individuals, mainly using LFS data. All focus on overall stocks rather than flows.

The more sophisticated econometric approach involves estimating models which focus on the propensity of a representative individual to obtain a given level of highest qualification. This is based on analysis of a combination of time series and cross-sectional data from the LFS micro dataset. The modelling of qualification structures and trends uses a multinomial logistic regression model. This model incorporates age group and gender differences in educational attainment, differentiating trends by age group and gender. In principle the model also incorporates country-specific effects on underlying structures and trends.

This method can in principle generate some insights into behavioural factors influencing historical changes ([19]). In practice available data allow only limited behavioural content and in most cases the focus is on use of aggregates rather than individual data. In this case logistic or linear trends are fitted to the aggregate data. In either case the predicted shares are applied to the population or labour force derived from Module 1* (E3ME*).

([18]) See for example, Wilson and Bosworth (2006).

([19]) This approach was used by IER in developing qualification supply projections for the UK as a whole and for Scotland (see Jones and Wilson, 2006 and Wilson and Bosworth, 2006).

2.3. Comparing skill supply and demand

To provide information on possible labour market imbalances and skill mismatches a further module has been added:
Module 7 – BALMOD: a module which confronts skill demand and skill supply projections, focusing on qualifications, and reconciling the two.

The possibility of skill imbalances in the labour market is important from both a policy and individual perspective. Such information can, in conjunction with corresponding demand estimates, throw light on possible future developments in European labour markets, highlighting potential mismatches and thus help inform decisions on investments in skills, especially formal qualifications, made by individuals, organisations and policy-makers.

Simply comparing current demand and supply projections is however problematic for both practical and theoretical reasons. Although the two sets of results are based on common data and are carried out simultaneously they do not incorporate direct interactions between supply and demand and therefore cannot be directly compared. The work on modelling interactions between supply and demand has started in Cedefop, but due to its complexity it might be incorporated only in the medium to longer term. There are also various other conceptual and methodological issues regarding imbalances that need to be considered with some care to avoid misleading inferences and interpretations. Some of these issues are discussed in more detail in Section 6 below.

For reasons set out in detail in Section 6, it is necessary to adjust the demand-side estimates of qualification shares to reconcile these with the available supply. This is done in BALMOD which distributes the available supply of people with qualifications to the jobs on offer, making certain assumptions about the patterns of unemployment rates for the three qualification categories (high, medium and low (or no) qualifications).

A final adjustment has been made to the estimates of employment by qualification (demand side) to consider the labour market accounts residual. This residual measures the difference between employment as measured for NA estimates (workplace-based, jobs) and the corresponding LFS estimates (heads, residence-based). Both measures are used in the project ([20]). The difference between the NA and LFS can be quite significant and needs to be

([20]) For a detailed discussion see Kriechel and Wilson (2010) and Livanos and Wilson (2007).

considered, especially when comparing demand and supply. The former are primarily NA-based and focus on jobs. The latter are mainly LFS-based and focus on residents.

Differences between skill demand and supply include:

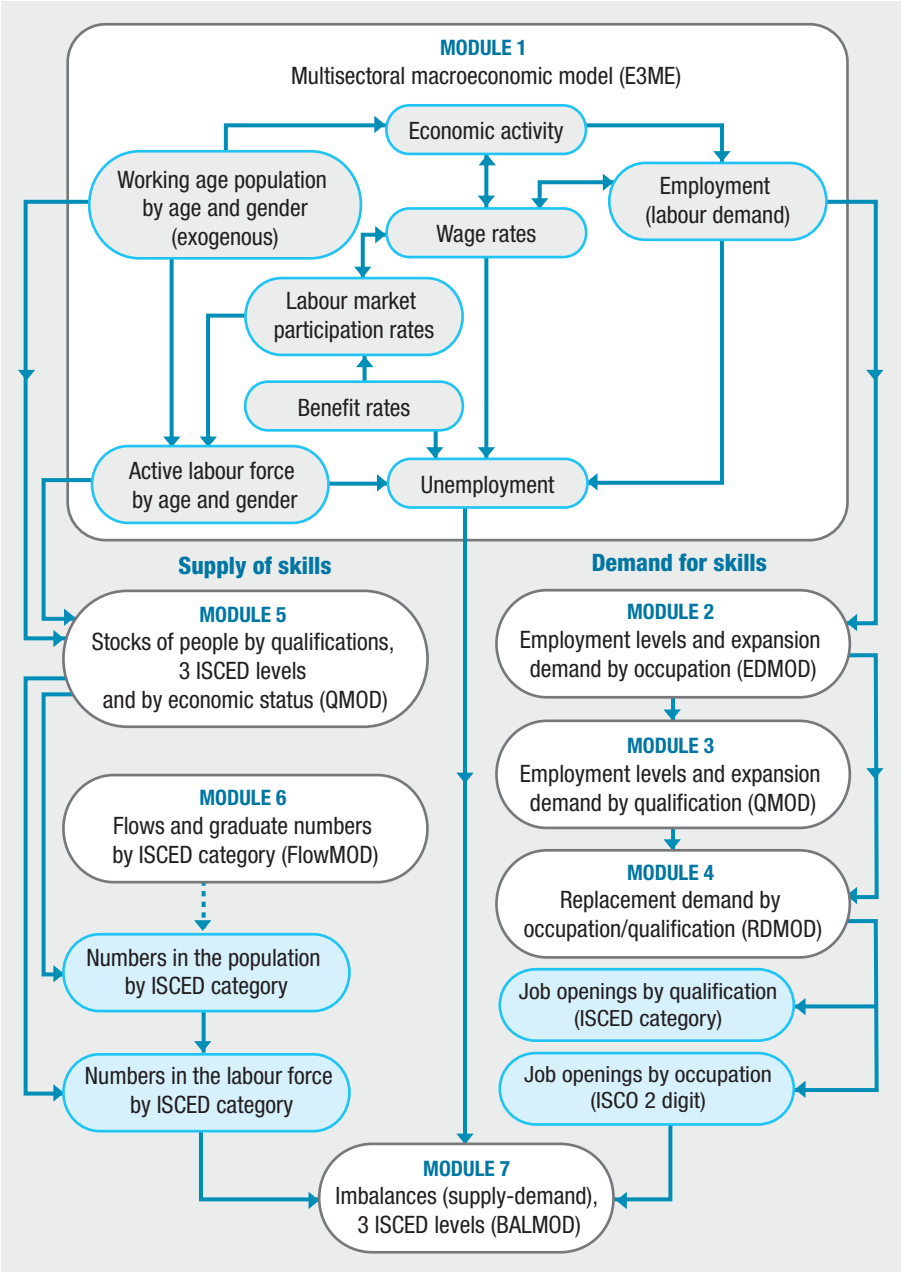
- double jobbing (some people have more than one job) or one full-time job is shared by two or more people;
- distinction between residence and workplace (many people do not live in the same country as they work; this is especially significant for some small countries such as Luxembourg);
- participants in training and related schemes who are also working in parallel (they may be included in the labour force as well as in education statistics – double counting);
- different definitions of unemployment (such as ILO definition versus restriction to unemployment beneficiaries);
- statistical errors (in measures of employment, unemployment and related indicators, including sampling and measurement errors);
- other differences caused by the use of different data sources such as treatment of nationals working abroad.

Most employment estimates use the NA-based measure. For qualifications three measures are presented:

(a) unconstrained employment estimates (E3ME, NA-based numbers) showing 'notional demand' (what employers would like to find according to past trends);
(b) constrained employment estimates based on LFS and reconciled with the supply (labour force);
(c) scaled employment estimates which are constrained (as above) and scaled to NA levels.

This publication refers mainly to the results of the scaled employment estimates. They are consistent with all the other NA-based estimates by sector and occupation presented in Section 5.

Figure 1. **Conceptual framework of modelling the demand for and supply of skills**



3. General economic and employment prospects

The financial crisis of 2008, and the subsequent worldwide recession, has had a dramatic impact on all economies and labour markets, and Europe is no exception. Although there are indications the world economy is now emerging from recession, it remains to be seen whether this is reality or a 'false dawn'. Temporary stimulus packages could be running out of steam; unemployment trends remain positive in most countries; and public finances are in a generally parlous state; all of which could lead to a 'double dip'. Even in the best case, it is likely growth will be weak for an extended period.

3.1. Baseline and 'no crisis' scenarios

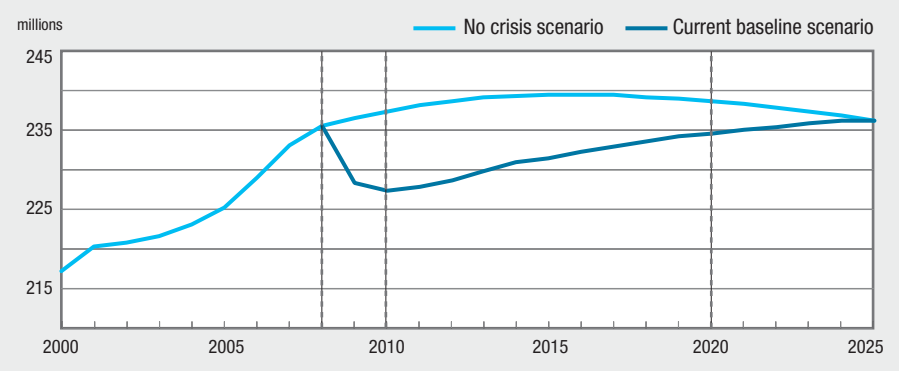
Based on the E3ME model estimates, the European economy suffered a decrease of gross domestic product (GDP) in 2008-09 on annual basis by 4.5%. Compared to an estimated growth in the case of 'no crisis' scenario (2.5%), this means real depression by 7%. The projected baseline scenario assumes termination of slow down in 2010. The EU's economy is expected to get back on track in the 'no crisis' scenario only after 2017 (Figure 2).

Figure 2. **Impact of the recession on GDP growth, EU-27+**

Source: Cedefop (CE estimates based on E3ME).

In contrast to GDP trends, which we expect to recover rather easily, employment recovery is likely to be more modest and lagged. The views set out here encompass that picture with the baseline case showing only gradual recovery of employment levels for Europe as a whole (Figure 3). The macro level picture exhibits a sharp fall in employment levels in 2009. These are now almost 10 million lower than might have been expected if the recession had not happened.

Figure 3. **Impact of the recession on employment, EU-27+**



Source: Cedefop (CE estimates based on E3ME).

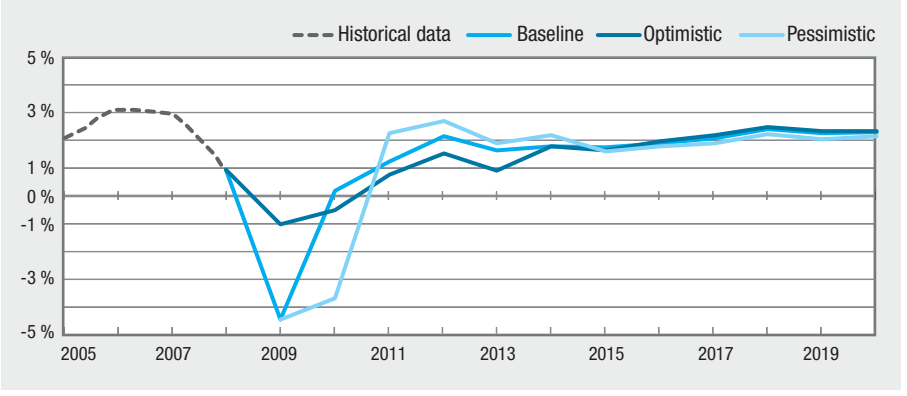
Labour supply has also been affected, as many younger people may have chosen to stay on in education and older people have withdrawn from the labour market as job opportunities have dwindled. The recession is encouraging participation in further training and higher education in the short term, but public funding provided through stimulus packages to support this training (packages that combine short- or part-time work or unemployment with training; additional funding for higher education institutes to secure places for people to upgrade their qualifications) may not be sustainable in the longer term. However, the recession also tends to decrease private investment of companies and individuals in continuing education and training. Should job opportunities for those who stay on in education fail to match their expectations, this might undermine the belief that education/training is a worthwhile investment and influence future participation and benefits.

3.2. Alternative scenarios

In 2008-09, the world economy moved into uncharted waters, with a financial crisis and a synchronised move into a deep recession unprecedented in recent years. There is still considerable uncertainty surrounding this process and subsequent recovery. To provide a wider range of possible developments, two additional alternative scenarios are explored around the central view (baseline scenario) discussed so far. One presents a more optimistic view about the speed with which the world economy will return to previous rates of growth. The other considers a more delayed and slower pace of recovery. Crudely these can be characterised as optimistic or pessimistic paths to recovery, as opposed to the baseline or central view ([21]).

The scenarios are based on different developments of driving factors for GDP growth such as: access to credit; consumer confidence; global impact; uncertainty over commodity prices; government responses and wealth effect on labour supply. The aim is to provide a range of possible results which encompass the likely upper and lower bounds of possible change. The scenarios are designed to show different short-term patterns of recovery. By 2020, they all assume a return to normal rates of economic growth.

Figure 4. **Alternative scenarios for European GDP growth, EU-27+**



Source: Cedefop (CE estimates based on E3ME).

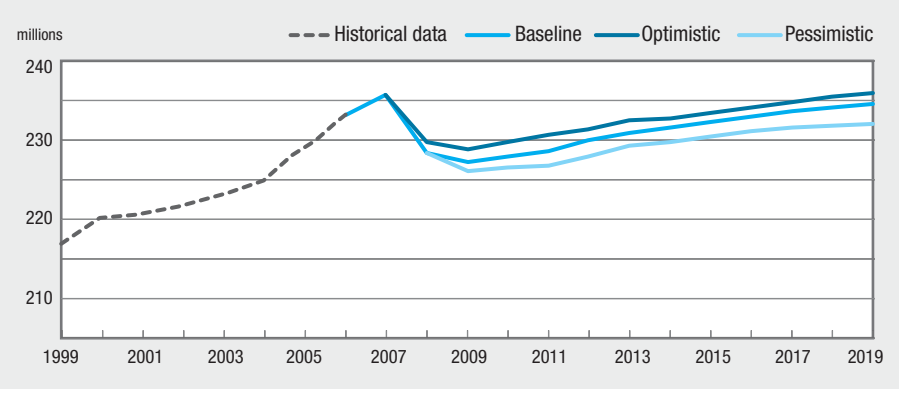
([21]) Pollitt and Chewpreecha (2010) describe the scenario input in more detail, highlighting the various areas of uncertainty linked to the crisis outcomes and possible values for other exogenous model input to E3ME.

Figure 4 illustrates the macroeconomic impacts of the three scenarios (baseline, optimistic and pessimistic) in terms of annual GDP growth in Europe. The figure focuses on the path of recovery to 2015, beyond which comparable longer-term trends in GDP growth are expected in all three scenarios.

The crisis, resulted in a substantial fall in European GDP in 2009, followed by no growth in 2010 and a more normal rate of growth in 2011 and the following years. However, longer-term growth might suffer if current stimulus packages come to an end and will impact on the potential rate of output growth.

Figure 5 shows the impact the different scenarios have on labour demand. In all cases there is a steep fall in 2009, following the economic and financial crisis, and recovery from 2011 onwards. Both the optimistic and pessimistic scenarios follow this trend, although in the pessimistic scenario the level of labour demand falls to lower levels in 2009-10 and takes longer to recover. The opposite is true in the optimistic scenario, with a smaller fall in 2009 and almost no fall in 2010. A further point to note is that the magnitudes of the difference from baseline in the pessimistic and optimistic scenarios are very similar.

Figure 5. **Alternative scenarios for aggregate labour demand, EU-27+**



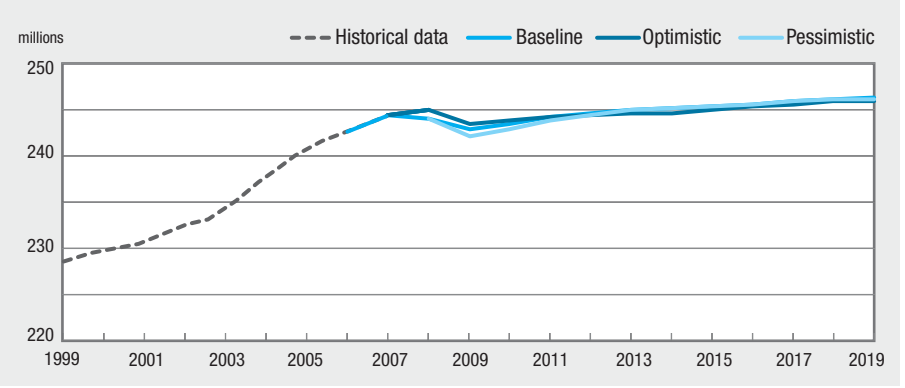
Source: Cedefop (CE estimates based on E3ME).

In the pessimistic scenario employment by 2020 is lower than in the baseline case. The opposite is true of the optimistic scenario – in all countries there is expected to be a positive difference from the baseline case by 2020. Figure 6 demonstrates the impact the scenarios have on overall labour supply. In the baseline scenario, labour supply declines slightly around 2009 due to

the recession across Europe, then recovers, but soon follows a steadily increasing trend. Labour supply in the optimistic and pessimistic scenarios follows similar trends in the medium term, but in the two or three years following the economic and financial crisis labour supply estimates deviate from the baseline.

The magnitudes of changes in labour supply from the baseline are in the majority of countries larger in the pessimistic scenario than the optimistic scenario. This is particularly true for the younger age groups. In the pessimistic scenario, individuals are more likely to remain in education or training, as their lower levels of experience will act as a disadvantage in a competitive labour market. For the male age groups up to 44-49 and the female age groups up to 50-54, labour supply decreases compared to the baseline. For older groups the opposite is true. Compared to the baseline, labour supply increases, as older age groups tend to remain in the labour market to offset reduced pension payments, instead of retiring earlier. It is therefore the youngest and the oldest age groups that drive the main differences in aggregate labour supply between scenarios.

Figure 6. **Alternative scenarios for aggregate labour supply, EU-27+**



Source: Cedefop (CE estimates based on E3ME).

The alternative scenarios' effects on labour supply in different countries by gender, age and qualification is discussed in Section 4.1.

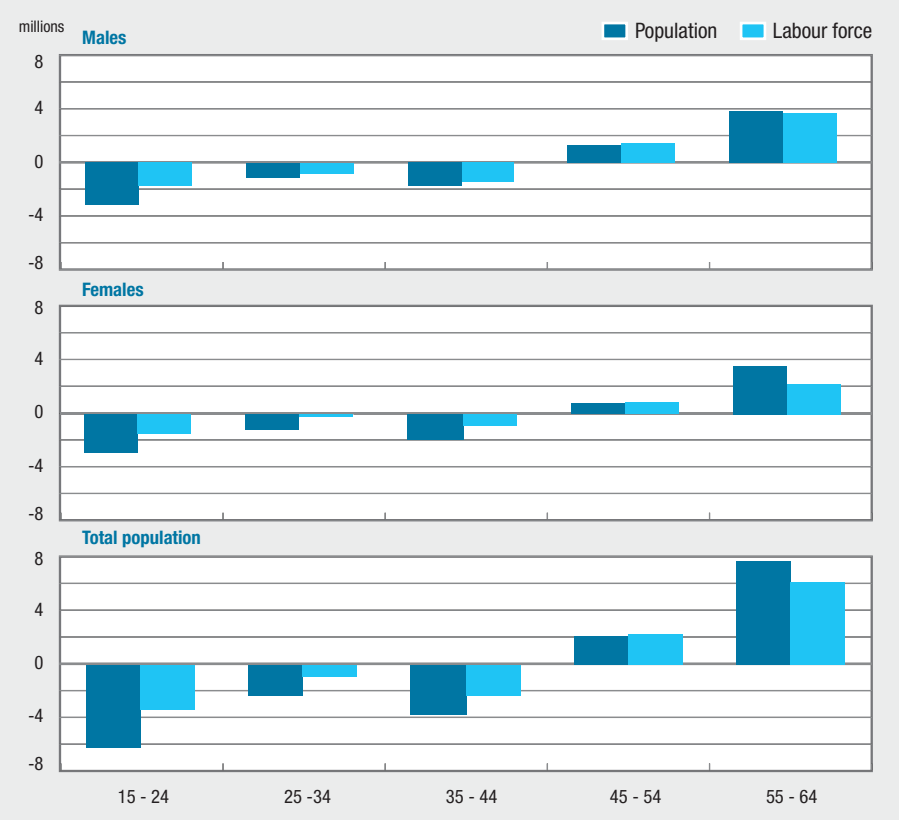
4. Supply of skills

4.1. Pan-European results

4.1.1. General prospects for population and the labour force

Demographic developments and in particular, the ageing population, are a major challenge for European labour markets. Figure 7 illustrates the expected changes in the European population and labour force older than 15.

Figure 7. **Changes in population and labour force by age, 2010-20, EU-27+**



Source: Cedefop (IER estimates from StockMOD).

In the next decade only the number of 45-54 and 55-64 year-olds will increase. In the age groups 15-44, population and labour force will decrease. Continuous efforts to increase labour market participation, in particular of women and older people, are needed to keep the decline in the labour force lower than that of the population. In the age group 45-54, growth in the labour force will be even higher than that of the population as a result of activation measures. Promoting a lifecycle approach to work and supporting active ageing helps to retain older age cohorts in employment and curtail early labour market exit.

These demographic developments also affect the skills available. Skills become obsolete when they are not used or as people get older and technologies or working practices change. Therefore those already participating in the labour market need to update, upgrade and broaden their knowledge, skills and competences. But recent statistics show that participation of adults in learning is stagnating. The rate of 9.5% of 25-64 year-olds who undertook lifelong learning in 2008 is below the European benchmark of 12.5% set for 2010 (for 2020 this benchmark has been raised to 15%). Evidence indicates that the share of young and more highly-qualified people who take part in training is much higher than that of lower-skilled and older workers.

4.1.2. **Changing supply by qualification**

Skills supply is measured by the highest qualifications held by the population or labour force. Expected trends in future skills supply have to be based on forecasts of population and decisions to take up education and training. Although ageing is a generally recognised phenomenon, the working age population (15+) is still expected to increase by more than 14 million in the next 10 years.

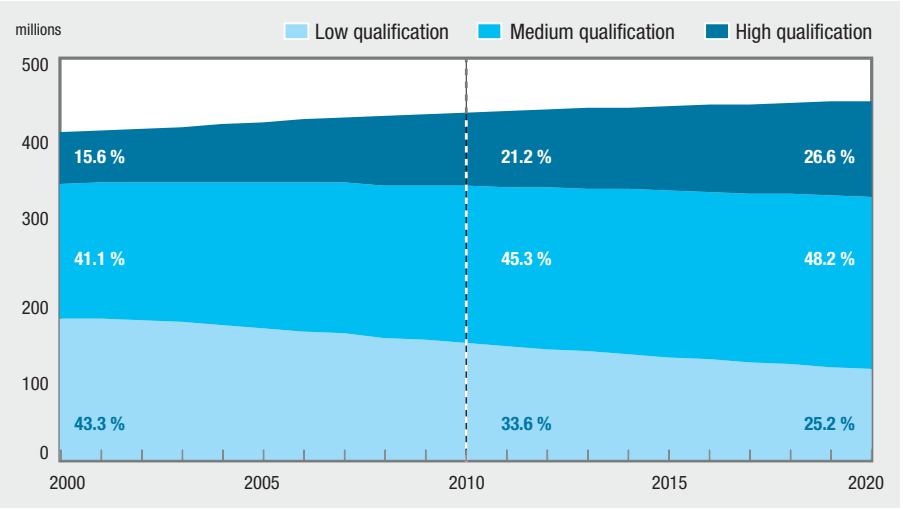
Projections of population composition by qualification/level of education thus depend on:

- changing demographic patterns,
- changing patterns of acquisition of qualifications.

Data on future demographic development are taken from official Eurostat projections. These also include explicit assumptions of migration patterns. The same population projections were used in the alternative scenarios. Further details are given in Pollitt and Chewpreecha (2010).

Assuming that past trends in education structure will continue more or less unchanged in the future, we can project the change in the composition of population by level of qualification. Results show the number of those with

Figure 8. **Trends in population (15+) by qualification, EU-27+**



Source: Cedefop (IER estimates from StockMOD).

high-level qualifications will rise by almost 28 million, and those with medium-level qualifications by almost 20 million. This increase will be compensated by a decrease of about 33 million people holding low qualifications (Figure 8).

The analysis presented hereafter focuses on the total labour force instead of the total population. The labour force is defined as economically active people (in employment or unemployed but actively searching for work (ILO definition). Labour force projections are derived from the population forecast. In addition, they require a projection of labour market participation rates (by gender, age and qualification). Labour market participation rates measure the probability and expected development of participation rates ([22]), namely the probability of persons to be in the labour market.

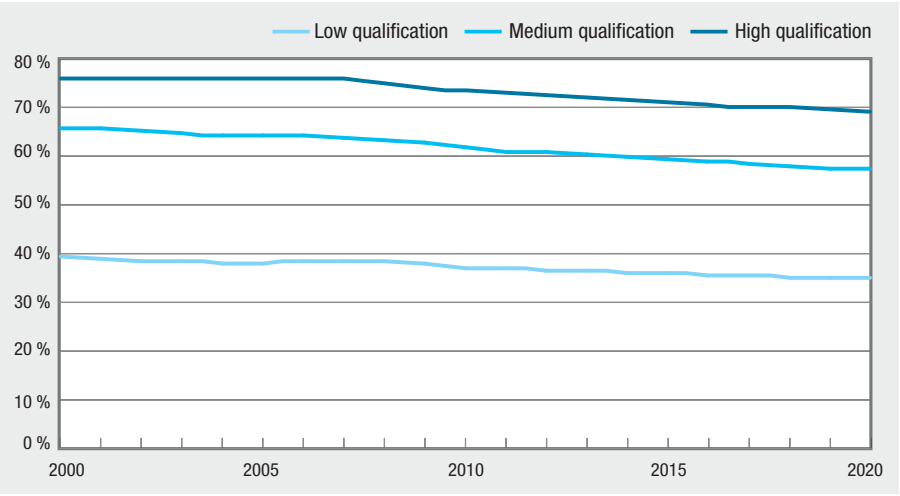
Projections of labour market participation are based on econometric analysis of the participation decision by age and gender, using LFS data for each country, embedded into the macroeconomic model (E3ME*). This is described in detail in Pollitt and Chewpreecha (2010); a detailed table of participation rates is available in Annex I.

Patterns of acquisition of qualifications are based on continuation of historical trends in stocks in the total population by country in StockMOD. This

([22]) Participation rates can be also referred to as activity rates.

uses a logistic specification described in Livanos and Wilson (2009a). Participation rates vary significantly between qualification categories (see Figure 9). Higher-qualified people tend to have higher rates of labour market participation. Overall, however, they are projected to decline slightly also because people over 65 are included. This reflects a complex interaction of positive and negative trends (diverging combined effects of age, gender and qualifications).

Figure 9. **Labour market participation rates by qualification category, EU-27+**



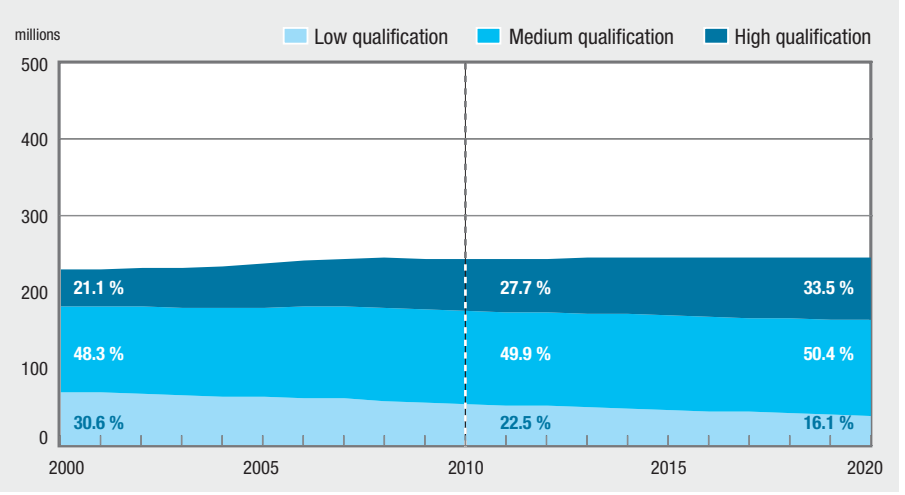
Source: Cedefop (IER estimates based on E3ME and StockMOD).

Changing composition of males and females of different age groups and changes of different qualifications in each group are expected to lead to declining trends in participation rates.

Historically, for Europe as a whole, participation rates among those with high-level qualifications have averaged around 75% in recent years. This is projected to fall to below 70% by 2020 (because of increasing shares of highly qualified women who have a lower participation rate than highly qualified men). For those with low qualifications participation rates are much lower, averaging just under 40% in recent years. This has also been a declining trend, which is projected to continue (around 35% in 2020). For those qualified at intermediate level, activity rates have averaged around 65% recently. These are projected to fall to around 57%.

Over all categories, the increasing proportion of the higher qualified labour force tends to offset these negative trends for individual categories. Overall, the absolute number of the population participating in the labour market as a whole (total supply) is projected to be fairly stable.

Figure 10. **Supply trends in labour force (15+) by qualification, EU-27+**



NB: This figure deliberately uses the same scale as Figure 8 to compare the size of population and the labour force.
Source: Cedefop (IER estimates based on E3ME and StockMOD).

In absolute numbers, the results suggest substantial further increases in total supply of high (graduate) and intermediate-level qualifications across Europe (Figure 10).

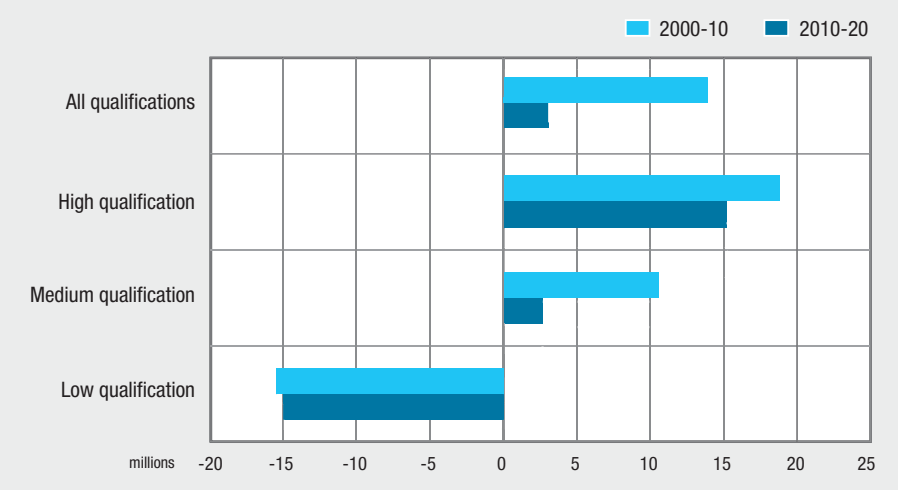
The baseline scenario projects that between 2010 and 2020 the labour force of Europe (EU-27+) aged 15+ holding high-level qualifications ([23]) will increase by more than 15 million (Figure 11). The underlying trends on which these results are based were established before the economic slowdown in 2009. But even if the recession's impact is quite strong, these trends are so robust that significant increases in supply of higher-level qualified people are very likely ([24]). A key element in this well established trend is that over the past few

([23]) For the age group 15-24 results should be interpreted with caution, as there are still many young people in education who will acquire a qualification later.

([24]) Initial evidence from individual countries suggests that the immediate impact of the recession is to encourage participation in education by young people given the difficulty in finding employment. Longer-term effects may not be so positive if those leaving the educational system with higher qualifications fail to find jobs that match their expectations.

decades new entrants to the labour market have tended to be more highly qualified than older people reaching the end of their working lives. However, other cohort effects may moderate the pace of change over the longer term, as higher-qualified cohorts will gradually begin to approach retirement age.

Figure 11. **Past and likely change of future supply of qualifications, labour force (15+), EU-27+**



Source: Cedefop (IER estimates based on E3ME and StockMOD).

The labour force with medium-level qualifications is also expected to rise, although not as sharply as the high-level qualification category. Between 2010 and 2020, the European labour force (EU-27+) aged 15+ holding medium-level qualifications will increase by just under three million. The relative small increase to the labour force may be due to some medium-level qualified people going on to gain higher qualifications later. However, the qualification structure of the labour force in 2020 shows that still over half the labour force will be qualified at intermediate level and this trend remains stable over the observed past and future periods.

In contrast, the proportions and number of those with low-level or no qualifications have been steadily falling. Between 2010 and 2020, the European labour force aged 15+ with low-level or no qualifications is projected to fall by around 15 million.

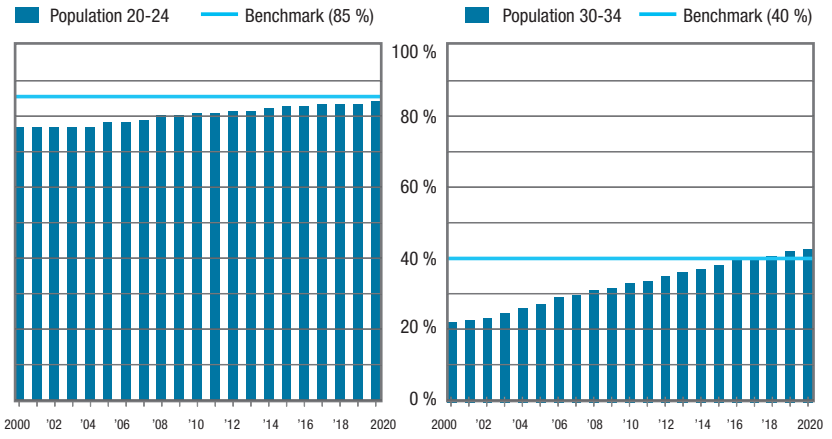
These trends are rather different for males and females. Generally speaking, female labour market participation rates are lower than those of

males. But they are increasing, not least because their qualification levels are rising, whereas participation rates of males are declining. The hierarchy across qualification levels is common to both genders. However, the rates of increase are generally higher for women than for men, reflecting that women are likely to be (formally) more highly qualified than men in the future. As noted, the number and share of all people with low-level qualifications is projected to decline across Europe. This decline is projected to be sharper for women than for men. These general trends are observed in almost all countries and are in line with the Lisbon agenda, which aims to increase the proportion of people holding higher-level qualifications.

Box 1. **European benchmarks**

The 2010 European benchmark for educational attainment of the 22 year-old population (measured for the 20-24 age cohort) is that 85% should have completed at least upper secondary education ([25]). This goal has not been reached so far. The results of the forecast show that it would not even be reached by 2020. However, in 2017 Europe is likely to reach a new European benchmark set for 2020 which requires at least 40% of the 30-34 year-old population to have successfully completed tertiary education (Figure 12).

Figure 12. **Comparison of skill supply results to European benchmarks**



Source: Cedefop (IER estimates based on E3ME and StockMOD).

([25]) European benchmarks in education and training are reference levels of European average performance in education and training adopted under the European strategy and cooperation in education and training (http://ec.europa.eu/education/lifelong-learning-policy/doc28_en.htm).

Figure 13. **Labour force by gender, qualification and age group, EU-27+**

Source: Cedefop (IER estimates based on E3ME and StockMOD).

If age groups in the labour force are examined in more detail, notable variations can be observed (see Figure 13). Young people, aged 15 to 24, are projected to experience only moderate increases in high-level qualifications. A reason could be that many are still in the process of acquiring a higher qualification and not (yet) in the labour force. The numbers of those with low- and medium-level qualifications are expected to decline. This can be attributed in part to general decline in total numbers in these age groups.

For older age groups (25+) the increase in numbers of high-level qualifications is much sharper, especially for women. The age group 30-39 is projected to experience some of the biggest increases in high-level qualifications. Note that this results in part from differences between age cohorts. The 30-39 year-old category in 2020 is essentially the same group of people as the 20-29 year-old group in 2010 and the 10-19 year-old group back in 2000. The comparisons shown in Figure 13 do not illustrate progression for particular cohorts but show how different cohorts are qualified as they reach that age range.

The number of people holding medium-level qualifications as their highest level is projected to decline for all groups aged up to 39, but to increase for groups aged 40+. This is again an indication of cohort effects as people age, and the fact that younger people are nowadays generally more highly qualified than older people.

4.2. Country results

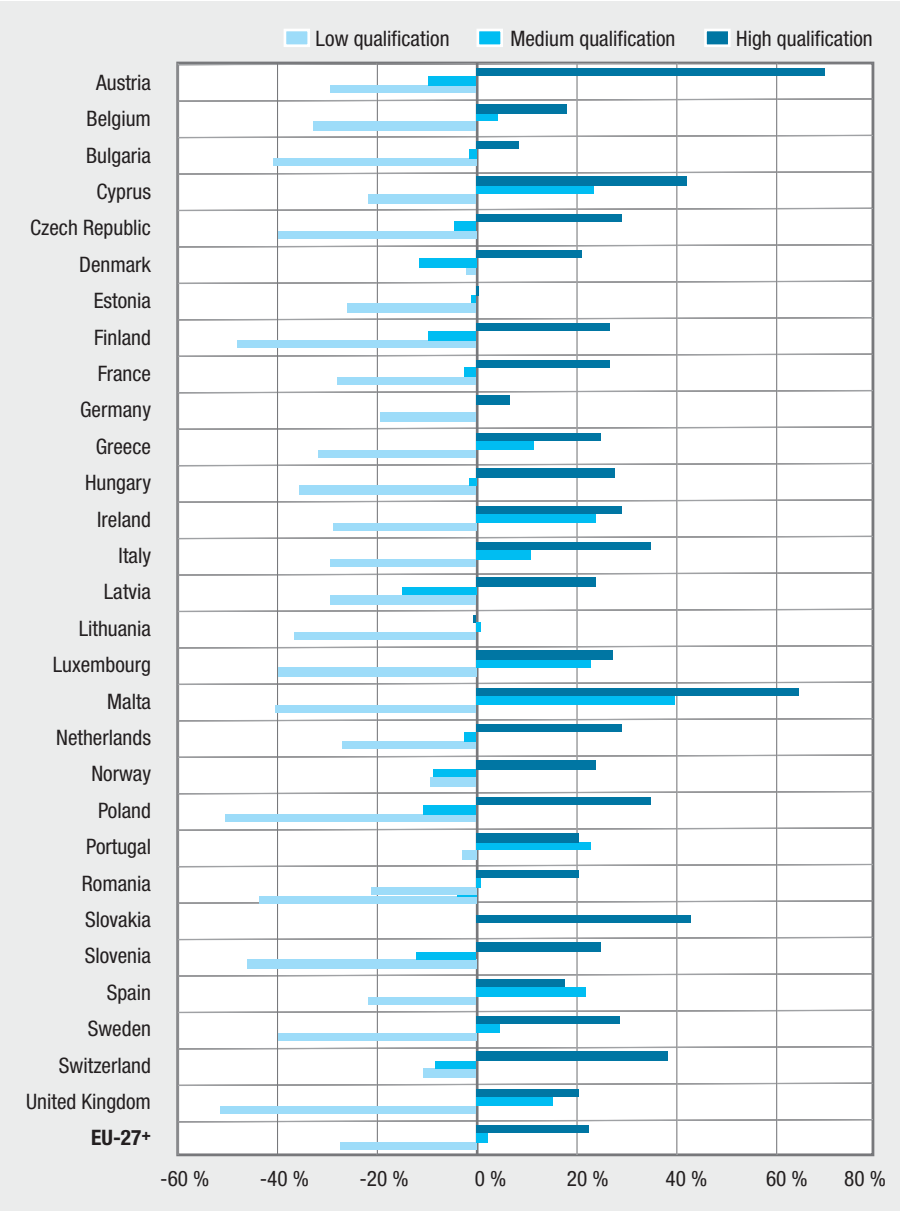
The patterns described above are generally common across countries in terms of the direction of the change, although with significant differences in magnitude. Therefore, while clear common patterns can be identified in the cases of low and high qualification – negative and positive respectively – the picture at medium level is more complex. While in some countries the number of the medium-qualified workforce is expected to rise between 2010 and 2020, in others it is projected to decline ([26]).

Figure 14 shows how dynamics compare across countries in percentage changes. Detailed data are available in Annex I.

Similar results are found when considering the shares of the labour force 15+ by qualifications. In all countries the share of the highly qualified workforce

([26]) It is appropriate to remark here that the estimates are based on projections of educational attainment by qualification levels but do not consider possible changes induced by recognition of non-formal and informal learning.

Figure 14. **Projected change (in %) in labour force by qualification and country, 2010-20**



NB: Numbers in the economically active labour force aged 15+.
Source: Cedefop (IER estimates based on E3ME and StockMOD).

are projected to be greater in 2020 than in 2010. In contrast, the share of people with low (or no) qualifications are generally projected to fall. Finally, the share of the labour force with medium-qualification level is also expected to increase in some countries and to decrease in others.

Against this general background, Figure 15 provides a picture of the results when taking the medium- and high-qualified labour force together.

The diagram consists of a scatter plot with the share of medium- and high-qualified labour force in 2010 on the Y-axis (level) and a measure of the predicted variability of these shares for 2010-20 on the X-axis (change in % points).

The overall results clearly show a general trend of convergence among countries. In fact, most countries present a high correlation between the levels of medium and high qualification shares in 2010 and the expected increase from 2010 to 2020.

Even though at this stage the estimates' accuracy does not allow us to draw any conclusion on individual performances, by and large it can be highlighted that most countries with a high initial level, will remain more or less stable in the coming decade. Few countries with a share over the current average are likely to move ahead, while several others are catching up (especially some Mediterranean countries starting from a relatively low share).

However, it is worth noting that similar analysis of only the highly-qualified labour force shows a quite different picture (Figure 16).

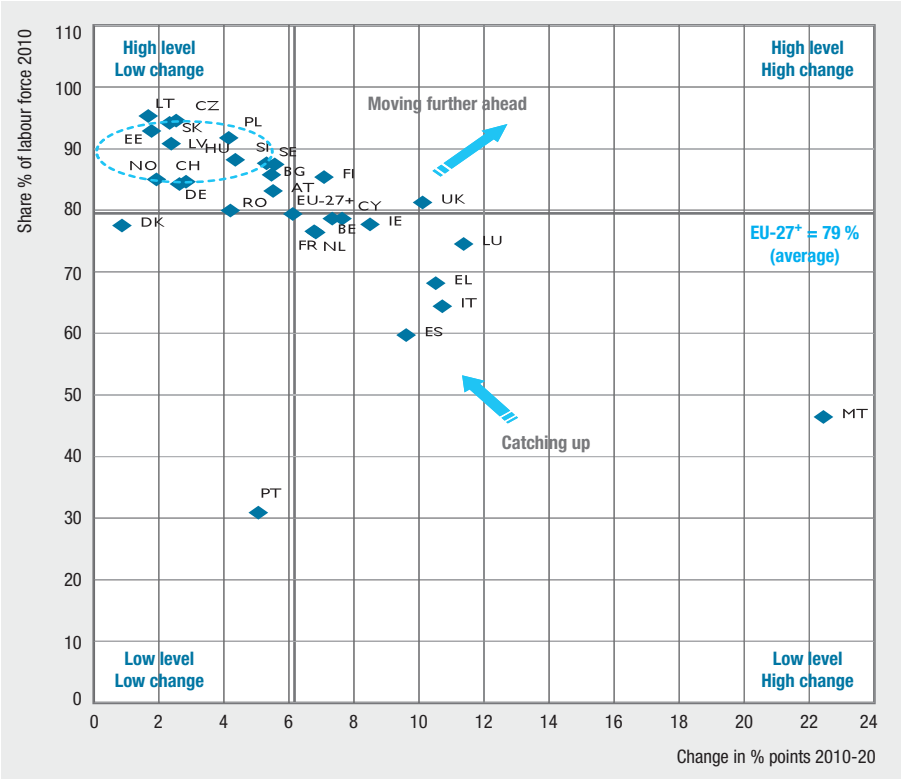
In this case differences among countries are bound to persist in the medium term and it is not possible to notice any clear correlation between the initial level and expected performances among countries (also shown by the increase of the dispersion index analysis ([27])). From this point of view the conclusion is twofold:

- although all countries will be increasing the share of high qualification in the labour force, no convergence among countries is expected between 2010 and 2020;
- the current structural trends on which the labour supply forecasts are based appear to be partially symmetric between medium and high qualification, and tend to produce an overall convergence trend.

Conversely, most countries will show a significant reduction of the share of low-qualified people in the labour force. However, despite the persisting challenge to reduce the share of young people who leave education and

([27]) In fact, the standard deviation for the share of the labour force with high qualification by countries increases significantly from 2010 to 2020 (from 7.8 to 8.4).

Figure 15. **Incidence of medium and high qualifications in the labour force by country. Projected level 2010 (%) and change in %-points 2010-20**

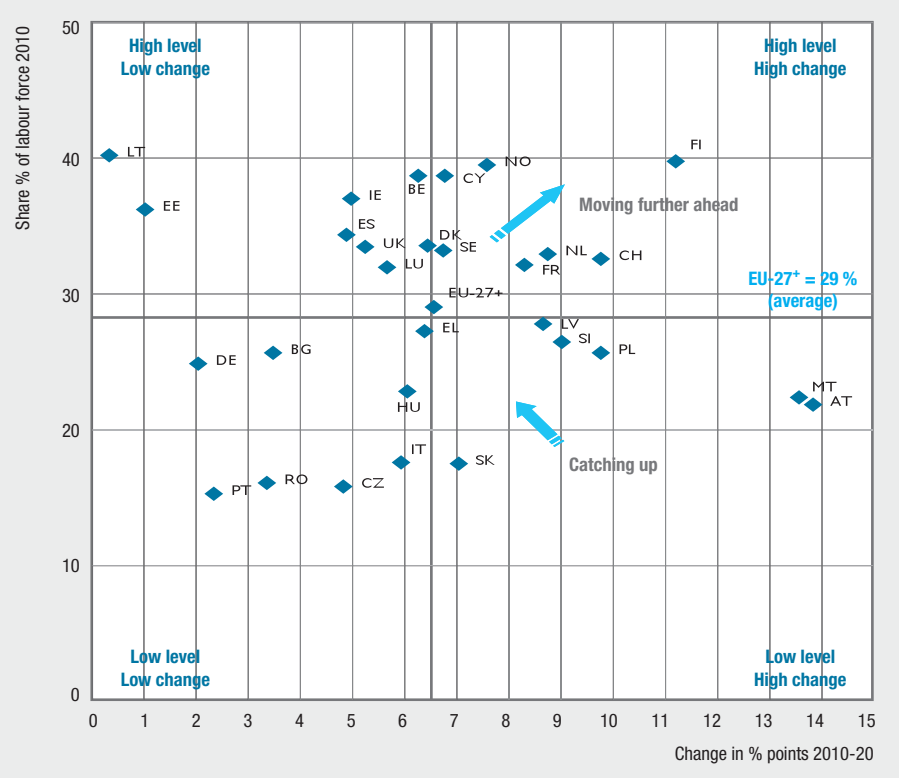


Source: Cedefop (IER estimates based on E3ME and StockMOD).

training without acquiring a formal qualification, most countries will reduce the overall share of low-skilled people mainly as a result of the age cohort effect. In addition, some countries which present a relatively low share of low qualification in 2010, are likely to experience a slight increase in the number of low-skilled people in their labour force. The reasons for this development can be manifold, for instance: market prospects that encourage people to leave education and training, lack of motivation or courage to stay in education and training, increasing number of people of migrant background and low educational attainment.

To understand better these dynamics, undoubtedly positive, it must be considered that the proportion of people with high and medium qualifications

Figure 16. **Incidence of high qualification in the labour force by country. Projected level 2010 (%) and change in %-points 2010-20**



Source: Cedefop (IER estimates based on E3ME and StockMOD).

has risen steadily in recent years in most countries, in the population as well as in the labour force. As participation rates of highly-qualified people are higher than those of people with medium-level or low qualifications, we can expect a natural and relatively positive trend for skill supply.

However, a concern for policy-makers is whether the historical trends identified will continue undisturbed by the recent economic crisis. The crisis may disrupt steady improvement in qualification profiles observed over recent decades. Initial indications suggest that the crisis may lead to increased participation in education and training and acquisition of qualifications, as individuals delay entry into a depressed labour market; they probably also expect better opportunities with higher-level qualifications after recovery. In

the longer term, potential financial constraints (for both individuals and governments) may discourage investment in human capital. Policy-makers may need to take proactive steps to ensure that projected improvements are actually realised and that investment, both in initial education and in continuing training as well as other forms of adult education, will continue.

The implications for the supply of skills by qualification level of the alternative scenarios are mixed. They reflect a combination of general country patterns for overall labour supply and acquisition of qualifications. In general the supply of those with higher-level qualifications is somewhat boosted in the optimistic scenario and conversely in the more pessimistic one, but countertendencies moderate these effects.

These results indicate only general aggregate trends. To be more useful to both policy-makers and individual labour-market participants, more research is needed and more detail is desirable. Progress is mainly dependent on improvements in the underlying data, especially the information provided by national statistical authorities to Eurostat. More effort needs to be made in Europe to ensure that data are consistent, both over time and across countries, and to build a better and more robust statistical infrastructure to help such research.

5. Demand for skills

Demand for skills is measured by the numbers of people in employment as a proxy for the number of jobs available ([28]). The projections depend on results from the multisectoral macroeconomic model (E3ME) together with analysis of changing occupational and qualifications requirements within sectors (EDMOD, QMOD) and replacement demand (RDMOD). Figures and results present the baseline scenario (unless mentioned otherwise).

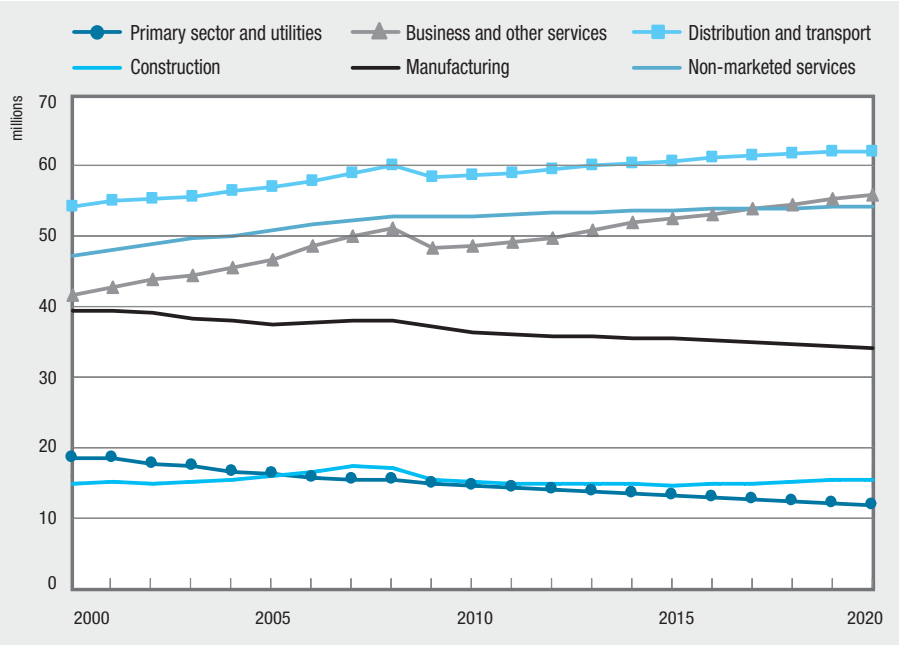
5.1. Pan-European results

5.1.1. **Prospects by sector**

Historical analysis confirms that Europe has experienced continuing shifts away from the primary sector (especially agriculture) and traditional manufacturing industries towards services and the knowledge-intensive sectors (Figure 17). Despite the economic crisis these basic trends are likely to continue to be a key feature over the coming decade. This applies to individual countries and the way these patterns are changing between European countries. Although in many newer and some older EU Member States employment is still relatively high in agriculture and manufacturing, there are clear signs that this is changing rapidly. In part this is an internal process, particular to each country, but it also reflects shifting patterns of activity and people across borders as capital and labour adjust to changing political and economic situations. In some countries this is leading to changes in the opposite direction as some manufacturing activities have been transferred eastwards and southwards within Europe. Results of the projections presented here suggest these patterns of change will continue in the immediate future and despite the recession, these will continue to be more evolutionary rather than revolutionary.

([28]) Strictly, this is the result of both demand and supply factors. Demand should also include any unfilled vacancies but no comprehensive and consistent measures of these are available, especially at pan-European level.

Figure 17. **Past and likely future trends in employment by sector (EU-27+)**



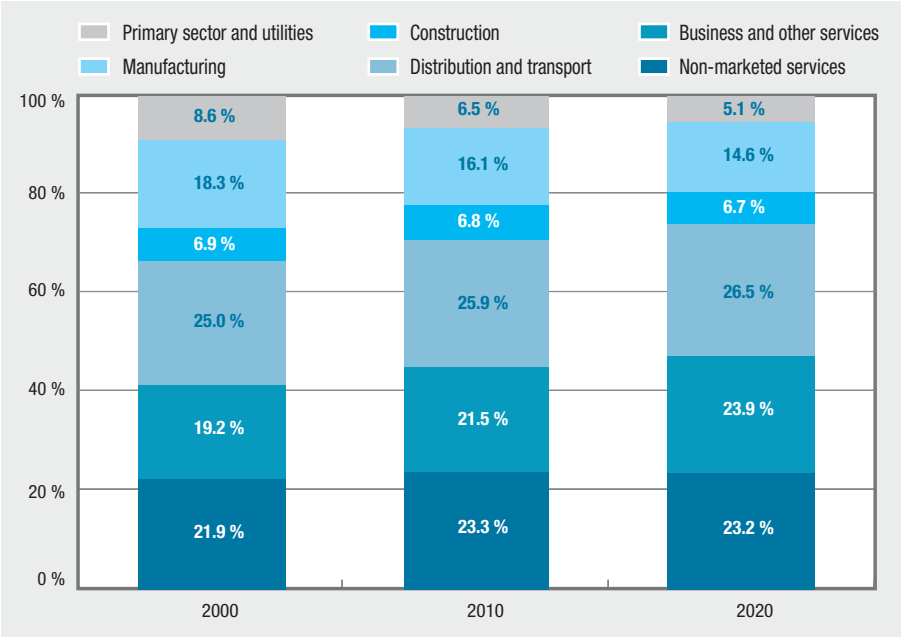
NB: Shares in employment (NA-based estimates).
Source: Cedefop (CE estimates based on E3ME).

The projection shows that in the next decade the total share of jobs in the primary sector and utilities will decrease from 6.5% to 5.1% (Figure 18). Although there might be expectations of an increasing share in manufacturing at national level, the total share of jobs in manufacturing and construction in EU-27+ will decrease from 22.9% in 2010 to 21.3% in 2020. Conversely, the share in the service sector is expected to rise from 70.7 to nearly 74%.

Substantial change is in prospect with around seven million additional jobs being created between 2010 and 2020 in EU-27+ (Figure 19). This is despite the loss of more than 2.5 million jobs in the primary sector, especially in agriculture and around two million in manufacturing and production. The main areas of employment growth with around 12 million jobs are services. Business and miscellaneous services have the best prospects, with around seven million additional jobs being created between 2010 and 2020. Distribution, transport, hotels and catering together are projected to see employment grow by 3.4 million over the next decade. Non-marketed services

(mainly public services) are expected to increase by just over a million. This moderate employment growth results from different developments within this sector: considerable demand increase in healthcare and education will be partly offset by reduced labour demand in public administration due to expected public budget constraints.

Figure 18. **Shares of broad sectors of employment (EU-27+)**

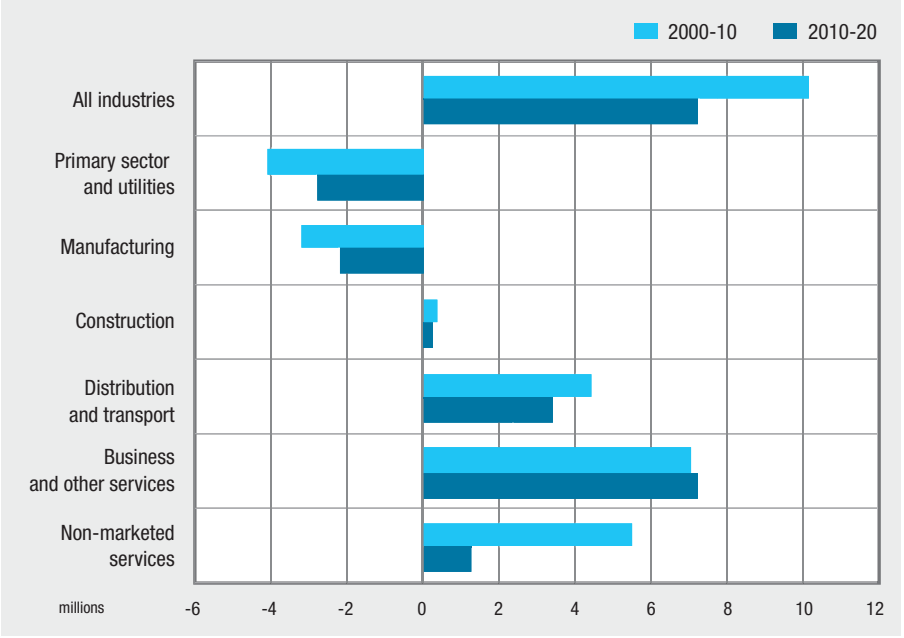


NB: Shares in employment (NA-based estimates).
Source: Cedefop (CE estimates based on E3ME).

The impact of the economic crisis appears to have accelerated the patterns of change in some sectors, and affected prospects, for example in the public sector as governments struggle to rebalance public finances. But many underlying sectoral trends are so robust that they are not expected to change radically.

However, despite the projected structural changes it is important to emphasise that the primary and manufacturing sectors will remain viable sources of jobs and crucial components of the European economy. In the baseline scenario, the primary sector will still employ around 12 million people in 2020 and manufacturing more than 34 million.

Figure 19. **Past and likely future sectoral employment change (EU-27+)**



NB: Shares in employment (NA-based estimates).
Source: Cedefop (CE estimates based on E3ME).

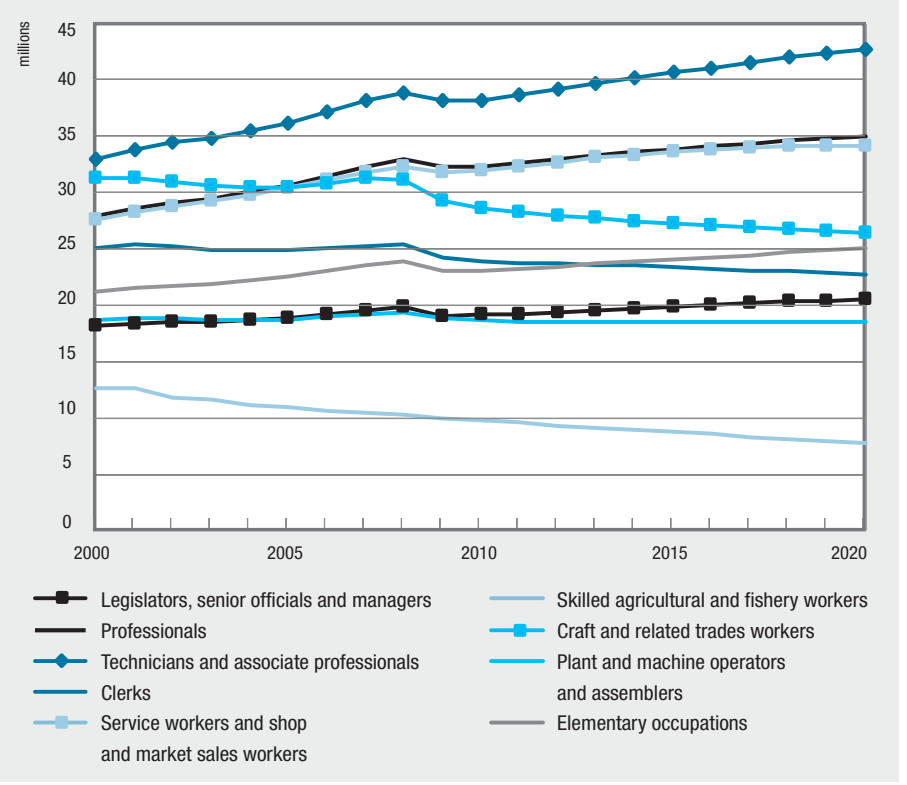
5.1.2. **Occupational prospects**

Projected sectoral changes will have significant implications for occupational skills needed in the future. These will be reinforced by changes in the way work is organised and jobs are performed within sectors. The main implications are continuing growth in demand for many occupations which require high- and medium-level skills as well as for some which require lower skills (Figures 20-22).

Almost 40% of people are currently employed in higher-level jobs such as management, professional work of one kind or another or technical assistance for those activities. These areas are all expected to experience increased demand over the next decade and to reach a share of 42%.

In contrast, jobs for traditional agricultural skilled workers, several other craft and related occupations and clerical occupations will decline. There will, however, be significant expansion in skilled jobs for many service workers, especially in retail and distribution, and also for some elementary occupations requiring little or no formal skills.

Figure 20. **Past and likely future trends in employment by occupation (EU-27+)**

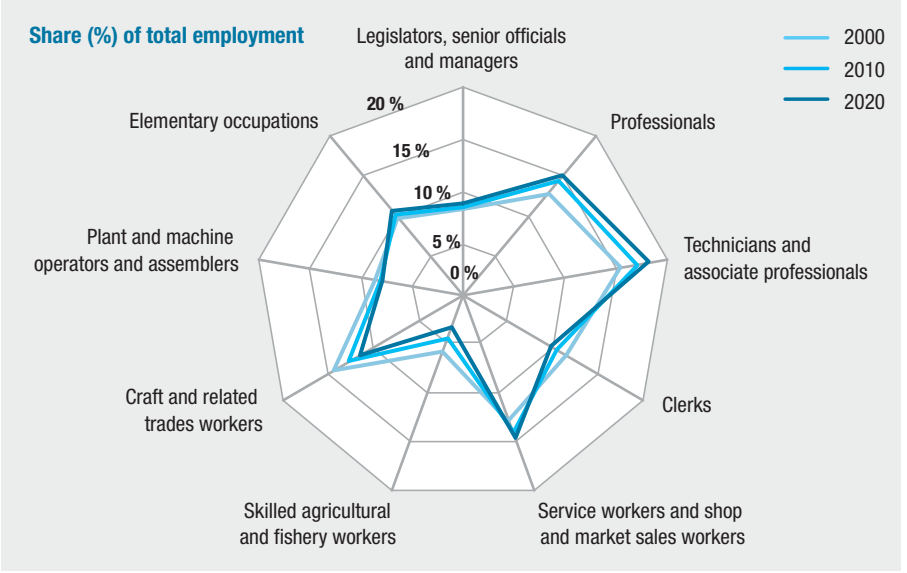


NB: Numbers in employment (NA-based estimates).
Source: Cedefop (IER estimates based on E3ME and EDMOD).

The latter – although representing a relatively small share of all jobs – indicates a risk of job polarisation. Structural and other changes will, if these trends continue, create many jobs at higher levels, but also a considerable number of jobs at the lower end of the job spectrum, with low pay and poor terms and conditions. This raises concerns about job quality and mismatch, and related problems of social equality and exclusion for many European citizens and migrants, and will pose challenges for policy-makers concerned with issues of equity and social cohesion.

The results emphasise that even those areas where employment levels are expected to fall there will nevertheless be significant numbers of job openings, as most people who leave the labour market will need to be replaced.

Figure 21. **The changing occupational structure of employment, EU-27+**



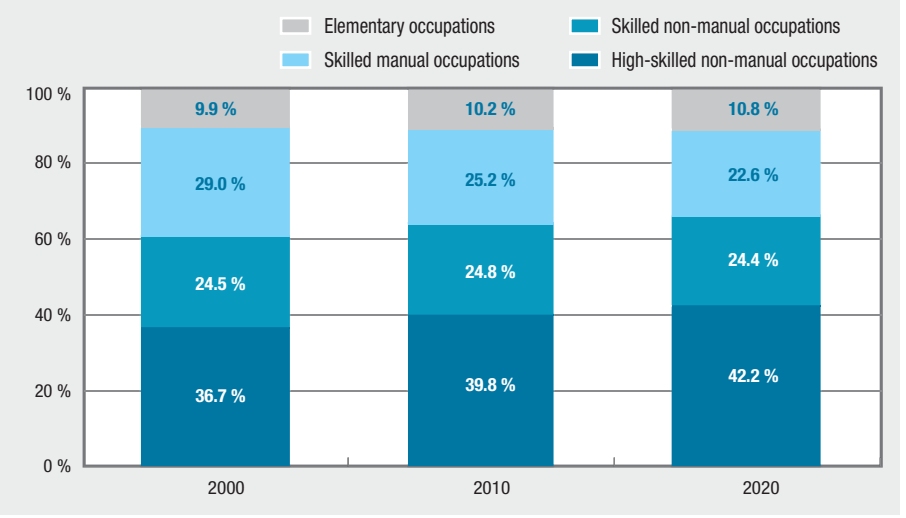
NB: Numbers in employment (NA-based estimates).
Source: Cedefop (IER estimates based on E3ME and EDMOD).

There is significant replacement demand by occupation (to replace those leaving for retirement, becoming inactive or other reasons) ([29]) even for occupations where employment levels are projected to fall sharply (Figure 23). This figure distinguishes expansion demand (projected net employment change by occupation) and replacement demand. Total requirements are the sum of both; they represent the total number of job openings. It is important that policy-makers, education and training providers and individual citizens all remain aware that many occupations likely to see job losses will remain viable sources of employment and make important contributions to the economy for many years to come.

But the nature and skill requirements of these jobs will not remain unchanged and it is important to understand the way in which they are evolving. This includes formal qualifications typically required to undertake such jobs. While there is no simple one-to-one relationship between occupation and qualification it is possible to explore how these are changing over time.

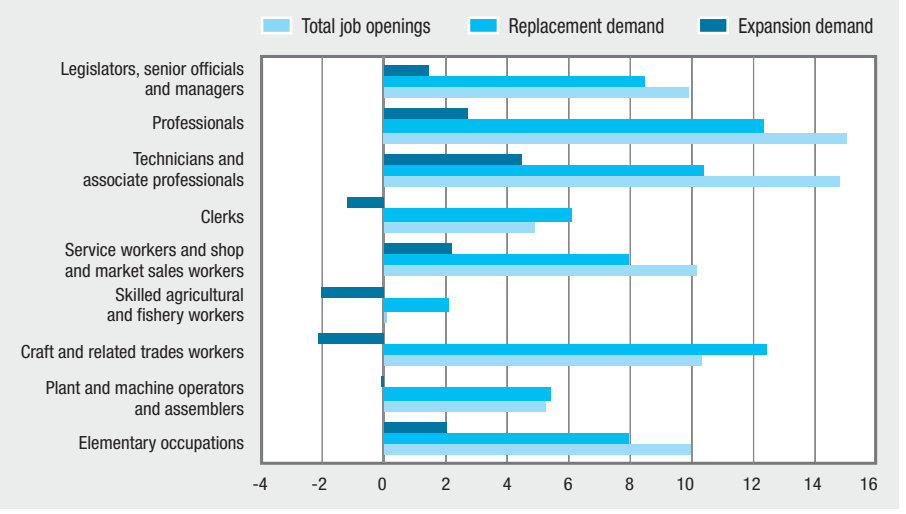
([29]) These are generated in the RDMOD module.

Figure 22. **Past and likely future occupational employment structure, EU-27+**



NB: Numbers in employment (NA-based estimates).
Source: Cedefop (IER estimates based on E3ME and EDMOD).

Figure 23. **Job openings by occupation group 2010-20, EU-27+**



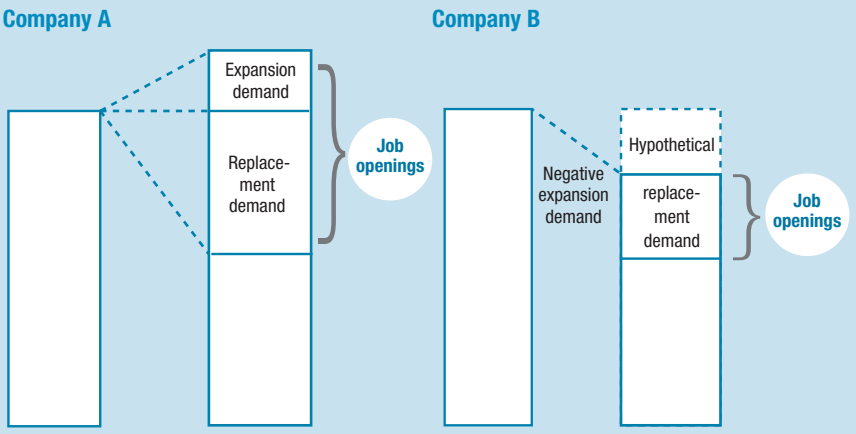
NB: Numbers in employment (NA-based estimates); job openings are the sum of expansion and replacement demand.
Source: Cedefop (IER estimates based on E3ME, EDMOD and RDMOD).

Box 2. **Expansion and replacement demand – Two examples**

Imagine two companies A and B with 100 employees each at the beginning of a year.

Company A is expanding its production. As a consequence, during the year there are three additional posts available and three workers recruited (expansion demand or positive net change). In the same period, however, seven workers leave the company because of retirement, emigration or other reasons. These seven vacancies are filled in this year (replacement demand). Altogether therefore, there are 7+3=10 job openings in company A in this period.

Company B has unfavourable sales and has to reduce its staff by four (negative 'expansion' demand or net change) in a given year. At the same time, 10 workers are leaving the company for various reasons (total hypothetical replacement demand). But because of the economic problems, four out of these 10 workers are not replaced. Thus, total job openings are -4+10=6 in this period.



5.1.3. **Implications for qualifications**

The analysis focuses on three qualification levels as highest educational attainment (high, ISCED 5-6; medium, ISCED 3-4; and low, ISCED 0-2; see Annex III for description). The results highlight the general increase in qualification levels across most jobs (Figures 24 and 25) and in particular the expected increase in number of jobs employing high- and medium-qualified people.

Results for sectors and occupations suggest prospects for demand of skills (measured by formal qualifications) are likely to remain positive. Changes in

industrial structure combine with skill-biased technological change to increase demand for highly-qualified and intermediate-qualified categories, to the detriment of the low-qualified group. These trends are reflected in the results.

(a) **Unconstrained estimates**

When looking at the projected changes in notional demand for formal qualifications – unconstrained by likely supply developments (see Section 2.3) and based on continuation of past patterns of employment by broad qualification level within both occupations and sectors – they are even more dramatic than for occupations. In total, if past trends continued without interaction with supply developments, the total net employment increase in Europe of around seven million jobs between 2010 and 2020 would imply increased demand of almost 10 million jobs at the highest qualification level and around 4.5 million jobs at medium level. These would be offset by a decline of seven million jobs for those with no or few formal qualifications.

In part the historical changes of these patterns reflect the growth in supply of people with formal qualifications. This is also going to be a feature of the future, if not at an even stronger pace. While there is a possibility of oversupply in some areas, there is considerable evidence of increasing demands for, and possibly even shortages of, qualified workers in many areas. Clearly the recession will have its impact too.

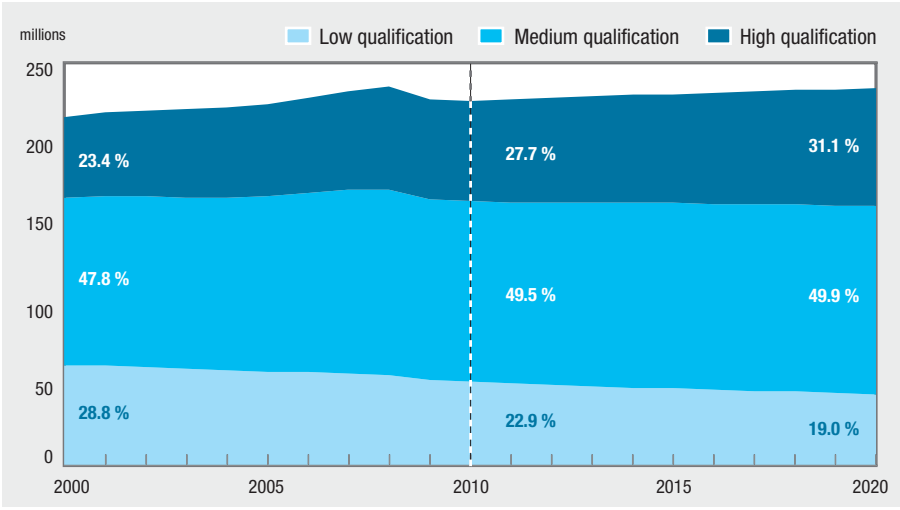
(b) **Constrained estimates**

In practice, future patterns of employment will reflect both demand and supply factors interacting. Substantial numbers of the workforce holding medium- or higher-level qualifications are already in the pipeline. In general, higher-qualified people tend to have more success in obtaining and retaining jobs than those lower qualified, so they are likely to secure employment at the expense of lower-qualified people. This is reflected in projections of constrained results developed in the project and presented in Figures 24 and 25.

Constrained estimates (see Section 2.3) allocate the projected numbers of qualified people (supply) to the jobs projected to be available (demand), assuming the main features of historical unemployment patterns among qualification categories will continue ([30]). In particular, unemployment among the higher qualified is expected to remain lower than among those qualified at medium level, who in turn are less likely to be out of a job than those with low (or no) qualifications.

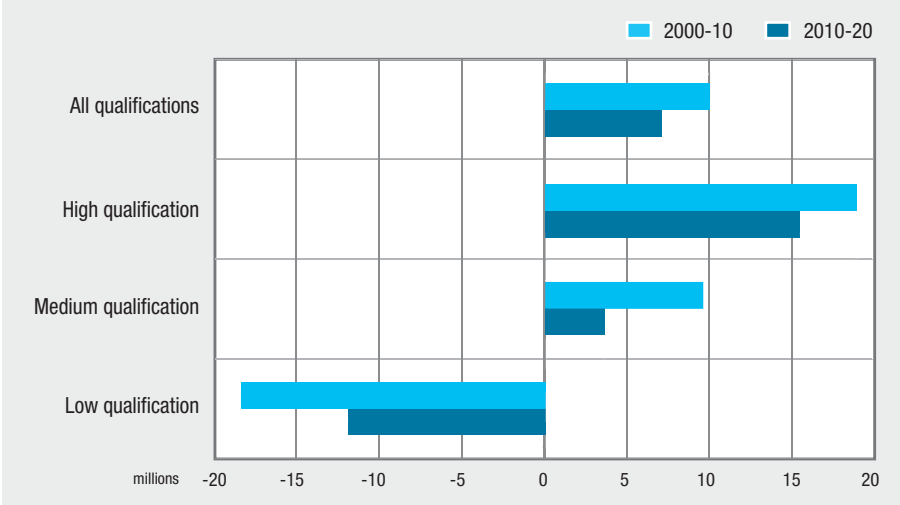
([30]) For details see Section 2.3.

Figure 24. **Past and likely future qualification change for those in employment, EU-27+**



NB: Constrained estimates, numbers in employment (LFS supply-based estimates).
Source: Cedefop (IER estimates based on E3ME, EDMOD and BALMOD).

Figure 25. **Past and projected qualification trends for those in employment, EU-27+**



NB:Constrained estimates, numbers in employment (LFS supply-based estimates).
Source: Cedefop (IER estimates based on E3ME, EDMOD and BALMOD).

The implications of this are:

- more rapid increases in effective demand (numbers in employment) for those with high-level qualifications in some occupations that used to require lower qualification levels (more such people are employed in less demanding jobs than they might have hoped or the nature of these jobs is changing and becoming more demanding);
- a faster projected decline in the number of jobs employing those with low (or no) qualifications (implying that those employed in many low-skill jobs might hold higher qualifications than might have been required in the past).

When considering supply developments in the demand projections, the overall number of jobs employing highly-qualified people is projected to rise by almost 16 million between 2010 and 2020, while the number of jobs employing people with low (or no) formal qualifications is expected to decline rapidly by around 12 million. Jobs requiring intermediate qualifications are expected to increase by almost four million. Some implications for imbalances and mismatches are discussed in more detail in Section 6.1.

As with occupations, it is not only the overall change in numbers of jobs that is important, but also replacement needs. Of the total of 73 million replacements projected, some 18 million will be for jobs where low or no qualifications are needed. About 21 million will be for jobs requiring high-level qualifications and the remaining 34 million for jobs at intermediate level (details in Annex II).

5.2. Country results

The general patterns of changing demand for skills (occupations, qualifications, expansion demand and replacement needs) are common across most countries. The patterns of sectoral change reflect common general drivers, such as demography, globalisation, international competition and technological and organisational change. Within sectors cost pressures, technological opportunities and increasing quality requirements for goods and services will drive occupational and qualification patterns in similar directions in most countries.

There are also some notable differences, depending on the stage of economic development of a particular country, and different industrial and occupational structures. However, in many cases an ongoing process of convergence becomes apparent. In part this is built in by assumption, as newer Member States are expected to converge towards output and

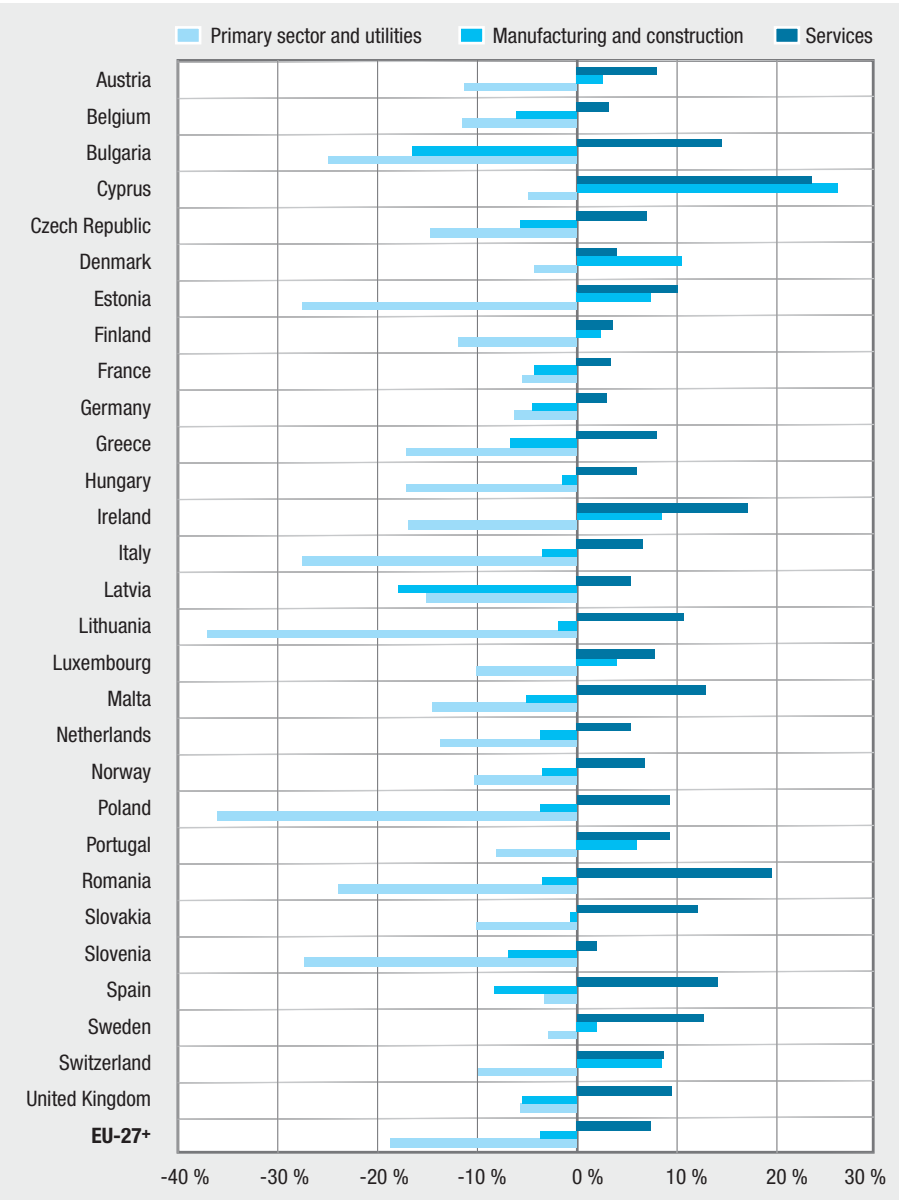
productivity paths of older Member States. This results in some restructuring of employment opportunities within Europe.

In the pessimistic scenario employment is worst affected in the construction and computing services sectors, with many countries expected to see a decrease of 1.5% per annum or more in employment compared to the baseline. This is not unsurprising as both sectors are heavily dependent on investment demand, which is one of the principal components that differs between the scenarios. Some sectors are expected (somewhat perversely!) to increase employment in the pessimistic scenario compared to the baseline case. In particular, the unallocated manufacturing sector (NACE 36 and 37) seems to have the largest increase of all 42 sectors. This is mainly due to a reduction in international imports that boost domestic production; the rest of the world also suffers in the pessimistic scenario.

Some similar patterns are also seen for the optimistic scenario, but it is important to note that the model includes many complex relationships that can produce such outcomes at detailed sectoral level. In the optimistic scenario, employment increases faster in industries closely related to consumption, such as retail and distribution. Generally, service sector employment grows faster in the optimistic scenario than in the baseline. Country sectoral developments for the next decade in the baseline scenario are shown in Figure 26. More detailed data are provided in Annex II.

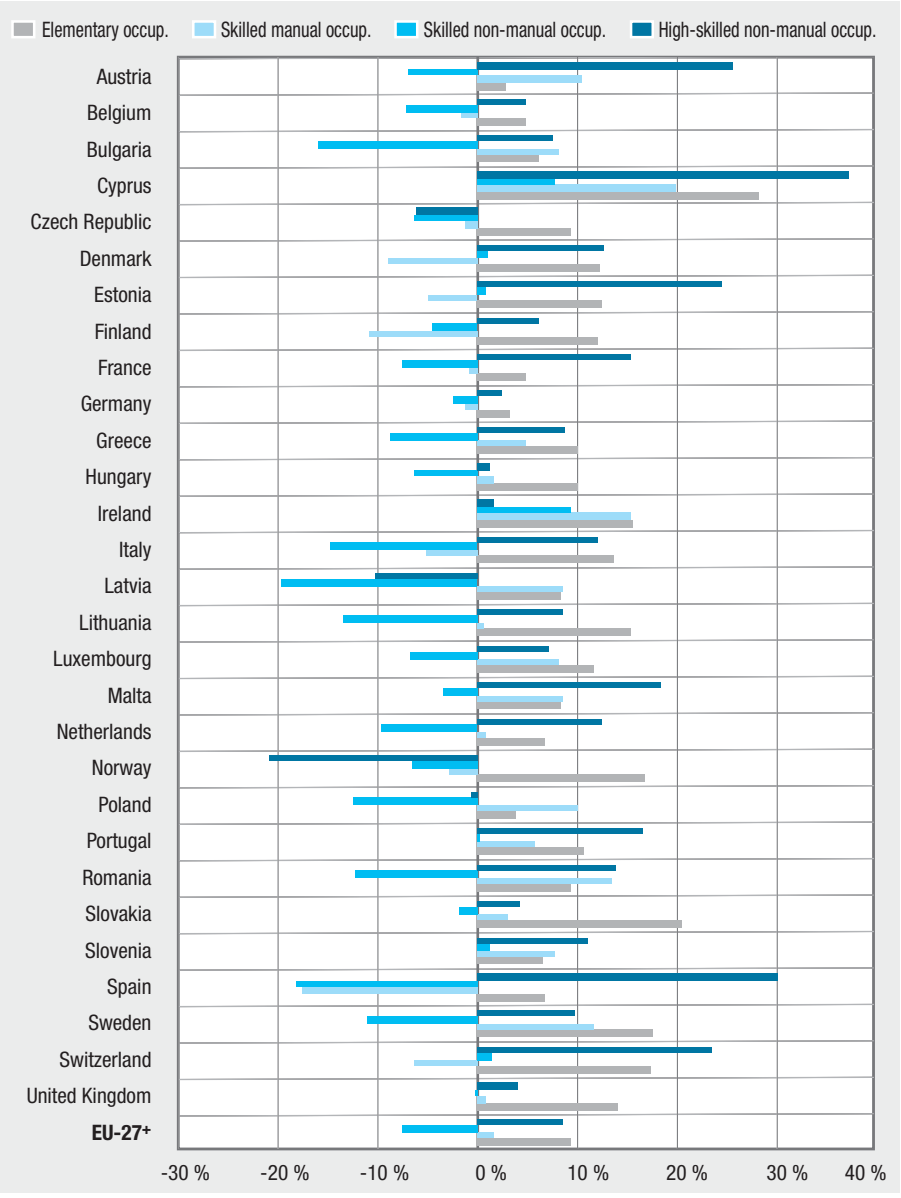
Macro and sectoral developments determine skills demand by impacting first on occupational and then on qualifications structures. Differences across countries tend to cancel out so the impact on overall patterns of skill demand is balanced out at EU-27+ level. Comparative country results for changing demand by occupation and qualification in the baseline scenario are provided in Figures 27 and 28. Detailed country results are in Annex II.

Figure 26. **Projected change in employment in broad sectors by country, 2010-20 (%)**



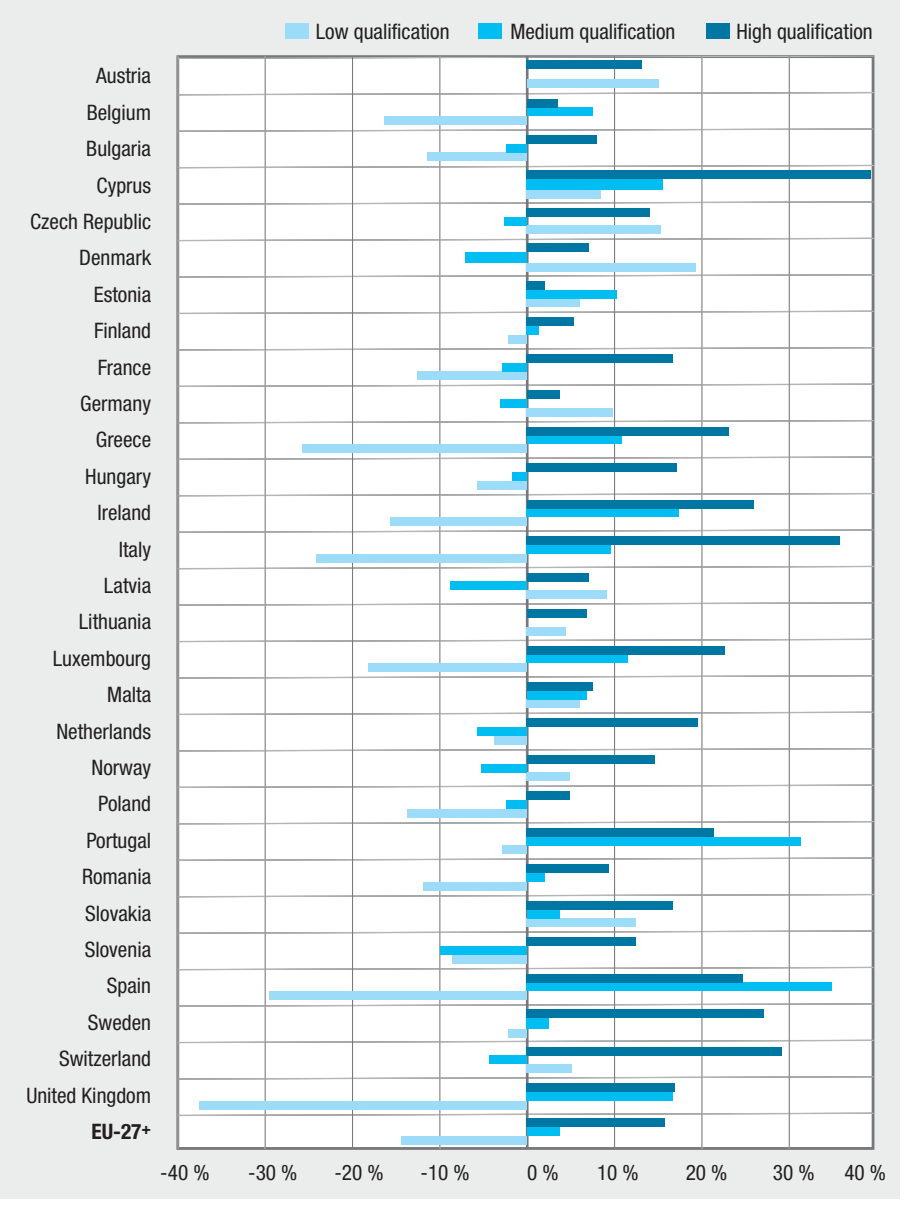
NB: Constrained estimates, numbers in employment (LFS supply-based estimates).
Source: Cedefop (IER estimates based on E3ME, EDMOD and BALMOD).

Figure 27. **Projected change in occupational structure by country, 2010-20 (%)**



NB: Changes in employment (NA-based estimates).
Source: Cedefop (IER estimates based on E3ME and EDMOD).

Figure 28. **Projected change in qualification structure by country, 2010-20 (%)**



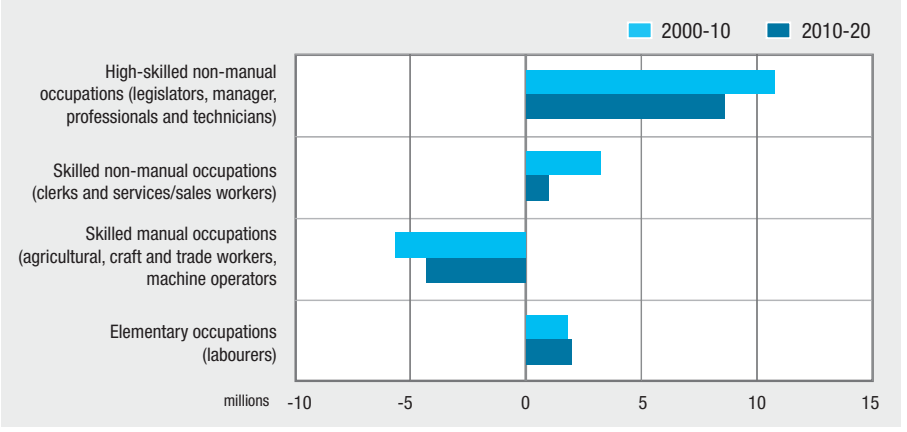
NB: Changes in employment (NA-based estimates).
Source: Cedefop (IER estimates based on E3ME, EDMOD and BALMOD).

6. The right skills for the right jobs?

6.1. Shift to knowledge- and skills-intensive occupations

Results show a considerable shift in labour demand towards skilled workers implying that future jobs will become more knowledge- and skills-intensive. The basic trends observed in recent years are expected to continue. Most projected increases are expected for high-skilled non-manual occupations, such as management, professional and associate professional jobs – more than 8.5 million in total between 2010 and 2020 (Figure 29). Technicians and associate professionals (including physical, engineering, life science, health and teaching associate professionals) have the highest potential for job creation in the next decade (around 4.5 million), followed by professionals (such as physical, mathematical and life-science engineers, health and teaching professionals) (2.7 million) and legislators, senior officials and managers (1.4 million). A more detailed occupational breakdown is provided in Annex II.

Figure 29. **Net employment change by broad occupational groups, 2010-20, EU-27+**



Source: Cedefop (IER estimates based on E3ME, EDMOD and RDMOD).

Currently almost 40% of people are employed in these knowledge- and skills-intensive occupations and this trend is expected to continue to reach a share of more than 42% of total employment in 2020 (Figures 21 and 22).

What exactly is behind these developments still needs to be analysed. Sectoral change is one of the key drivers of occupational structures, but globalisation, technological and organisational changes as well as new patterns of international trade also contribute substantially. Whether people have the right skills to match these jobs, is a question which a more detailed analysis of fundamental changes in the occupational structure should help to answer.

Skill forecasts are based on past trends and behaviour patterns and depend on the data available. They analyse systematically what continuation of these trends would imply. Being restricted to formal qualifications, however, they cannot provide qualitative information on the knowledge, skills and competences people have, or what jobs require.

But evidence shows that employers do not recruit people based only on their formal qualifications (vocational or academic), but also look for other competences that add value to their organisation. They prefer flexible workers able to adapt quickly to unforeseen changes. Therefore individual skills profiles should ideally combine specific skills needed for a job with transversal core skills such as the ability to analyse and organise complex information, take responsibility, manage risks and take decisive actions (European Commission, 2010a).

Changing occupational demand also reflects the changing skill supply. People are becoming generally more highly qualified and shape their jobs and, thus, might increase job requirements. However, some of these changes are not (yet) captured by traditional classifications.

6.2. Change in skills intensity of jobs versus job polarisation

At first glance, some European labour market developments may seem contradictory, such as the two main phenomena observed on the demand side: higher demand for high and medium qualifications across all jobs and polarisation of jobs. However, they are not contradictory when looking at them in more detail.

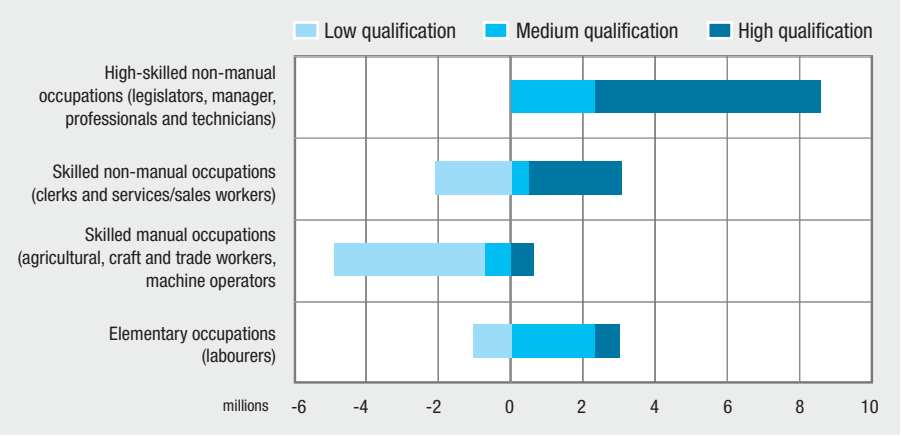
Polarisation refers to ‘jobs’ where occupations (ISCO classification) are seen as a proxy for job tasks and requirements. ‘Upskilling’ on the other hand refers to the skills and qualifications of individuals necessary to perform a job.

It is possible many jobs – independently of whether they are increasing or decreasing in number – require more highly-skilled/qualified people than in the past. Therefore a distinction should be made between changes in absolute numbers of jobs and changes in the skills/qualification composition within each of these job categories.

The current forecast confirms what Cedefop already pointed out in its first demand forecast (Cedefop, 2008): increasing demand (net change) for high-skilled non-manual occupations as well as elementary occupations. Conversely, demand for skilled non-manual occupations is expected to rise only slightly (such as clerks, service/sale workers) and demand for skilled manual occupations (such as skilled agricultural, craft and trade workers, machine operators) is expected to decline substantially. One could interpret this development as 'job polarisation'. Although for Europe as a whole the risk of job polarisation is not strong, it could be more pronounced in countries still in transition to service-based economies. These developments could be caused by globalisation and technological change whereby traditional manufacturing is moved abroad and technology is displacing many routine jobs.

However, within all these occupational groups – including elementary occupations – there is a clear trend of increasing requirements with an increased deployment of high and medium-level qualified people, and a decrease of those with low qualifications (Figure 30).

Figure 30. **Net employment change by occupation and qualification, 2010-20, EU-27+**



NB: Changes in employment (NA-based estimates).
Source: Cedefop (IER estimates based on E3ME, EDMOD and BALMOD).

The figures above relate to the net employment change 2010-20. But when the need to replace people leaving employment because of retirement, emigration, etc. is also considered, total demand (replacement plus expansion demand) are positive (Figure 23). For all occupations/jobs, replacement exceeds expansion demand significantly. This means there will be considerable job openings, even if not all people leaving a job will be replaced.

Concluding, it is important to distinguish between 'jobs' (occupations) and 'skills' (qualifications). For jobs at aggregate level, a pattern of polarisation seems to emerge with more jobs being created at upper and lower levels within the traditional hierarchy of jobs established by the ISCO classification, and stagnation or even decrease of new jobs at medium levels. On qualifications, however, an increase in skills requirements is expected in all jobs. This development needs to be researched further to clarify a range of interesting questions, as for instance:

- how do skill requirements develop in jobs not (yet) captured by the traditional ISCO classification;
- what does this mean in terms of 'overskilling' or 'overqualification', such as people deployed in jobs below their abilities or qualification level and the potential consequences (see Section 6.3);
- what recruitment criteria do employers use (such as focus on competences or informally-acquired skills rather than on formal qualifications, or focus on generic or 'soft' skills ([31]) rather than specific occupational skills)? Are formal qualifications increasingly becoming a necessary but no longer sufficient criterion in the recruitment process;
- what does this mean in terms of labour shortages as well as surpluses in some fields (skill mismatch);
- what are the characteristics and employment conditions of people working in jobs which do not correspond to their skills and qualifications?

6.3. Imbalances, skill mismatches and reconciliation

Initial projections of the demand for and supply of skills have been developed independently. In reality there are large numbers of adjustment mechanisms that operate in the labour market to reconcile or lower imbalances and

([31]) These include the eight key competences defined in the European framework for key competences for lifelong learning. *Official Journal of the European Communities L 394*, 30 December 2006, p. 10.

mismatches. In the short term, these include adjustments in wages and different kinds of mobility, as well as changes in ways employers use the skills available. In the longer term and with some time lags, both supply and demand will adjust to reflect the signals and incentives that arise.

Generally, employers will not cease to operate if they cannot find the ideal mix of skills. They will operate with what is available ([32]). Conversely, if the educational system delivers too many people with particular levels of formal qualification this does not necessarily imply that such people will remain unemployed. Rather they tend to find jobs that make less direct use of their qualifications since education and training often still puts them at an advantage in the labour market compared to those with lower-level qualifications. As career mobility theory suggests, a given job – even at lower level – can be a basis for future mobility and the career of an individual. The labour market operates as a sorting mechanism that allocates people to jobs, based on the limited information available to both sides (employers as well as actual and potential employees).

The results discussed above reflect how this mechanism reconciles the projected patterns of demand for skills with the available supply. In the current sets of results the initial projections of supply of those available with higher- and medium-level qualifications show more rapid growth than implied on the demand side. This tendency could be reinforced by the impact of the recession. The implication is that some higher-qualified people will need to take jobs that have not typically required such levels of formal qualification.

Career mobility theory suggests this is most likely a temporary phenomenon. A situation of overskilling will be resolved over time by subsequent moves to higher-level jobs. Empirical evidence, however, suggests that for some people, overskilling reflects a more permanent situation (Cedefop, 2010a). The longer it lasts, the more it may prove a cause of frustration for those involved, although as already highlighted it also opens up opportunities for individuals to expand their jobs in ways that employers may not have thought about.

Cedefop (2010a) considers the possibility that overskilling may also be the result of conscious decisions by employers. Hiring overskilled workers can be based on the belief that they are more productive and better able to deal with

([32]) Although this may, of course, affect their longer-term prospects, as emphasised in many academic and official assessments of what Europe needs to do to remain competitive and stay at the leading edge of technological and other developments. See, for example, the discussion in Berman and Machin (2000).

the dynamics of modern workplaces or the expectation that higher-skilled workers will be in short supply in the near future. Assessing the short- and long-term overall impacts of overskilling can only be answered by considering the interaction of productivity impacts, scarring effects, motivation and job satisfaction, the accessibility of career paths and the possibility to shape jobs, and requires more fundamental analysis.

In principle, these mechanisms can be modelled and incorporated into a forecasting tool ([33]). In practice, this demands very detailed and rich data that are, at present, not available at pan-European level. In the present results a more limited reconciliation is imposed that recognises the key features of this process. This is described in more detail in Kriechel and Wilson (2010).

Projected numbers on the supply side are taken as given for this purpose. This reflects the fact that the total numbers of people available by qualification level are largely predetermined by demography and educational and training decisions already made. The generally higher-qualified new entrants to the labour market, partly replacing lower-qualified older people imply that substantial improvements in average qualification levels of the labour force are inevitable in the short to medium term ([34]).

Projections on the demand side are then adjusted to allocate the available supply by broad qualification level to the jobs on offer. This is done at detailed level for each country, distinguishing both sectors and occupations. In future work, other ways in which both demand and supply may respond to any initial imbalances and mismatches will be explored.

However, not only level of qualification matters on the labour market. The chance to find an adequate job also largely depends on the field of study. This could not be tackled by this forecast, but work is in progress to include it in the next round, if data quality and availability allow for it.

Historical evidence on patterns of unemployment by qualification level are used to develop estimates of how overall levels of unemployment projected by the macroeconomic model are shared between different qualification categories. The results reflect the observed hierarchical patterns in historical data: those with high-level qualifications are much less likely to become and remain unemployed than those with medium-level qualifications. In turn, those

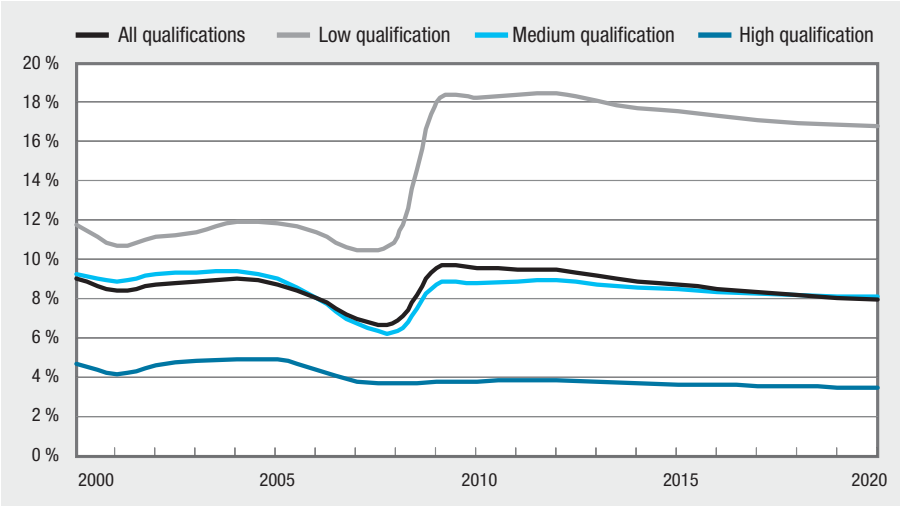
([33]) For example, see the work by ROA in the Dutch labour market. Borghans and Heijke (1996) describe the basis of the model with substitution. On the interpretation of gaps in supply and demand see Borghans and Willems (1998).

([34]) Although there is more uncertainty about what proportion of these will be economically active and whether positive historical trends in qualification attainment rates will be maintained in the face of rising unemployment rates.

with medium-level qualifications are likely to be much less affected by unemployment than those with low (or no) qualifications.

This does not mean that higher-qualified people escape unscathed from the recession. Their share of total unemployment is projected to rise, since they are a growing proportion of the labour force. However, the higher qualified are likely to suffer less from unemployment than the lower qualified in terms of rates (probabilities) of becoming or remaining unemployed. Figure 31 sets out the recent historical and projected future paths for unemployment rates for the three qualification categories. It illustrates the strong correlation of unemployment rates and qualification levels as well as the potential impact of the recession and the subsequent recovery.

Figure 31. **Unemployment rates by qualification category, EU-27+**



NB: Constrained estimates.
Source: Cedefop (IER estimates based on E3ME, EDMOD and BALMOD).

But this process of reconciliation between the demand and supply numbers does not imply that employers' skill demands and available supply match. As mentioned above, some individuals may be employed in jobs that do not strictly require the levels or the kind of qualifications they possess. This could imply wasted resources as the investment in prior education and training they have made is not being fully utilised. It could also be a result of 'wrong' educational choices taken long ago. Other tensions may arise as individuals become frustrated that jobs do not meet their expectations, and that their skills

are not being fully utilised. This may hamper significantly their job satisfaction and subsequently their motivation to be committed to their jobs. It may also hamper expectations and satisfaction of employers and productivity. On the other hand, there may be various benefits in employing better-qualified people in jobs not traditionally requiring such high-level qualifications (increasing innovation, better service or improved products). Supply may in a sense begin to create its own demand, as such individuals identify better ways of doing and shaping their jobs, particularly in a situation of rapid economic and occupational change.

In the longer term, such phenomena raise some key policy questions about maximising utilisation of skills and helping to improve employers' ability to operate in an intensely competitive world economy. Present results suggest that governments may need to stimulate demand from employers and find ways to increase utilisation of skills if such problems are to be avoided. Employers may also react proactively and change particular job profiles to increase their match with available skills. Another important aspect of imbalances is the geographical dimension. Results suggest there may be some structural differences across Europe which call for more action to address underutilisation of skills in particular countries.

Differences between skill supply and demand cannot be simply interpreted as unemployment. As discussed in Section 2.3, differences arise because: some people have more than one job, while others share one job; unclear distinction between residence and workplace as well as errors and differences in measuring employment, unemployment and related indicators in different sources. In any case, results show that for those with higher qualifications the 'supply' trend (the labour force) has been rising more rapidly than the 'demand' trend (employment), and this difference is projected to continue. For those with low (or no) qualifications the opposite is true. At medium level the trends follow more or less parallel paths.

The recession will probably exacerbate these differences in trends for skill demand and supply. As discussed above, it could be more difficult for some people qualified at medium and higher levels to find the jobs they would like, especially in the short term. There are some indications that the positive trends in demand are less strong than before the crisis and the subsequent recession. The recession will probably also reinforce incentives to stay in education for many young people facing very difficult labour market conditions. This will tend to accelerate positive trends in supply of those with intermediate and high-level qualifications – but it remains open whether job requirements change in the same scope and direction.

In presenting implications for imbalances it is important not to try to interpret results too literally. Both the trends in supply (towards a more highly-educated workforce) and the trends in demand (towards greater use of such people in employment) go in the same direction, but are hard to predict precisely and in detail.

Other Cedefop research (Cedefop, 2010a) suggests that formal overeducation (or over-qualification) is not a problem *per se*. In a general cultural sense it is probably impossible for an individual to be too well-educated. And if those that are overeducated in a formal sense have lower skills than needed, the labour market matches supply and demand making it difficult to speak about skill mismatch. But underutilisation of skills and competences is a potential problem. So are job quality and terms or conditions of employment that fail to match the expectations raised by a person's education and training. These issues also emerge in national studies.

6.4. Reflecting on the core outcomes

While trends of supply and demand forecasts seem to develop similarly, the questions about potential imbalances and mismatches point to taking a closer look at the results and to contextualise them. What the figures cannot show, for instance, is how different economic models (labour market regulation, occupational specificity of qualifications or job mobility) or differences in the economic structure, vocational specificity of qualifications and use of part-time work and temporary contracts influence skills supply and demand and more generally the dynamic interaction between the broader economic and social context and skills development.

Whether employing more highly-skilled people in jobs that used to require lower-level skills indicates that jobs are changing in content and becoming more demanding needs to be explored further. We need more information about rationale, motivation and expectations that influences employers' recruitment behaviour. Do they focus more on higher-level generic skills or more specific skills relating to the occupation? We need a better understanding of how occupational profiles and tasks are developing and what people really need to know and be able to do in particular jobs. We also need to understand better what people know and are able to do when they hold specific qualifications in terms of learning outcomes of the respective education and training programme. But also in terms of the knowledge, skills and competences they really have. And we need more effective ways to assess these skills and competences.

The proxies we use in the forecasts cannot tell us the full story. Changing job requirements or new jobs that straddle traditional occupational boundaries are not fully captured by the ISCO classification, with its inherent hierarchy of occupations. Formal qualifications expressed in ISCED levels as a proxy for skills do not give a clear picture of the learning outcomes which form the basis of national and European qualifications frameworks. Therefore, formal qualifications as a proxy for skills should be complemented – not necessarily replaced – by information on the outcomes of education and training programmes as well as the skills employers expect when recruiting people. The new initiative by DG Employment, DG Education and Culture and Cedefop to complement traditional classification systems of occupations and qualifications by related competences expressed in a common language could help improve the data in the medium to longer term. This could contribute to a better match of supply and demand, also across national boundaries. A better match could lead to a win-win situation for employees and employers: it could increase individual job satisfaction and career perspectives as well as productivity, innovation and competitiveness.

A large share of tomorrow's labour force is already in the labour market. Structural changes imply that more people will need skills to move to other jobs. Evidence shows that the match between qualifications and labour market entry occupations is strong in countries where qualifications are more occupation-specific than in others ([35]). But this can turn into a disadvantage when structural change or other labour market developments require them to change jobs. Policy-makers should ensure that education and training provides both specific skills and sufficient key competences as well as transversal skills for smooth transition to other jobs and coping with change. These skills should be acquired not only in initial, but also in continuing training.

Ageing populations will require higher productivity by those in employment to support those who have retired. This requires increasing labour market participation, and also activating the long-term unemployed and giving them a chance to acquire the skills required. As the projections show, women will become more highly qualified than men. To ensure that their potential will be used, it is not enough to redirect women to occupations that used to be dominated by men; social barriers and glass ceilings also need removing.

([35]) The concepts of prevailing 'qualificational' and 'occupational' spaces in several countries and their implications for the transitions from school to work are discussed in Cedefop, Descy and Tessaring (2001), p. 339 et seq. See also Danish Technology Institute (2008).

Today, women's share in management positions is only 20%; only 2 to 3% of workers in top positions in the largest and most powerful companies are women (Wirth, 2009). Policy measures to make combining work and family commitments easier are essential.

The forecast shows that the European benchmark for 2010 to increase the share of 20-24 year-olds with at least upper secondary education and training to 85% might not be reached even by 2020. Nevertheless, the new target of 40% for those aged 30-34 with tertiary attainment (set for 2020) could be reached by 2017.

The current high number of the low-skilled working population (25-64 year-olds) of almost 80 million in EU-27 (2008) is a growing concern for policy-makers. Even though the number of people with low or no qualifications is expected to decrease (to around 50 million of this age group in 2020), one fact remains: they will be at a disadvantage when getting a job, staying in a job or moving to another job. And, they are less likely to get access to education and training to upgrade or broaden their skills. Low-qualified people may also lack the courage and motivation to take up learning. A challenging working environment and more demanding tasks can stimulate skills development and encourage other forms of learning.

Putting the skills workers have to work effectively, is essential. Companies could use their workforce more productively by changing their work organisation (through collaborative approaches), open up opportunities for upward job mobility or by moving into different or value-added products or services. Working environment and work organisation could give people room to shape their jobs and/or create new ones.

Knowledge, skills and competences that remain unused can limit productivity and innovation and the competitiveness of the enterprise and make workers more vulnerable to labour market change. This also entails assessing their potential which might not be visible, namely the skills that people have acquired at work or through other forms of informal learning. Identifying, assessing and recognising the skills people have, irrespective of where and how these have been acquired, is particularly relevant for people who only hold low or no formal qualifications. But skill assessment could also benefit employers to become more aware of existing potential and gaps. As the third continuing vocational training survey (CVTS3) suggests, nearly three quarters of enterprises that did not provide training, assumed existing skills and competences of employees correspond to current needs (Cedefop, 2010b). At the same time other evidence suggests that a number of people feel they have the knowledge, skills and competences to do more challenging tasks.

People need support and guidance to understand how best to develop their skills and find occupations that match these. Formative assessment of people's tacit knowledge and skills and competences acquired at work, in voluntary activities, in their leisure time or in family situations can provide a valuable base. Summative assessment leads to certification which is valued on the labour market and eventually, can open up career progression and encourage further learning. To become a 'currency' for their holders, qualifications awarded based on validation of non-formal and informal learning should be integrated into national qualifications frameworks.

Changes in the structure of occupations and skill requirements mean that we have to adopt less linear approaches to learning and work. Sound labour market information, guidance and counselling that considers people's skills portfolios, skills development at the workplace and (more) formal flexible learning paths that take existing skills into account need to complement one another. In short, Europe should give greater emphasis to bring the world of education and work together, to increase utilisation of skills and stimulate employer demand.

It is also important to look beyond the fence. Europe's competitor countries, in particular the BRIC countries (Brazil, Russia, India, China) and other fast developing nations are also aiming to increase their human capital and shares of high-level jobs. Europe is already losing part of its highly-skilled workforce in the global race for talent. Winning such jobs and talents will remain a highly competitive game, dependent on achieving higher productivity in the EU. Optimal allocation (and use) of skilled workers may be a necessary (but probably not sufficient) condition for this. Better matching supply of skills with the right jobs will be essential. Europe has no room for complacency.

7. What next?

Less than five years ago there was no system that provided consistent skills projections across Europe. This project has now set in place a firm foundation for undertaking such work regularly, including:

- providing a general conceptual framework;
- establishing sound basic data on demand for and supply of skills;
- developing models for generating projections, using these and other data consistently and transparently;
- setting up a mechanism for critically assessing results and suggesting ways to improve the general approach.

There are many areas that still need further refinement and improvement. Some can be accomplished in the current research work, others require more substantial interventions. In particular there is an urgent need to improve existing data sources – the need for robust and detailed information on the occupational structure of employment remains central. There is also a case for some improved and new surveys but these need to be focused on the right areas, adding light to the central issues of changing skill needs rather than emphasising the ephemeral and marginal ([36]).

There is also a need for better harmonisation of work at national level (harmonising data output at least, if not input, namely survey methods, etc.). More attention is also desirable on fields of study and detail by occupation (but this all requires better data). Last but not least, much development work needs to be done to model and incorporate the complex interactions between supply and demand.

The results presented in this report represent the most comprehensive and consistent set of skill projections ever produced for Europe. Although there are still many data problems and questions outstanding, many trends emerging from the analysis are robust and not sensitive to detailed data problems nor to the detailed specifications for models used to explain changing patterns of skill demand and supply. This suggests that such projections can provide valuable and robust information to a broad range of users, from individuals making educational and career choices, education and training providers, guidance and employment services, enterprises that invest

([36]) Cedefop is currently developing a European employer survey on changing skill needs.

in education and training, through to policy-makers operating at the highest strategic level.

Such pan-European projections are not a substitute for projections at national level. Rather they are complementary, offering a broad and consistent outlook for the whole of Europe. While this may not be able to compete with what is being done in some individual countries (based on many years investment in data, systems and knowledge), it can provide a common framework within which these more detailed analyses can be compared. Further, they require more qualitative analyses of the complex nature of skills, competences and knowledge – and the requirements of the labour market.

There are of course data issues, which are especially severe for some smaller countries where sample sizes in the LFS are often inadequate to provide robust estimates on detailed/disaggregated employment structures. Even for many larger countries there are difficulties arising from changes in classification and other technical issues many of which can only be addressed by painstaking and detailed dialogue between individual country experts and the relevant statistical authorities at national and international levels. One conclusion of this research is the urgent need to address these concerns so better labour market information and intelligence can be developed in the future, to help guide the choices and decisions of all Europe's citizens. Efforts to address these concerns are being made in continuing research work by Cedefop and others. Despite these reservations about the quality of existing data, however, it should be underlined that many results emerging from the analysis are quite robust.

These results are just a starting point. Cedefop, in cooperation with the research team and country experts in its network Skillsnet, is continuing this work by developing further analysis of skill demand, skill supply and future labour market imbalances and mismatches. Cedefop intends to carry out regular updates of both demand and supply forecasts, and further methodological and data improvements, as well as enriching results with additional qualitative research. In the longer term, the intention is to initiate dialogue and find consensus with all Member States on establishing a common European approach to skills forecasting which can be used by all countries, a bottom-up approach to collecting data and forecasting skills at European level.

It is important to bear in mind that the audience for these results is not just policy-makers. It is crucial to escape from the thrall of planning – and recognise that such information is crucial to making markets work better by better informing individual choices. This raises significant issues of dissemination.

There is a need for better web-based tools. Lessons from other countries such as the US (with its O*NET) demonstrate the value of such information. Cedefop is exploring new ways of disseminating forecast results to improve European labour market information and intelligence. Cedefop will also continue its work on researching various forms of skill mismatch and investigating sectoral skill needs, in particular for green jobs. In addition, Cedefop contributes substantially to further development of EU tools and principles based on learning outcomes, defined in terms of knowledge, skills and competences.

Annexes

ANNEX I

Skill supply: detailed tables

Table 1. **Population (15+) by age, gender and qualification, EU-27+, 2000-20**

Popu-lation	All qualification					Low qualification				
	Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
	2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
Males and females										
15+	409 992	435 247	449 572	25 256	14 324	177 537	146 144	113 020	-31 393	-33 124
15-19	31 744	29 413	27 090	-2 332	-2 323	24 694	22 403	19 536	-2 292	-2 867
20-24	33 309	32 843	28 887	-467	-3 956	7 860	6 525	4 826	-1 335	-1 699
25-29	35 518	34 547	32 506	-971	-2 041	8 520	5 633	3 678	-2 887	-1 955
30-34	38 007	35 751	35 414	-2 255	-338	10 353	6 653	4 368	-3 700	-2 285
35-39	37 909	37 230	36 076	-679	-1 154	11 161	8 400	5 741	-2 760	-2 660
40-44	36 150	39 088	36 426	2 938	-2 662	11 488	9 443	6 372	-2 045	-3 071
45-49	34 147	38 092	37 372	3 945	-720	12 305	9 978	6 729	-2 328	-3 249
50-54	32 264	35 587	38 441	3 323	2 854	13 721	10 354	7 233	-3 366	-3 122
55-59	26 990	32 946	36 796	5 957	3 849	13 182	10 860	7 460	-2 321	-3 400
60-64	26 297	30 101	33 936	3 804	3 835	14 511	11 949	8 227	-2 563	-3 722
65+	77 656	89 649	106 628	11 992	16 979	49 742	43 946	38 852	-5 796	-5 095
Males										
15+	197 485	210 685	218 309	13 200	7 624	77 232	66 029	53 043	-11 203	-12 986
15-19	16 230	15 079	13 869	-1 152	-1 209	12 850	11 868	10 380	-982	-1 488
20-24	16 911	16 717	14 698	-194	-2 019	4 391	3 710	2 810	-681	-900
25-29	17 950	17 504	16 492	-446	-1 011	4 359	3 167	2 173	-1 192	-994
30-34	19 204	18 123	17 985	-1 081	-138	5 126	3 650	2 527	-1 476	-1 124
35-39	19 078	18 800	18 304	-278	-496	5 368	4 364	3 281	-1 004	-1 083
40-44	18 090	19 687	18 427	1 597	-1 260	5 207	4 877	3 750	-330	-1 126
45-49	16 973	19 037	18 767	2 063	-269	5 406	4 791	3 659	-615	-1 133
50-54	15 976	17 586	19 167	1 610	1 581	5 847	4 661	3 590	-1 186	-1 071
55-59	13 203	16 058	18 090	2 855	2 032	5 510	4 596	3 386	-914	-1 210
60-64	12 545	14 498	16 377	1 953	1 878	5 975	5 017	3 548	-958	-1 470
65+	31 324	37 597	46 133	6 272	8 536	17 193	15 327	13 940	-1 865	-1 387
Females										
15+	212 507	224 563	231 262	12 056	6 700	100 305	80 115	59 977	-20 190	-20 138
15-19	15 514	14 334	13 220	-1 180	-1 114	11 845	10 535	9 156	-1 310	-1 379
20-24	16 398	16 126	14 189	-272	-1 937	3 469	2 815	2 016	-654	-799
25-29	17 568	17 043	16 014	-525	-1 029	4 161	2 465	1 505	-1 696	-961
30-34	18 802	17 628	17 428	-1 175	-200	5 227	3 003	1 841	-2 224	-1 162
35-39	18 831	18 430	17 772	-401	-658	5 793	4 037	2 460	-1 756	-1 577
40-44	18 060	19 401	17 999	1 341	-1 402	6 282	4 567	2 622	-1 715	-1 945
45-49	17 174	19 056	18 605	1 882	-451	6 899	5 186	3 070	-1 713	-2 116
50-54	16 288	18 001	19 274	1 714	1 273	7 874	5 693	3 643	-2 181	-2 050
55-59	13 787	16 889	18 706	3 101	1 817	7 671	6 264	4 074	-1 407	-2 190
60-64	13 752	15 603	17 560	1 851	1 957	8 536	6 931	4 679	-1 605	-2 252
65+	46 332	52 052	60 496	5 720	8 444	32 549	28 619	24 912	-3 930	-3 707

Source: Cedefop (IER estimates based on StockMOD).

Medium qualification					High qualification				
Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
168 487	197 082	216 836	28 595	19 754	63 968	92 022	119 716	28 054	27 694
6 944	6 732	7 184	-211	452	106	277	369	171	92
21 814	21 491	18 507	-323	-2 985	3 635	4 827	5 554	1 192	728
18 804	17 156	14 245	-1 647	-2 912	8 195	11 758	14 584	3 563	2 826
19 114	17 251	15 838	-1 864	-1 413	8 539	11 848	15 208	3 308	3 360
18 540	18 318	17 903	-221	-415	8 209	10 512	12 432	2 303	1 921
17 322	19 938	19 849	2 616	-89	7 340	9 707	10 204	2 367	498
15 247	19 221	20 721	3 974	1 500	6 594	8 894	9 922	2 299	1 029
12 901	17 349	20 656	4 447	3 307	5 642	7 884	10 553	2 243	2 669
9 623	15 342	19 188	5 719	3 846	4 185	6 744	10 148	2 559	3 404
8 456	12 382	16 578	3 926	4 196	3 330	5 770	9 132	2 440	3 361
19 721	31 901	46 168	12 180	14 267	8 193	13 801	21 609	5 608	7 808
86 551	99 145	107 888	12 594	8 743	33 702	45 511	57 378	11 809	11 867
3 343	3 107	3 347	-236	240	37	104	142	66	39
10 966	10 962	9 528	-4	-1 434	1 554	2 045	2 361	491	315
9 780	9 169	7 893	-611	-1 277	3 810	5 167	6 427	1 356	1 260
9 761	9 045	8 540	-716	-505	4 317	5 428	6 919	1 112	1 491
9 447	9 408	9 216	-39	-191	4 264	5 029	5 807	765	778
9 004	10 013	9 846	1 009	-166	3 880	4 798	4 830	918	33
7 989	9 740	10 403	1 750	664	3 578	4 506	4 705	928	200
6 897	8 877	10 529	1 980	1 652	3 233	4 048	5 048	815	1 001
5 176	7 813	9 554	2 637	1 741	2 517	3 648	5 149	1 132	1 501
4 553	6 319	8 141	1 766	1 822	2 017	3 162	4 688	1 145	1 526
9 636	14 693	20 891	5 058	6 198	4 496	7 576	11 301	3 080	3 725
81 936	97 937	108 948	16 001	11 011	30 266	46 511	62 338	16 245	15 827
3 600	3 625	3 837	25	212	69	174	227	105	53
10 849	10 529	8 979	-319	-1 550	2 081	2 781	3 194	701	412
9 023	7 987	6 352	-1 036	-1 635	4 384	6 591	8 157	2 207	1 566
9 353	8 206	7 298	-1 147	-908	4 223	6 419	8 289	2 197	1 870
9 093	8 911	8 687	-182	-224	3 945	5 483	6 626	1 538	1 143
8 318	9 925	10 003	1 607	78	3 460	4 909	5 374	1 449	465
7 258	9 481	10 317	2 223	836	3 017	4 388	5 217	1 371	829
6 005	8 472	10 127	2 467	1 655	2 409	3 836	5 504	1 427	1 668
4 447	7 529	9 634	3 082	2 105	1 668	3 095	4 998	1 427	1 903
3 903	6 063	8 437	2 160	2 374	1 313	2 608	4 444	1 295	1 836
10 086	17 208	25 276	7 122	8 069	3 697	6 225	10 308	2 528	4 082

Table 2. **Labour force (15+) by age, gender and qualification, EU-27+, 2000-20**

Labour force	All qualification					Low qualification				
	Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
	2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
Males and females										
15+	228 838	242 874	245 904	14 036	3 030	70 094	54 527	39 501	-15 567	-15 025
15-19	7 880	6 717	5 847	-1 163	-870	5 167	4 194	3 493	-973	-701
20-24	20 641	19 836	17 370	-806	-2 465	5 306	4 268	3 267	-1 038	-1 001
25-29	28 388	27 903	26 750	-485	-1 152	6 108	4 019	2 701	-2 089	-1 318
30-34	31 886	30 091	30 282	-1 795	191	7 656	4 878	3 287	-2 778	-1 591
35-39	31 823	31 504	31 134	-319	-370	8 233	6 187	4 367	-2 046	-1 820
40-44	30 582	33 668	31 660	3 086	-2 008	8 509	7 109	4 930	-1 399	-2 179
45-49	28 204	32 058	31 703	3 854	-354	8 820	7 335	5 088	-1 485	-2 247
50-54	23 984	27 570	30 212	3 586	2 642	8 591	6 763	4 834	-1 828	-1 930
55-59	15 020	20 016	23 970	4 996	3 954	5 921	5 162	3 705	-759	-1 457
60-64	6 536	9 530	11 677	2 994	2 147	3 247	2 982	2 207	-264	-775
65+	3 895	3 983	5 298	88	1 315	2 536	1 628	1 622	-908	-6
Males										
15+	128 087	133 451	135 460	5 364	2 010	39 923	32 013	24 411	-7 910	-7 602
15-19	4 343	3 667	3 197	-677	-470	3 025	2 456	1 979	-569	-477
20-24	11 042	10 805	9 476	-236	-1 329	3 311	2 743	2 102	-569	-641
25-29	15 579	15 147	14 340	-432	-807	3 745	2 654	1 839	-1 091	-816
30-34	17 859	16 587	16 588	-1 272	1	4 625	3 172	2 213	-1 454	-959
35-39	17 738	17 224	16 954	-514	-271	4 771	3 760	2 854	-1 011	-907
40-44	16 807	18 284	17 082	1 478	-1 203	4 630	4 254	3 273	-376	-981
45-49	15 540	17 256	17 127	1 716	-129	4 701	4 096	3 170	-606	-925
50-54	13 607	15 020	16 537	1 414	1 516	4 648	3 698	2 873	-950	-825
55-59	9 050	11 165	13 385	2 114	2 221	3 281	2 696	2 042	-585	-654
60-64	4 210	5 814	7 312	1 604	1 498	1 863	1 639	1 256	-224	-383
65+	2 313	2 481	3 463	169	981	1 323	847	812	-477	-35
Females										
15+	100 751	109 424	110 444	8 673	1 021	30 170	22 513	15 090	-7 657	-7 423
15-19	3 536	3 050	2 650	-486	-400	2 142	1 738	1 515	-403	-224
20-24	9 600	9 030	7 895	-569	-1 136	1 995	1 525	1 165	-470	-360
25-29	12 809	12 756	12 410	-54	-345	2 363	1 365	863	-998	-503
30-34	14 027	13 503	13 694	-523	190	3 031	1 706	1 074	-1 325	-633
35-39	14 085	14 280	14 181	195	-99	3 462	2 427	1 513	-1 035	-913
40-44	13 775	15 384	14 579	1 609	-805	3 879	2 855	1 657	-1 023	-1 198
45-49	12 664	14 802	14 576	2 138	-225	4 119	3 240	1 918	-879	-1 322
50-54	10 378	12 549	13 675	2 172	1 125	3 944	3 065	1 961	-878	-1 105
55-59	5 969	8 852	10 585	2 882	1 733	2 640	2 467	1 664	-174	-803
60-64	2 326	3 716	4 365	1 391	649	1 384	1 343	951	-41	-392
65+	1 582	1 501	1 835	-81	334	1 212	782	810	-431	29

Source: Cedefop (IER estimates based on StockMOD).

Medium qualification					High qualification				
Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
110 486	121 114	123 861	10 628	2 747	48 258	67 234	82 542	18 976	15 308
2 673	2 467	2 289	-206	-178	40	56	65	17	9
12 935	12 401	10 726	-534	-1 675	2 401	3 167	3 378	766	211
15 087	13 664	11 507	-1 423	-2 157	7 193	10 219	12 542	3 026	2 323
16 418	14 481	13 331	-1 937	-1 150	7 811	10 731	13 664	2 920	2 933
16 069	15 731	15 457	-337	-274	7 522	9 585	11 310	2 064	1 725
15 226	17 514	17 333	2 288	-181	6 847	9 045	9 397	2 198	353
13 192	16 459	17 512	3 267	1 053	6 192	8 264	9 103	2 072	840
10 274	13 712	16 118	3 439	2 406	5 119	7 094	9 260	1 975	2 165
5 851	9 575	12 368	3 725	2 793	3 248	5 279	7 897	2 030	2 618
1 985	3 811	5 193	1 826	1 382	1 304	2 737	4 277	1 433	1 540
778	1 297	2 027	520	730	581	1 057	1 648	476	591
61 819	67 355	69 748	5 536	2 393	26 345	34 082	41 300	7 738	7 218
1 305	1 191	1 197	-115	6	13	21	22	8	1
6 751	6 749	5 940	-3	-808	979	1 314	1 434	335	119
8 435	7 880	6 792	-555	-1 088	3 399	4 613	5 709	1 214	1 097
9 144	8 297	7 850	-847	-447	4 090	5 118	6 525	1 029	1 407
8 882	8 699	8 566	-183	-132	4 085	4 765	5 534	680	769
8 430	9 390	9 171	960	-219	3 747	4 640	4 637	894	-3
7 366	8 873	9 491	1 506	619	3 472	4 288	4 465	816	178
5 928	7 575	9 010	1 647	1 436	3 031	3 748	4 653	716	906
3 637	5 437	6 976	1 800	1 539	2 132	3 032	4 367	900	1 335
1 395	2 409	3 341	1 014	933	952	1 766	2 715	813	949
545	857	1 413	312	556	444	778	1 238	334	461
48 667	53 759	54 112	5 091	354	21 914	33 152	41 242	11 238	8 090
1 368	1 276	1 092	-92	-185	26	36	43	9	8
6 183	5 653	4 786	-531	-867	1 422	1 853	1 944	431	92
6 652	5 784	4 715	-868	-1 069	3 794	5 606	6 833	1 812	1 227
7 273	6 184	5 480	-1 090	-703	3 722	5 613	7 140	1 891	1 527
7 187	7 033	6 891	-154	-142	3 437	4 820	5 776	1 383	956
6 796	8 124	8 162	1 328	38	3 100	4 404	4 760	1 304	356
5 825	7 586	8 020	1 761	434	2 720	3 976	4 638	1 256	662
4 346	6 137	7 108	1 791	970	2 088	3 347	4 606	1 259	1 260
2 213	4 138	5 392	1 925	1 254	1 116	2 247	3 529	1 131	1 282
590	1 403	1 852	812	450	352	971	1 562	619	591
233	441	614	208	174	137	279	410	142	131

Table 3. **Labour force (15+) by country and qualification, 2000-20**

Labour force	All qualification					Low qualification				
	Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
	2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
Belgium	4 410	4 724	4 802	314	78	1 420	1 014	680	-406	-334
Bulgaria	3 428	3 511	3 352	83	-159	844	500	294	-344	-206
Czech Rep.	5 124	5 199	5 136	75	-63	530	306	183	-224	-123
Denmark	2 844	2 907	2 951	63	44	638	656	641	18	-15
Germany	39 447	41 458	40 815	2 011	-643	7 253	6 384	5 139	-869	-1 245
Estonia	653	691	675	38	-16	81	50	37	-31	-13
Ireland	1 747	2 212	2 524	465	312	605	493	349	-112	-144
Greece	4 617	4 924	4 981	307	57	1 945	1 575	1 071	-370	-504
Spain	17 909	22 971	23 625	5 062	654	9 722	9 256	7 250	-466	-2 006
France	25 748	27 529	27 787	1 781	258	8 199	6 467	4 646	-1 732	-1 821
Italy	23 475	24 360	24 532	885	172	10 846	8 702	6 140	-2 144	-2 562
Cyprus	309	403	488	94	85	104	86	67	-18	-19
Latvia	1 098	1 170	1 107	72	-63	155	108	76	-47	-32
Lithuania	1 688	1 613	1 586	-75	-27	211	76	48	-135	-28
Luxembourg	186	216	234	30	18	62	55	33	-7	-22
Hungary	4 074	4 124	4 168	50	44	750	490	314	-260	-176
Malta	151	166	170	15	4	110	89	53	-21	-36
Netherlands	8 080	8 655	8 846	575	191	2 513	2 047	1 488	-466	-559
Norway	2 353	2 552	2 652	199	100	328	383	347	55	-36
Austria	3 865	4 154	4 331	289	177	812	703	495	-109	-208
Poland	17 348	17 172	16 769	-176	-403	2 716	1 418	694	-1 298	-724
Portugal	5 201	5 515	5 775	314	260	4 080	3 811	3 698	-269	-113
Romania	11 714	9 896	9 861	-1 818	-35	4 168	1 992	1 570	-2 176	-422
Switzerland	3 943	4 363	4 650	420	287	806	692	616	-114	-76
Slovenia	955	1 006	939	51	-67	197	125	67	-72	-58
Slovakia	2 575	2 611	2 666	36	55	242	146	82	-96	-64
Finland	2 664	2 638	2 615	-26	-23	663	387	199	-276	-188
Sweden	4 364	4 858	5 208	494	350	925	610	365	-315	-245
UK	28 870	31 277	32 663	2 407	1 386	9 166	5 905	2 858	-3 261	-3 047
EU-27+	228 838	242 874	245 904	14 036	3 030	70 094	54 527	39 501	-15 567	-15 026
EU-27	222 542	235 960	238 603	13 418	2 643	68 959	53 452	38 538	-15 507	-14 914

Source: Cedefop (IER estimates based on StockMOD).

Medium qualification					High qualification				
Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
1 584	1 883	1 965	299	82	1 406	1 826	2 158	420	332
1 884	2 111	2 082	227	-29	701	899	975	198	76
3 989	4 076	3 898	87	-178	605	817	1 055	212	238
1 519	1 275	1 128	-244	-147	687	976	1 181	289	205
22 531	24 786	24 716	2 255	-70	9 663	10 287	10 960	624	673
378	391	387	13	-4	193	250	251	57	1
717	899	1 114	182	215	425	819	1 061	394	242
1 796	2 009	2 236	213	227	876	1 340	1 674	464	334
3 405	5 826	7 104	2 421	1 278	4 781	7 889	9 271	3 108	1 382
11 358	12 229	11 914	871	-315	6 190	8 833	11 227	2 643	2 394
9 945	11 393	12 638	1 448	1 245	2 684	4 264	5 753	1 580	1 489
119	161	199	42	38	86	156	222	70	66
730	737	627	7	-110	213	325	403	112	78
760	888	895	128	7	717	648	643	-69	-5
84	92	113	8	21	39	69	88	30	19
2 666	2 695	2 653	29	-42	658	939	1 201	281	262
30	40	56	10	16	11	37	61	26	24
3 620	3 762	3 674	142	-88	1 947	2 846	3 684	899	838
1 286	1 161	1 056	-125	-105	738	1 008	1 248	270	240
2 465	2 545	2 290	80	-255	587	907	1 546	320	639
12 495	11 354	10 139	-1 141	-1 215	2 136	4 400	5 935	2 264	1 535
631	863	1 061	232	198	491	841	1 015	350	174
6 559	6 320	6 381	-239	61	987	1 584	1 911	597	327
2224	2252	2067	28	-185	913	1419	1967	506	548
601	615	539	14	-76	157	266	333	109	67
2060	2011	1932	-49	-79	273	455	652	182	197
1 164	1 202	1 083	38	-119	837	1 049	1 333	212	284
2 151	2 638	2 765	487	127	1 288	1 610	2 078	322	468
11 733	14 899	17 149	3 166	2 250	7 970	10 472	12 656	2 502	2 184
110 486	121 114	123 861	10 628	2 747	48 258	67 234	82 542	18 976	15 308
106 976	117 700	120 738	10 724	3 038	46 607	64 807	79 327	18 200	14 520

Table 4. **Participation (activity) rates (in %) by gender, age group and qualification, EU-27+, 2000-20**

Activity rates	All qualifications			Low qualification			Medium qualification			High qualification		
	2000	2010	2020	2000	2010	2020	2000	2010	2020	2000	2010	2020
Males and females												
15+	55.8	55.8	54.7	39.5	37.3	35.0	65.6	61.5	57.1	75.4	73.1	68.9
15-19	24.8	22.8	21.6	20.9	18.7	17.9	38.5	36.6	31.9	37.2	20.2	17.6
20-24	62.0	60.4	60.1	67.5	65.4	67.7	59.3	57.7	58.0	66.1	65.6	60.8
25-29	79.9	80.8	82.3	71.7	71.4	73.4	80.2	79.6	80.8	87.8	86.9	86.0
30-34	83.9	84.2	85.5	74.0	73.3	75.2	85.9	83.9	84.2	91.5	90.6	89.9
35-39	83.9	84.6	86.3	73.8	73.7	76.1	86.7	85.9	86.3	91.6	91.2	91.0
40-44	84.6	86.1	86.9	74.1	75.3	77.4	87.9	87.8	87.3	93.3	93.2	92.1
45-49	82.6	84.2	84.8	71.7	73.5	75.6	86.5	85.6	84.5	93.9	92.9	91.7
50-54	74.3	77.5	78.6	62.6	65.3	66.8	79.6	79.0	78.0	90.7	90.0	87.7
55-59	55.7	60.8	65.1	44.9	47.5	49.7	60.8	62.4	64.5	77.6	78.3	77.8
60-64	24.9	31.7	34.4	22.4	25.0	26.8	23.5	30.8	31.3	39.2	47.4	46.8
65+	5.0	4.4	5.0	5.1	3.7	4.2	3.9	4.1	4.4	7.1	7.7	7.6
Males												
15+	64.9	63.3	62.0	51.7	48.5	46.0	71.4	67.9	64.6	78.2	74.9	72.0
15-19	26.8	24.3	23.1	23.5	20.7	19.1	39.0	38.3	35.8	35.0	19.9	15.3
20-24	65.3	64.6	64.5	75.4	73.9	74.8	61.6	61.6	62.3	63.0	64.2	60.7
25-29	86.8	86.5	87.0	85.9	83.8	84.6	86.2	85.9	86.1	89.2	89.3	88.8
30-34	93.0	91.5	92.2	90.2	86.9	87.6	93.7	91.7	91.9	94.7	94.3	94.3
35-39	93.0	91.6	92.6	88.9	86.2	87.0	94.0	92.5	92.9	95.8	94.8	95.3
40-44	92.9	92.9	92.7	88.9	87.2	87.3	93.6	93.8	93.1	96.6	96.7	96.0
45-49	91.6	90.6	91.3	87.0	85.5	86.7	92.2	91.1	91.2	97.0	95.2	94.9
50-54	85.2	85.4	86.3	79.5	79.3	80.0	85.9	85.3	85.6	93.8	92.6	92.2
55-59	68.6	69.5	74.0	59.5	58.6	60.3	70.3	69.6	73.0	84.7	83.1	84.8
60-64	33.6	40.1	44.6	31.2	32.7	35.4	30.6	38.1	41.0	47.2	55.8	57.9
65+	7.4	6.6	7.5	7.7	5.5	5.8	5.7	5.8	6.8	9.9	10.3	11.0
Females												
15+	47.4	48.7	47.8	30.1	28.1	25.2	59.4	54.9	49.7	72.4	71.3	66.2
15-19	22.8	21.3	20.0	18.1	16.5	16.5	38.0	35.2	28.5	38.4	20.4	19.1
20-24	58.5	56.0	55.6	57.5	54.2	57.8	57.0	53.7	53.3	68.3	66.6	60.9
25-29	72.9	74.8	77.5	56.8	55.4	57.3	73.7	72.4	74.2	86.5	85.1	83.8
30-34	74.6	76.6	78.6	58.0	56.8	58.3	77.8	75.4	75.1	88.1	87.4	86.1
35-39	74.8	77.5	79.8	59.8	60.1	61.5	79.0	78.9	79.3	87.1	87.9	87.2
40-44	76.3	79.3	81.0	61.7	62.5	63.2	81.7	81.9	81.6	89.6	89.7	88.6
45-49	73.7	77.7	78.3	59.7	62.5	62.5	80.3	80.0	77.7	90.2	90.6	88.9
50-54	63.7	69.7	70.9	50.1	53.8	53.8	72.4	72.4	70.2	86.7	87.2	83.7
55-59	43.3	52.4	56.6	34.4	39.4	40.8	49.8	55.0	56.0	66.9	72.6	70.6
60-64	16.9	23.8	24.9	16.2	19.4	20.3	15.1	23.1	22.0	26.8	37.2	35.1
65+	3.4	2.9	3.0	3.7	2.7	3.3	2.3	2.6	2.4	3.7	4.5	4.0

Source: Cedefop (IER estimates based on E3ME and StockMOD).

ANNEX II

Skill demand: detailed tables

Table 5. **Employment trends by industry, EU-27+, 2000-20**

Industry	Levels (000s)			Changes (000s)		Shares (%)			Growth p.a. (%)	
	2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
Primary sector and utilities	18 773	14 704	11 923	-4 068	-2 782	8.6	6.5	5.1	-2.4	-2.1
Agriculture, etc.	15 958	12 295	9 808	-3 663	-2 488	7.4	5.4	4.2	-2.6	-2.2
Mining and quarrying	944	838	656	-106	-182	0.4	0.4	0.3	-1.2	-2.4
Electricity, gas and water	1 870	1 571	1 459	-299	-112	0.9	0.7	0.6	-1.7	-0.7
Manufacturing	39 698	36 526	34 338	-3 172	-2 188	18.3	16.1	14.6	-0.8	-0.6
Food, drink and tobacco	5 561	5 440	5 108	-121	-332	2.6	2.4	2.2	-0.2	-0.6
Engineering	8 354	7 458	7 125	-896	-333	3.8	3.3	3.0	-1.1	-0.5
Rest of manufacturing	25 783	23 628	22 105	-2 155	-1 524	11.9	10.4	9.4	-0.9	-0.7
Construction	15 039	15 425	15 701	386	275	6.9	6.8	6.7	0.3	0.2
Distribution and transport	54 321	58 773	62 179	4 452	3 406	25.0	25.9	26.5	0.8	0.6
Distribution	32 267	34 187	36 226	1 920	2 039	14.9	15.0	15.4	0.6	0.6
Hotels and catering	9 136	10 984	12 004	1 848	1 020	4.2	4.8	5.1	1.9	0.9
Transport and telecommunications	12 917	13 601	13 949	684	347	5.9	6.0	5.9	0.5	0.3
Business and other services	41 735	48 773	56 033	7 038	7 260	19.2	21.5	23.9	1.6	1.4
Banking and insurance	6 087	5 647	5 823	-440	176	2.8	2.5	2.5	-0.7	0.3
Other business services	22 754	28 066	33 315	5 312	5 249	10.5	12.3	14.2	2.1	1.7
Miscellaneous services	12 894	15 060	16 895	2 166	1 836	5.9	6.6	7.2	1.6	1.2
Non-marketed services	47 548	53 056	54 309	5 508	1 253	21.9	23.3	23.2	1.1	0.2
Public admin. and defence	14 306	15 053	14 602	748	-451	6.6	6.6	6.2	0.5	-0.3
Education	14 331	15 867	16 156	1 536	289	6.6	7.0	6.9	1.0	0.2
Health and social work	18 912	22 135	23 551	3 224	1 416	8.7	9.7	10.0	1.6	0.6
All industries	**217 114**	**227 258**	**234 482**	**10 144**	**7 224**	**100.0**	**100.0**	**100.0**	**0.5**	**0.3**

Source: Cedefop (IER estimates based on E3ME model).

Table 6. **Employment trends by occupation, EU-27+, 2000-20**

Occupation	Levels (000s)			Changes (000s)		Shares (%)			Growth p.a. (%)	
	2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
Legislators, senior officials and managers	18 118	19 134	20 574	1 016	1 440	8.3	8.4	8.8	0.6	0.8
11 Legislators and senior officials	518	576	746	59	170	0.2	0.3	0.3	1.1	2.6
12 Corporate managers	9 466	10 601	11 950	1 134	1 349	4.4	4.7	5.1	1.1	1.2
13 Managers of small enterprises	8 134	7 957	7 878	-177	-79	3.7	3.5	3.4	-0.2	-0.1
Professionals	27 967	32 400	35 075	4 433	2 675	12.9	14.3	15.0	1.6	0.8
21 Physical, mathematical and engineering science professionals	6 923	7 873	8 717	950	844	3.2	3.5	3.7	1.3	1.0
22 Life science and health professionals	3 651	3 998	4 086	348	87	1.7	1.8	1.7	0.9	0.2
23 Teaching professionals	8 357	8 903	8 307	546	-596	3.8	3.9	3.5	0.6	-0.7
24 Other professionals	9 036	11 626	13 965	2591	2 339	4.2	5.1	6.0	2.6	1.9
Technicians and associate professionals	33 058	38 332	42 803	5 274	4 471	15.2	16.9	18.3	1.6	1.2
31 Physical and engineering science associate professionals	7 983	8 689	9 440	706	751	3.7	3.8	4.0	0.9	0.8
32 Life science and health associate professionals	5 557	6 048	6 036	490	-12	2.6	2.7	2.6	0.8	0.0
33 Teaching associate professionals	2 693	3 101	3543	408	442	1.2	1.4	1.5	1.4	1.3
34 Other associate professionals	16 825	20 494	23 784	3 669	3 290	7.7	9.0	10.1	2.0	1.5
Clerks	25 171	23 936	22 743	-1 235	-1 193	11.6	10.5	9.7	-0.5	-0.5
41 Office clerks	20 911	19 414	17 564	-1 498	-1 850	9.6	8.5	7.5	-0.7	-1.0
42 Customer service clerks	4 260	4 522	5 179	262	657	2.0	2.0	2.2	0.6	1.4
Service workers and shop and market sales workers	27 673	32 088	34 283	4 415	2 195	12.7	14.1	14.6	1.6	0.7
51 Personal and protective services workers	17 266	20 713	22 208	3 447	1 496	8.0	9.1	9.5	1.8	0.7
52 Models, salespersons and demonstrators	10 407	11 375	12 075	968	700	4.8	5.0	5.1	0.9	0.6
Skilled agricultural and fishery workers	12 607	9 710	7 674	-2 897	-2 036	5.8	4.3	3.3	-2.6	-2.3
Craft and related trades workers	31 282	28 672	26 529	-2 610	-2 143	14.4	12.6	11.3	-0.8	-0.7
71 Extraction and building trades workers	12090	12 272	12 262	182	-10	5.6	5.4	5.2	0.1	0.0
72 Metal, machinery and related trade workers	12 030	10 589	9 260	-1 441	-1329	5.5	4.7	3.9	-1.3	-1.3
73 Precision, handicraft, craft printing and related trade workers	1 901	1 369	1 190	-533	-178	0.9	0.6	0.5	-3.2	-1.4
74 Other craft and related trades workers	5 261	4 442	3 817	-818	-625	2.4	2.0	1.6	-1.7	-1.5
Plant and machine operators and assemblers	18 729	18 626	18 502	-103	-124	8.6	8.2	7.9	-0.1	-0.1
81 Stationary plant and related operators	2 254	2 217	2 325	-37	108	1.0	1.0	1.0	-0.2	0.5
82 Machine operators and assemblers	7 296	6 883	6 636	-413	-247	3.4	3.0	2.8	-0.6	-0.4
83 Drivers and mobile plant operators	9 179	9 526	9 541	347	15	4.2	4.2	4.1	0.4	0.0
Elementary occupations	21 277	23 115	25 106	1 838	1 991	9.8	10.2	10.7	0.9	0.9
91 Sales and services elementary occupations	13 071	14 831	15 985	1 760	1 153	6.0	6.5	6.8	1.3	0.8
92 Agricultural, fishery and related labourers	2 062	1 692	1 585	-370	-107	0.9	0.7	0.7	-2.0	-0.7
93 Labourers in mining, construction, manufacturing and transport	6 144	6 592	7 536	448	944	2.8	2.9	3.2	0.7	1.3
All occupations	**217 114**	**227 258**	**234 482**	**10 144**	**7 224**	**100.0**	**100.0**	**100.0**	**0.5**	**0.3**

NB: All occupations (total) include also armed forces.
Source: Cedefop (IER estimates based on E3ME and EDMOD).

Table 7. **Total job openings (expansion and replacement demand) by occupation, EU-27+, 2010-20**

Occupation	Change 2010-20 (000s)			Change 2010-20 (% of 2010 level)		
	Expansion demand	Replacement demand	Total job openings	Expansion demand	Replacement demand	Total job openings
Legislators, senior officials and managers	1 440	8 456	9 896	7.5	44.2	51.7
11 Legislators and senior officials	170	32	202	29.5	5.6	35.1
12 Corporate managers	1 349	5 767	7 116	12.7	54.4	67.1
13 Managers of small enterprises	-79	2 655	2 576	-1.0	33.4	32.4
Professionals	2 675	12 357	15 031	8.3	38.1	46.4
21 Physical, mathematical and engineering science professionals	844	3 463	4 307	10.7	44.0	54.7
22 Life science and health professionals	87	884	972	2.2	22.1	24.3
23 Teaching professionals	-596	3 129	2 533	-6.7	35.2	28.5
24 Other professionals	2 339	4 880	7 220	20.1	42.0	62.1
Technicians and associate professionals	4 471	10 375	14 846	11.7	27.1	38.7
31 Physical and engineering science associate professionals	751	2 647	3 398	8.6	30.5	39.1
32 Life science and health associate professionals	-12	1 553	1 542	-0.2	25.7	25.5
33 Teaching associate professionals	442	740	1 182	14.3	23.9	38.1
34 Other associate professionals	3 290	5 434	8 724	16.1	26.5	42.6
Clerks	-1 193	6 075	4 882	-5.0	25.4	20.4
41 Office clerks	-1 850	4 638	2 788	-9.5	23.9	14.4
42 Customer services clerks	657	1 436	2 093	14.5	31.8	46.3
Service workers and shop and market sales workers	2 196	7 945	10 141	6.8	24.8	31.6
51 Personal and protective services workers	1 496	5 169	6 665	7.2	25.0	32.2
52 Models, salespersons and demonstrators	700	2 776	3 476	6.2	24.4	30.6
Skilled agricultural and fishery workers	-2 036	2 094	58	-21.0	21.6	0.6
Craft and related trades workers	-2 143	12 457	10 314	-7.5	43.4	36.0
71 Extraction and building trades workers	-10	7 371	7 361	-0.1	60.1	60.0
72 Metal, machinery and related trades workers	-1 329	2 740	1 412	-12.5	25.9	13.3
73 Precision, handicraft, craft printing and related trades	-178	487	308	-13.0	35.6	22.5
74 Other craft and related trades workers	-625	1 859	1 234	-14.1	41.8	27.8
Plant and machine operators and assemblers	-124	5 375	5 251	-0.7	28.9	28.2
81 Stationary plant and related operators	108	1 032	1 141	4.9	46.6	51.5
82 Machine operators and assemblers	-247	1 758	1 511	-3.6	25.5	21.9
83 Drivers and mobile plant operators	15	2 584	2 599	0.2	27.1	27.3
Elementary occupations	1 991	7 958	9 949	8.6	34.4	43.0
91 Sales and services elementary occupations	1 153	4 725	5 878	7.8	31.9	39.6
92 Agricultural, fishery and related labourers	-107	557	450	-6.3	32.9	26.6
93 Labourers in mining, construction, manufacturing and transport	944	2 675	3 619	14.3	40.6	54.9
All occupations	**7 224**	**73 086**	**80 310**	**3.2**	**32.2**	**35.3**

NB: All occupations (total) include also armed forces.
Source: Cedefop (IER estimates based on E3ME, EDMOD and RDMOD).

Table 8. **Employment trends by qualification, EU-27+, 2000-20**

	Levels (000s)			Changes (000s)		Shares (%)			Growth p.a. (%)	
	2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
Low qualification	64 722	46 106	34 052	-18 615	-12 054	29.8	20.3	14.5	-3.3	-3.0
Medium qualification	104 589	114 241	117 909	9 652	3 668	48.2	50.3	50.3	0.9	0.3
High qualification	47 802	66 910	82 520	19 108	15 610	22.0	29.4	35.2	3.4	2.1
All qualifications	**217 114**	**227 258**	**234 482**	**10 144**	**7 224**	**100**	**100**	**100**	**0.5**	**0.3**

NB: Constrained and scaled estimates.
Source: Cedefop (IER estimates based on E3ME, EDMOD and BALMOD).

Table 9. **Total job openings (expansion and replacement demand) by qualification, EU-27+, 2010-20**

	Levels (000s)			Change (%)		
	Expansion demand	Replacement demand	Total job openings	Expansion demand	Replacement demand	Total job openings
Low qualification	-12 054	18 132	6 078	-23.2	34.9	11.7
Medium qualification	3 668	33 808	37 475	3.3	30.1	33.3
High qualification	15 610	21 142	36 757	24.8	33.6	58.4
All qualifications	**7 224**	**73 066**	**80 310**	**3.2**	**32.2**	**35.3**

NB: Constrained and scaled estimates.
Source: Cedefop (IER estimates based on E3ME, EDMOD, RDMOD and BALMOD).

Table 10. **Employment trends by country, 2010-20**

All industries	Levels (000s)			Share of EU-27+ total (%)			Change 2010-2020		
	2000	2010	2020	2000	2010	2020	000s	%	% p.a.
Austria	3 789	4 003	4 226	1.7	1.8	1.8	224	5.5	0.5
Belgium	4 097	4 390	4 435	1.9	1.9	1.9	45	1.0	0.1
Bulgaria	3 240	3 736	3 685	1.5	1.6	1.6	-51	-1.3	-0.1
Cyprus	315	390	479	0.1	0.2	0.2	89	21.6	2.0
Czech Republic	4 940	5 106	5 178	2.3	2.2	2.2	72	1.4	0.1
Denmark	2 754	2 790	2 930	1.3	1.2	1.2	140	5.0	0.5
Estonia	583	610	653	0.3	0.3	0.3	44	7.1	0.7
Finland	2 296	2 455	2 514	1.1	1.1	1.1	60	2.4	0.2
France	24 331	25 076	25 463	11.2	11.0	10.9	387	1.5	0.2
Germany	39 144	39 619	39 992	18.0	17.4	17.1	373	1.0	0.1
Greece	4 253	4 737	4 844	2.0	2.1	2.1	107	2.3	0.2
Hungary	3 848	3 811	3 898	1.8	1.7	1.7	87	2.3	0.2
Ireland	1 699	2 074	2 343	0.8	0.9	1.0	270	12.6	1.2
Italy	22 931	24 076	24 617	10.6	10.6	10.5	541	2.2	0.2
Latvia	946	1 011	989	0.4	0.4	0.4	-21	-2.1	-0.2
Lithuania	1 398	1 441	1 483	0.6	0.6	0.6	42	2.9	0.3
Luxembourg	263	353	376	0.1	0.2	0.2	24	6.6	0.6
Malta	146	161	172	0.1	0.1	0.1	11	6.5	0.6
Netherlands	8 115	8 618	8 898	3.7	3.8	3.8	281	3.2	0.3
Norway	2 315	2 511	2 616	1.1	1.1	1.1	106	4.2	0.4
Poland	13 617	15 262	15 013	6.3	6.7	6.4	-250	-1.6	-0.2
Portugal	5 031	4 988	5 301	2.3	2.2	2.3	313	6.2	0.6
Romania	9 919	8 900	8 886	4.6	3.9	3.8	-14	-0.2	0.0
Slovakia	2 026	2 131	2 273	0.9	0.9	1.0	142	6.5	0.6
Slovenia	906	912	877	0.4	0.4	0.4	-35	-3.9	-0.4
Spain	16 410	18 891	20 310	7.6	8.3	8.7	1 419	7.4	0.7
Sweden	4 296	4 360	4 793	2.0	1.9	2.0	433	9.7	0.9
Switzerland	4 087	4 429	4 780	1.9	1.9	2.0	351	7.8	0.8
United Kingdom	29 420	30 419	32 457	13.6	13.4	13.8	2 038	6.6	0.6
EU-27+	217 114	227 258	234 482	100.0	100.0	100.0	7 224	3.2	0.3
EU-27	210 712	220 318	227 086	97.1	96.9	96.8	6 768	3.0	0.3

Source: Cedefop (IER estimates based on E3ME model).

Table 11. **Employment trends by country and broad sector (in 000s), 2010-20**

	Primary sector and utilities		Manufacturing		Construction		Distribution and transport		Business and other services		Non-marketed services	
	Levels 2010	Change 2010-20	Levels 2010	Change 2010-20	Levels 2010	Change 2010-20	Levels 2010	Change 2010-20	Levels 2010	Change 2010-20	Levels 2010	Change 2010-20
Austria	240	-27	649	-30	254	53	1 126	34	807	152	927	42
Belgium	110	-13	583	-70	252	20	1 083	-9	1 081	92	1 281	26
Bulgaria	808	-202	649	-193	233	47	977	119	450	175	619	3
Cyprus	18	-1	40	0	32	18	140	19	83	33	77	19
Czech Republic	271	-40	1 356	-50	406	-52	1 307	42	882	102	884	70
Denmark	96	-4	366	47	179	10	720	19	576	31	854	38
Estonia	34	-10	118	24	55	-11	173	22	92	15	138	3
Finland	133	-16	415	0	184	14	575	-29	442	70	707	21
France	996	-55	3 110	-255	1 736	49	5 802	73	6 073	550	7 359	26
Germany	1 149	-73	7 485	-454	1 893	41	9 936	-283	9 865	895	9 290	247
Greece	570	-98	485	-23	402	-37	1 590	131	692	94	999	41
Hungary	232	-40	873	-121	273	104	1 005	17	577	140	852	-13
Ireland	134	-23	271	7	183	32	573	99	428	68	485	86
Italy	1 113	-309	4 622	-109	1 904	-119	5 884	15	5 890	1 034	4 663	28
Latvia	79	-12	155	-18	100	-28	310	3	159	51	208	-18
Lithuania	139	-52	250	-25	114	19	417	22	193	68	328	10
Luxembourg	7	-1	35	1	34	1	99	7	117	12	60	2
Malta	7	-1	33	-4	13	2	48	7	18	1	43	5
Netherlands	285	-39	941	-89	459	38	2 212	102	2 557	197	2 164	71
Norway	121	-13	277	-6	155	-9	646	29	448	77	863	27
Poland	2 408	-869	3 281	-259	1 067	96	3 646	426	1 854	364	3 006	-9
Portugal	619	-50	862	20	491	62	1 432	171	638	102	947	8
Romania	2 911	-703	1 628	-208	456	136	1 944	608	583	124	1 378	29
Slovakia	117	-12	527	-35	171	31	599	77	286	51	432	30
Slovenia	90	-25	217	-29	86	8	201	-13	152	16	166	8
Spain	993	-33	2 908	-14	1 789	-379	5 467	1 175	3 886	415	3 848	254
Sweden	136	-4	693	18	246	1	968	67	867	178	1 451	174
Switzerland	177	-18	712	66	296	20	1 164	45	1 108	189	972	49
United Kingdom	712	-41	2 984	-379	1 966	108	8 731	409	7 971	1 964	8 054	-22
EU-27+	14 704	-2 782	36 526	-2 188	15 425	275	58 773	3 406	48 773	7 260	53 056	1 253
EU-27	14 406	-2 752	35 537	-2 248	14 975	264	56 963	3 332	47 217	6 995	51 220	1 177

Source: Cedefop (IER estimates based on E3ME model).

Table 12. **Employment by country and occupation (in 000s), 2010**

Levels (000s)

	Occupation major group									
	1	2	3	4	5	6	7	8	9	All
Austria	272	458	799	497	592	187	475	233	478	4 003
Belgium	502	968	542	601	500	83	386	319	457	4 390
Bulgaria	237	441	337	251	546	440	464	471	517	3 736
Cyprus	15	55	46	59	69	11	46	21	64	390
Czech Republic	354	617	1 154	360	620	74	871	764	276	5 106
Denmark	231	445	610	232	445	57	267	175	320	2 790
Estonia	76	96	82	29	80	7	85	82	69	610
Finland	247	454	419	153	380	100	309	188	191	2 455
France	2 213	3 635	4 610	3 045	3 167	837	2 686	1 957	2 672	25 076
Germany	2 257	6 141	8 647	4 896	5 354	674	5 144	2 867	3 521	39 619
Greece	485	655	443	533	703	500	691	333	327	4 737
Hungary	280	532	507	370	579	96	636	494	295	3 811
Ireland	322	351	152	265	374	14	248	166	172	2 074
Italy	1 985	2 524	5 491	2 372	2 929	468	3 584	2 018	2 448	24 076
Latvia	92	143	176	49	129	32	168	100	121	1 011
Lithuania	153	284	135	61	207	78	237	132	149	1 441
Luxembourg	24	81	48	57	34	6	38	24	41	353
Malta	12	19	25	17	23	2	22	18	21	161
Netherlands	917	1 754	1 545	1 037	1 194	111	710	459	860	8 618
Norway	141	328	642	172	602	59	256	182	119	2 511
Poland	1 011	2 359	1 782	1 230	1 663	1 877	2 532	1 516	1 235	15 262
Portugal	325	430	445	472	758	567	944	387	620	4 988
Romania	251	889	923	398	900	2 242	1 236	934	1 074	8 900
Slovakia	121	233	416	143	318	17	356	332	178	2 131
Slovenia	61	139	162	81	92	48	116	127	81	912
Spain	1 415	2 360	2 406	1 780	3 038	490	2 626	1 783	2 884	18 891
Sweden	239	850	872	377	829	88	409	445	243	4 360
Switzerland	239	823	897	504	625	163	679	228	267	4 429
United Kingdom	4 655	4 337	4 021	3 892	5 337	381	2 453	1 871	3 416	30 419
EU-27+	19 134	32 400	38 332	23 936	32 087	9 710	28 673	18 626	23 115	227 258
EU-27	18 754	31 249	36 793	23 260	30 861	9 488	27 737	18 216	22 730	220 318

NB: All include armed forces.
Source: Cedefop (IER estimates based on E3ME and EDMOD).

Occupation major group:

1 Legislators, senior officials and managers
2 Professionals
3 Technicians and associate professionals
4 Clerks
5 Service workers and shop and market sales workers
6 Skilled agricultural and fishery workers
7 Craft and related trades workers
8 Plant and machine operators and assemblers
9 Elementary occupations

Table 13. **Employment trends by country and occupation (in 000s), 2010-20**

Changes (000s)

	Occupation major group									
	1	2	3	4	5	6	7	8	9	All
Austria	-1	30	15	-1	115	-34	-18	-11	124	224
Belgium	2	-18	116	-92	74	0	-49	-7	23	45
Cyprus	4	19	10	22	3	-1	6	1	24	89
Bulgaria	5	35	23	21	46	-144	-31	-45	40	-51
Czech Republic	33	101	68	-5	-6	-11	-86	-12	-17	72
Denmark	46	48	66	-56	-5	-16	7	14	41	140
Estonia	14	1	18	0	-5	-4	-5	11	17	44
Finland	30	52	54	-32	-26	-18	6	-15	12	60
France	181	122	210	-214	173	-92	-256	-61	411	387
Germany	-127	565	134	-274	162	3	-273	57	91	373
Greece	-23	11	172	7	54	-92	-58	17	29	107
Hungary	52	36	47	18	-2	-22	-83	27	4	87
Ireland	60	16	54	6	92	1	24	15	3	270
Italy	144	217	1 029	-350	85	-176	-539	-183	301	541
Latvia	13	-11	33	1	15	-12	-34	-12	-12	-22
Lithuania	39	42	8	-7	8	-31	-17	-12	13	42
Luxembourg	1	19	-2	4	4	0	-4	0	3	24
Malta	2	1	2	2	2	0	0	-2	4	11
Netherlands	81	156	53	-25	43	-19	-50	-54	108	281
Norway	-11	79	122	14	-35	-16	-10	-7	-25	106
Poland	31	149	20	37	260	-652	-90	4	-7	-250
Portugal	-26	89	67	57	15	-35	17	24	103	313
Romania	37	62	96	52	125	-509	-90	58	151	-14
Slovakia	12	0	40	1	35	-6	-8	23	20	142
Slovenia	-2	9	18	-12	-19	-31	-11	-11	25	-35
Spain	211	90	796	70	497	-105	-382	-52	289	1 419
Sweden	84	225	95	0	37	-4	5	-17	11	433
Switzerland	124	215	3	-56	-15	-21	19	18	64	351
United Kingdom	426	316	1 105	-381	466	14	-133	109	142	2 038
EU-27+	1 440	2 675	4 471	-1 193	2 196	-2 036	-2 143	-124	1 991	7 224
EU-27	1 327	2 381	4 347	-1 151	2 247	-1 998	-2 152	-135	1 952	6 767

NB: All include armed forces.
Source: Cedefop (IER estimates based on E3ME and EDMOD).

Occupation major group:

1 Legislators, senior officials and managers
2 Professionals
3 Technicians and associate professionals
4 Clerks
5 Service workers and shop and market sales workers
6 Skilled agricultural and fishery workers
7 Craft and related trades workers
8 Plant and machine operators and assemblers
9 Elementary occupations

Table 14. **Replacement demand by country and occupation (in 000s), 2010-20**

Levels (000s)

	Occupation major group									
	1	2	3	4	5	6	7	8	9	All
Austria	156	140	179	104	132	62	227	105	190	1 295
Belgium	162	216	110	135	136	19	143	80	117	1 119
Bulgaria	61	90	72	39	86	70	136	86	133	773
Cyprus	8	14	9	12	20	4	31	13	29	139
Czech Republic	149	235	329	89	165	27	320	178	92	1 584
Denmark	141	195	192	89	176	12	134	73	154	1 166
Estonia	16	36	25	8	25	3	32	30	28	204
Finland	149	230	141	62	181	39	163	81	87	1 135
France	975	1 507	1 285	747	913	179	1 056	568	421	7 651
Germany	1 042	2 917	1 873	1 363	1 247	206	1 833	829	1 358	12 668
Greece	235	192	100	83	121	109	373	99	103	1 416
Hungary	99	196	131	93	136	28	258	114	91	1 145
Ireland	117	107	27	61	89	4	92	56	93	647
Italy	1 170	1 103	1 492	513	511	165	1 607	517	682	7 762
Latvia	25	55	68	9	29	8	63	27	50	334
Lithuania	40	99	53	12	48	17	94	30	57	450
Luxembourg	7	21	17	14	7	2	14	7	8	96
Malta	5	4	5	4	5	1	6	4	3	36
Netherlands	566	713	487	245	363	36	341	173	345	3 269
Norway	113	223	243	74	324	18	149	91	49	1 286
Poland	207	527	394	188	265	263	688	185	200	2 917
Portugal	110	122	66	106	141	195	491	85	244	1 561
Romania	61	374	344	63	130	261	597	194	351	2 374
Slovenia	19	38	29	17	19	10	66	28	28	252
Slovakia	22	66	142	29	56	4	134	64	67	584
Spain	543	667	497	370	524	118	1 445	608	870	5 644
Sweden	181	528	446	232	395	43	326	263	155	2 570
Switzerland	25	168	269	174	183	63	247	77	97	1 304
United Kingdom	2 049	1 572	1 347	1 138	1 517	129	1 390	710	1 854	11 705
EU-27+	8 454	12 357	10 374	6 074	7 945	2 094	12 457	5 374	7 957	73 086
EU-27	8 316	11 966	9 862	5 826	7 437	2 013	12 061	5 205	7 811	70 497

NB: All include armed forces.
Source: Cedefop (IER estimates based on E3ME, EDMOD and RDMOD).

Occupation major group:

1 Legislators, senior officials and managers
2 Professionals
3 Technicians and associate professionals
4 Clerks
5 Service workers and shop and market sales workers
6 Skilled agricultural and fishery workers
7 Craft and related trades workers
8 Plant and machine operators and assemblers
9 Elementary occupations

Table 15. **Total job openings by country and occupation (in 000s), 2010-20**

	All qualification					Low qualification				
	Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
	2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
Austria	3 789	4 003	4 226	214	224	775	642	460	-133	-182
Belgium	4 097	4 390	4 435	293	45	1 264	888	580	-376	-309
Bulgaria	3 240	3 736	3 685	495	-51	713	459	292	-254	-166
Cyprus	315	390	479	75	89	104	81	64	-23	-17
Czech Rep.	4 940	5 106	5 178	166	72	433	235	156	-198	-79
Denmark	2 754	2 790	2 930	36	140	608	605	625	-3	20
Estonia	583	610	653	27	44	63	35	34	-27	-1
Finland	2 296	2 455	2 514	159	59	529	333	181	-196	-152
France	24 331	25 076	25 463	745	387	7 363	5 563	3 994	-1 800	-1 569
Germany	39 144	39 619	39 992	475	373	6 864	5 555	4 687	-1 310	-868
Greece	4 253	4 737	4 844	484	107	1 834	1 527	1 049	-307	-477
Hungary	3 848	3 811	3 898	-37	86	671	373	240	-298	-134
Ireland	1 699	2 074	2 343	375	270	568	436	299	-132	-137
Italy	22 931	24 076	24 617	1 145	541	10 456	8 424	6 032	-2 032	-2 392
Latvia	946	1 011	989	65	-22	123	82	61	-41	-21
Lithuania	1 398	1 441	1 483	43	41	159	62	43	-97	-19
Luxembourg	263	353	376	90	24	87	88	51	1	-37
Malta	146	161	172	15	11	105	84	52	-21	-31
Netherlands	8 115	8 618	8 898	503	281	2 476	1 995	1 472	-481	-523
Norway	2 315	2 511	2 616	196	106	310	345	313	35	-32
Poland	13 617	15 262	15 013	1 645	-250	1 992	1 144	556	-848	-588
Portugal	5 031	4 988	5 301	-43	313	3 947	3 439	3 388	-508	-52
Romania	9 919	8 900	8 886	-1 019	-14	3 642	1 758	1 384	-1 884	-374
Slovakia	2 026	2 131	2 273	105	142	142	70	49	-72	-21
Slovenia	906	912	877	6	-35	180	107	60	-72	-48
Spain	16 410	18 891	20 310	2 481	1 419	8 790	7 043	5 765	-1 746	-1 278
Sweden	4 296	4 360	4 793	64	433	883	479	300	-405	-179
Switzerland	4 087	4 429	4 780	342	351	819	685	624	-134	-60
UK	29 420	30 419	32 457	999	2 038	9 039	5 213	2 579	-3 826	-2 634
EU-27⁺	217 114	227 258	234 482	10 144	7 224	64 722	46 106	34 052	-18 615	-12 054
EU-27	210 712	220 318	227 086	9 607	6 767	63 593	45 076	33 115	-18 516	-11 962

NB:
1. These estimates of demand are constrained to reconcile them with the supply side projections and scaled to match NA-based employment estimates.
2. The EU-27⁺ total is regarded as the best estimate for the whole of Europe.
2. For technical reasons, connected with the reconciliation and constraining processes used, the sum of the individual countries (EU-27 + NO and CH) does not match the EU-27⁺ total.
3. The EU-27 figure is the sum of the EU-27 countries. The difference between this and the EU-27⁺ total is not the sum of Norway (NO) and Switzerland (CH).
4. These inconsistencies will be resolved in the next round of results.

Source: Cedefop (IER estimates based on E3ME, EDMOD, RDMOD and BALMOD).

Medium qualification					High qualification				
Levels (000s)			Change (000s)		Levels (000s)			Change (000s)	
2000	2010	2020	2000-10	2010-20	2000	2010	2020	2000-10	2010-20
2 427	2 469	2 238	42	-230	587	892	1 528	305	636
1 468	1 744	1 793	276	49	1 365	1 758	2 063	393	305
1 789	2 270	2 291	481	20	739	1 007	1 102	268	95
121	156	195	35	39	90	153	220	63	67
3 886	4 028	3 927	142	-101	621	843	1 095	222	252
1 470	1 237	1 126	-233	-111	676	947	1 178	271	231
332	341	373	9	32	189	234	246	45	13
1 003	1 108	1 028	104	-80	763	1 014	1 306	251	292
10 851	11 209	10 917	359	-292	6 117	8 303	10 551	2 186	2 248
22 352	23 734	24 190	1 382	455	9 928	10 330	11 116	402	786
1 583	1 903	2 147	320	243	836	1 307	1 648	471	341
2 521	2 508	2 469	-13	-39	655	930	1 189	274	259
707	844	1 028	137	183	424	793	1 017	369	224
9 728	11 331	12 707	1 603	1 376	2 748	4 321	5 878	1 573	1 558
625	634	555	9	-79	198	295	373	97	78
596	770	823	174	52	642	609	617	-34	8
120	152	183	32	31	55	113	143	57	30
30	40	57	10	17	11	37	62	26	25
3 663	3 753	3 695	91	-59	1 976	2 869	3 732	893	862
1 272	1 159	1 056	-112	-104	733	1 006	1 247	273	241
9 723	9 954	8 851	231	-1 104	1 902	4 164	5 606	2 262	1 442
603	781	975	177	194	480	768	939	288	171
5 412	5 638	5 687	225	50	865	1 504	1 814	639	310
1 634	1 662	1 644	28	-18	250	400	580	150	180
570	555	499	-15	-56	156	250	318	93	68
3 120	4 808	6 065	1 688	1 257	4 500	7 039	8 479	2 539	1 440
2 111	2 384	2 541	274	156	1 302	1 497	1 953	195	455
2 310	2 289	2 124	-21	-165	958	1 455	2 031	497	576
12 015	14 452	16 818	2 436	2 367	8 365	10 754	13 059	2 389	2 305
104 589	114 241	117 909	9 652	3 668	47 802	66 910	82 520	19 108	15 610
101 007	110 793	114 730	9 786	3 936	46 111	64 449	79 241	18 337	14 793

Table 16. **Employment trends by country and qualification (in 000s), 2010-20**

Levels (000s)

	Occupation major group									
	1	2	3	4	5	6	7	8	9	All
Austria	154	170	195	103	247	28	209	94	314	1 519
Belgium	164	198	226	43	210	19	93	73	140	1 164
Bulgaria	66	125	95	60	132	-74	105	41	173	723
Cyprus	12	33	19	34	23	3	37	14	53	227
Czech Republic	182	336	397	83	158	15	234	166	75	1 656
Denmark	187	243	258	33	171	-3	141	87	194	1 306
Estonia	30	37	43	8	20	-1	27	41	45	247
France	1 155	1 628	1 496	533	1 087	86	800	507	832	8 038
Finland	180	282	195	30	155	22	169	66	99	1 194
Germany	915	3 482	2 007	1 089	1 408	209	1 560	886	1 449	13 041
Greece	212	204	272	90	176	17	315	116	132	1 523
Hungary	151	232	178	111	134	5	175	141	95	1 231
Ireland	177	123	81	67	182	5	116	71	96	917
Italy	1 314	1 320	2 521	164	595	-11	1 069	334	983	8 303
Latvia	38	44	101	10	44	-4	29	15	38	313
Lithuania	79	141	61	5	56	-15	77	18	71	492
Luxembourg	8	40	15	18	10	2	10	6	11	120
Malta	7	5	7	5	7	0	7	2	7	47
Netherlands	647	869	540	221	406	16	291	118	453	3 550
Norway	102	302	364	88	289	2	139	85	25	1 391
Poland	238	676	415	225	525	-390	597	188	192	2 667
Portugal	84	210	133	163	156	161	508	109	347	1 874
Romania	98	437	440	115	255	-248	507	252	502	2 360
Slovakia	34	67	182	30	91	-2	125	87	86	725
Slovenia	17	47	47	5	1	-21	55	17	53	217
Spain	755	757	1 293	440	1 021	14	1 064	556	1 160	7 063
Sweden	265	753	541	232	432	38	331	246	166	3 003
Switzerland	149	383	272	118	168	41	266	95	161	1 654
United Kingdom	2 475	1 888	2 452	757	1 982	143	1 257	820	1 996	13 743
EU-27+	9 895	15 031	14 845	4 881	10 141	58	10 314	5 250	9 948	80 310
EU-27	9 643	14 347	14 208	4 675	9 684	14	9 909	5 070	9 763	77 264

NB: All include armed forces.
Source: Cedefop (IER estimates based on E3ME and EDMOD).

Occupation major group:

1 Legislators, senior officials and managers
2 Professionals
3 Technicians and associate professionals
4 Clerks
5 Service workers and shop and market sales workers
6 Skilled agricultural and fishery workers
7 Craft and related trades workers
8 Plant and machine operators and assemblers
9 Elementary occupations

ANNEX III

Classifications and aggregations used

Industries and sectors

Aggregation of NACE Rev 1.1 two and three digit industries to 41 industries

	41-industry [NACE]	NACE Rev 1.1 [NACE]
1	Agriculture, etc. [01-05]	Agriculture, hunting and related service activities [01]
		Forestry, logging and related service activities [02]
		Fishing, fish farming and related service activities [05]
2	Coal [10]	Mining of coal and lignite; extraction of peat [10]
3	Oil and gas, etc. [11, 12]	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying [11]
		Mining of uranium and thorium ores [12]
4	Other mining [13, 14]	Mining of metal ores [13]
		Other mining and quarrying [14]
5	Food, drink and tobacco [15, 16]	Manufacture of food products and beverages [15]
		Manufacture of tobacco products [16]
6	Textiles, clothing and leather [17-19]	Manufacture of textiles [17]
		Manufacture of wearing apparel; dressing and dyeing of fur [18]
		Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear [19]
7	Wood and paper [20, 21]	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials [20]
		Manufacture of pulp, paper and paper products [21]

	41-industry [NACE]	NACE Rev 1.1 [NACE]
8	Printing and publishing [22]	Publishing, printing and reproduction of recorded media [22]
9	Manufactured fuels [23]	Manufacture of coke, refined petroleum products and nuclear fuel [23]
10	Pharmaceuticals [24.4]	Manufacture of pharmaceuticals, medicinal chemicals and botanical products [24.4]
11	Chemicals nes [24(ex24.4)]	Manufacture of chemicals and chemical products (except pharmaceuticals, etc.) [24 (ex 24.4)]
12	Rubber and plastics [25]	Manufacture of rubber and plastic products [25]
13	Non-metallic mineral products [26]	Manufacture of other non-metallic mineral products [26]
14	Basic metals [27]	Manufacture of basic metals [27]
15	Metal goods [28]	Manufacture of fabricated metal products, except machinery and equipment [28]
16	Mechanical engineering [29]	Manufacture of machinery and equipment n.e.c. [29]
17	Electronics [30, 32]	Manufacture of office machinery and computers [30]
		Manufacture of radio, television and communication equipment and apparatus [32]
18	Electrical engineering and instruments [31,33]	Manufacture of electrical machinery and apparatus n.e.c. [31]
		Manufacture of medical, precision and optical instruments, watches and clocks [33]
19	Motor vehicles [34]	Manufacture of motor vehicles, trailers and semi-trailers [34]
20	Other transport equipment [35]	Manufacture of other transport equipment [35]
21	Manufacturing nes [36, 37]	Manufacture of furniture; manufacturing n.e.c. [36] Recycling [37]
22	Electricity [40.1, 40.3]	Electricity, steam and hot water supply [40.1, 40.3]
23	Gas supply [40.2]	Manufacture of gas; distribution of gaseous fuels through mains [40.2]
24	Water supply [41]	Collection, purification and distribution of water [41]
25	Construction [45]	Construction [45]

	41-industry [NACE]	NACE Rev 1.1 [NACE]
26	Distribution [50, 51]	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel [50]
		Wholesale trade and commission trade, except of motor vehicles and motorcycles [51]
27	Retailing [52]	Retail trade, except of motor vehicles and motorcycles;
		repair of personal and household goods [52]
28	Hotels and catering [55]	Hotels and restaurants [55]
29	Land transport, etc.[60, 63]	Land transport; transport via pipelines [60]
		Supporting and auxiliary transport activities; activities of travel agencies [63]
30	Water transport [61]	Water transport [61]
31	Air transport [62]	Air transport [62]
32	Communications [64]	Post and telecommunications [64]
33	Banking and finance [65, 67]	Financial intermediation, except insurance and pension funding [65]
		Activities auxiliary to financial intermediation [67]
34	Insurance [66]	Insurance and pension funding, except compulsory social security [66]
35	Computing services [72]	Computer and related activities [72]
36	Professional services [70, 71, 73, 74.1-74.4]	Real estate activities [70]
		Renting of machinery and equipment without operator and of personal and household goods [71]
		Research and development [73]
		Other business activities (professional services) [74.1-74.4]
37	Other Business services [74.5-74.8]	Other business activities (business services) [74.5-74.8]
38	Public administration & Defence [75]	Public administration and defence; compulsory social security [75]
39	Education [80]	Education [80]

	41-industry [NACE]	NACE Rev 1.1 [NACE]
40	Health and social work [85]	Health and social work [85]
41	Miscellaneous services [90-93, 95-97, 99]	Sewage and refuse disposal, sanitation and similar activities [90]
		Activities of membership organisations n.e.c. [91]
		Recreational, cultural and sporting activities [92]
		Other service activities [93]
		Activities of households as employers of domestic staff [95]
		Undifferentiated goods producing activities of private households for own use [96]
		Undifferentiated services producing activities of private households for own use [97]
		Extra-territorial organisations and bodies [99]

Source: http://forum.europa.eu.int/irc/dsis/employment/info/data/eu_lfs/Related_documents/Nace_Rev_1.1.htm

Aggregation of 41-industry to 6-industry

	6-industry [NACE]		41-industry [NACE]
1	Primary sector and utilities [01-14, 40, 41]	1	Agriculture, etc. [01-05]
		2	Coal [10]
		3	Oil and gas, etc. [11, 12]
		4	Other mining [13, 14]
		22	Electricity [40.1, 40.3]
		23	Gas supply [40.2]
		24	Water supply [41]
2	Manufacturing [15-37]	5	Food, drink and tobacco [15, 16]
		6	Textiles, clothing and leather [17-19]
		7	Wood and paper [20, 21]
		8	Printing and publishing [22]
		9	Manufactured fuels [23]
		10	Pharmaceuticals [24.4]
		11	Chemicals nes [24(ex24.4)]

41-industry [NACE]		NACE Rev 1.1 [NACE]	
		12	Rubber and plastics [25]
		13	Non-metallic mineral products [26]
		14	Basic metals [27]
		15	Metal goods [28]
		16	Mechanical engineering [29]
		17	Electronics [30, 32]
		18	Electrical engineering and instruments [31, 33]
		19	Motor vehicles [34]
		20	Other transport equipment [35]
		21	Manufacturing nes [36, 37]
3	Construction [45]	25	Construction [45]
4	Distribution and transport [50-64]	26	Distribution [50, 51]
		27	Retailing [52]
		28	Hotels and catering [55]
		29	Land transport, etc. [60, 63]
		30	Water transport [61]
		31	Air transport [62]
		32	Communications [64]
5	Business and other services [65-74, 90-99]	33	Banking and finance [65, 67]
		34	Insurance [66]
		35	Computing services [72]
		36	Professional services [70, 71, 73, 74.1-74.4]
		37	Other Business services [74.5-74.8]
		41	Miscellaneous services [90-93,95,99]
6	Non-marketed services [75, 80, 85]	38	Public administration and defence [75]
		39	Education [80]
		40	Health and social work [85]

Occupations

ISCO

Major group 1:	**legislators, senior officials and managers**
	11 Legislators and senior officials
	12 Corporate managers
	13 Managers of small enterprises
Major group 2:	**professionals**
	21 Physical, mathematical and engineering science professionals
	22 Life science and health professionals
	23 Teaching professionals
	24 Other professionals
Major group 3:	**technicians and associate professionals**
	31 Physical and engineering science associate professionals
	32 Life science and health associate professionals
	33 Teaching associate professionals
	34 Other associate professionals
Major group 4:	**clerks**
	41 Office clerks
	42 Customer services clerks
Major group 5:	**service workers and shop and market sales workers**
	51 Personal and protective services workers
	52 Models, salespersons and demonstrators
Major group 6:	**skilled agricultural and fishery workers**
	61 Skilled agricultural and fishery workers
Major group 7:	**craft and related trades workers**
	71 Extraction and building trades workers
	72 Metal, machinery and related trades workers
	73 Precision, handicraft, craft printing and related trades workers
	74 Other craft and related trades workers
Major group 8:	**plant and machine operators and assemblers**
	81 Stationary plant and related operators
	82 Machine operators and assemblers
	83 Drivers and mobile plant operators
Major group 9:	**elementary occupations**
	91 Sales and services elementary occupations
	92 Agricultural, fishery and related labourers
	93 Labourers in mining, construction, manufacturing and transport
Major group 0:	**armed forces**

Qualifications

Level of qualification

Low	(Pre-)primary and lower secondary (ISCED 0-2)
Medium	Upper and post-secondary (ISCED 3-4)
High	Tertiary (ISCED 5-6)

ISCED 0	**Pre-primary education** Programmes at level 0, (pre-primary) defined as the initial stage of organised instruction are designed primarily to introduce young children to a school-type environment, to provide a bridge between the home- and a school-based atmosphere. Upon completion of these programmes, children continue their education at level 1 (primary education).
ISCED 1	**Primary education or first stage of basic education** Programmes at level 1 are normally designed on a unit or project basis to give students a sound basic education in reading, writing and mathematics along with an elementary understanding of other subjects such as history, geography, natural science, social science, art and music. In some cases religious instruction is featured. The core at this level consists of education provided for children, the customary or legal age of entrance being not younger than five years or older than seven years. This level covers, in principle, six years of full-time schooling.
ISCED 2	**Lower secondary education or second stage of basic education** The contents of education at this stage are typically designed to complete the provision of basic education which began at ISCED level 1. In many, if not most countries, the educational aim is to lay the foundation for lifelong learning and human development. The programmes at this level are usually on a more subject oriented pattern using more specialised teachers and more often several teachers conducting classes in their field of specialisation. The full implementation of basic skills occurs at this level. The end of this level often coincides with the end of compulsory schooling where it exists.
ISCED 3	**Upper secondary education** This level of education typically begins at the end of full-time compulsory education for those countries that have a system of compulsory education. More specialisation may be observed at this level than at ISCED level 2 and often teachers need to be more qualified or specialised than for ISCED level 2. The entrance age to this level is typically 15 to 16 years. The educational programmes included at this level typically require the completion of some nine years of full-time education (since the beginning of level 1) for admission or a combination of education and vocational or technical experience. • ISCED 3A: programmes designed to provide direct access to ISCED 5A; • ISCED 3B: programmes designed to provide direct access to ISCED 5B; • ISCED 3C: programmes not designed to lead to ISCED 5A or 5B.
ISCED 4	**Post-secondary non-tertiary education** ISCED 4 captures programmes that straddle the boundary between upper secondary and post-secondary education from an international point of view, even though they might clearly be considered as upper secondary or post-secondary programmes in a national context. These programmes can, considering their content, not be regarded as tertiary programmes. They are often not significantly more advanced than programmes at ISCED 3 but they serve to broaden the knowledge of participants who have already completed a programme at level 3. Typical examples are programmes designed to prepare students for studies at level 5 who, although

	having completed ISCED level 3, did not follow a curriculum which would allow entry to level 5, namely pre-degree foundation courses or short vocational programmes. Second cycle programmes can be included as well. • ISCED 4A: see text for ISCED 3; • ISCED 4B: see text for ISCED 3; • ISCED 4C: see text for ISCED 3.
ISCED 5	**First stage of tertiary education (not leading directly to an advanced research qualification)** This level consists of tertiary programmes having an educational content more advanced than those offered at levels 3 and 4. Entry to these programmes normally requires the successful completion of ISCED level 3A or 3B or a similar qualification at ISCED level 4A. They do not lead to the award of an advanced research qualification (ISCED 6). These programmes must have a cumulative duration of at least two years. ISCED 5A: programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements; ISCED 5B: programmes that are practically oriented/ occupationally specific and are mainly designed for participants to acquire the practical skills and know-how needed for employment in a particular occupation or trade or class of occupations or trades, the successful completion of which usually provides the participants with a labour-market relevant qualification.
ISCED 6	**Second stage of tertiary education (leading to an advanced research qualification)** This level is reserved for tertiary programmes which lead to the award of an advanced research qualification. The programmes are, therefore, devoted to advanced study and original research and not based on course-work only. They typically require the submission of a thesis or dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge. They prepare graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government, industry, etc.

Documentation by EULFS: Levels of education and training ISCED 1997
(http://circa.europa.eu/irc/dsis/employment/info/data/eu_lfs/Related_documents/ISCED_EN.htm)

ANNEX IV

List of contributing country experts

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	MEŠTROVIĆ, Branka	Croatian Employment Service
	STOJIĆ, Hrvoje	The Institute of Economics
	TOMIĆ, Iva	The Institute of Economics Cyprus
Cyprus	MOUROUZIDES, Yiannis	Human Resource Development Authority
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	GREBE, Tim	GIB
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	SAUERMANN, Jan	ROA

	Name	Organisation
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	KUSIDEL, Ewa	University of Lodz
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	GHINARARU, Catalin	National Scientific Research Institute for Labour and Social Protection
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	GARDINER, Ben	Cambridge Econometrics
	LIVANOS, Ilias	IER
	POLLITT, Hector	Cambridge Econometrics
	WILSON, Rob	IER

All of these experts have been involved in some stage of the development of this project since 2007. They have taken time to review and comment upon the methodology and emerging findings and contributed considerably to the project.

Acronyms and definitions

Institutions and organisations

CE	Cambridge Econometrics
Cedefop	European Centre for the Development of Vocational Training
DG	Directorate-General
EU	European Union
Eurostat	Statistical Office of the European Communities
IER	Institute for Employment Research
ILO	International Labour Organisation
OECD	Organisation for Economic Cooperation and Development
ROA	Research Centre for Education and the Labour Market, University of Maastricht
Skillsnet	Cedefop's network on early identification of skill needs
UOE	Unesco-OECD-Eurostat
Unesco	United Nations Educational, Scientific and Cultural Organization
US	United States

Others

AMECO	Annual macroeconomic database of the European Commission's
	Directorate-General for Economic and Financial Affairs
BALMOD	Module to reconcile skill supply and demand projections
BRIC countries	Brazil, Russia, India and China
CGE	Computable general equilibrium
E3ME	Energy-environment-economy model of Europe (multisectoral macroeconomic model)
E3ME*	E3ME augmented to include detailed labour supply model
EDMOD	Module to produce occupational demand projections (expansion demands)
EU-27	The 27 EU Member States
EU-27^{+}	The 27 EU Member States plus Norway and Switzerland
FlowMOD	Module of flows in and out of the education system
GDP	Gross domestic product
ISCED	International standard classification of education
ISCO	International standard classification of occupations
LFS	Labour force survey
LMII	Labour market information and intelligence

NA	National accounts
NACE	Statistical classification of economic activities (in the European Community)
O*NET	Occupational information network, which is being developed under the sponsorship of the US Department of Labor/Employment and Training Administration
p.a.	Per annum
QMOD	Module to produce qualification projections
RDMOD	Module to produce projections of replacement demands
StockMOD	Module of numbers acquiring qualifications (stocks)
WTO	World Trade Organization

Definitions of terms used

Conceptual framework	The general theoretical and methodological approach to modelling and projecting the demand for and supply of skills.
Employment	The number of people in work (headcount), national accounts definition, (or the number of jobs in some cases), split by various dimensions, including sector, occupation, gender and highest qualification held.
Labour force	The number of people economically active (the sum over the various age ranges of the working age population * the relevant labour market participation rate) which includes employed and unemployed.
Population (15+)	Anyone of age 15 or over is classified as part of the population in the context of the model. People over 65 are included in this definition, as these age groups have participation rates greater than zero.
Working age population	Anyone of age 15-64 is classified as part of the working-age population.
Participation or activity rate	The percentage of the population that is either employed or unemployed (ILO definition of labour force). This is differentiated by gender and age group.
Qualifications	This term refers to the highest level of education/qualification held by the individual. The ISCED classification is used for this purpose. The most aggregate level distinguishes three main levels of education/qualification: high (ISCED 5-6), medium (ISCED 3-4, excluding 3c short) and low (ISCED 0-2, plus 3c short).
Demand	In the context of the model, labour demand is taken to be the same as employment levels (number of jobs available). It does not include (for example) unfilled vacancies.

Country abbreviations

AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DK	Denmark
EE	Estonia
FI	Finland
FR	France
DE	Germany
EL	Greece
HU	Hungary
IE	Ireland
IT	Italy
LV	Latvia
LT	Lithuania
LU	Luxembourg
MT	Malta
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
SK	Slovakia
SI	Slovenia
ES	Spain
SE	Sweden
CH	Switzerland
UK	United Kingdom
US	United States

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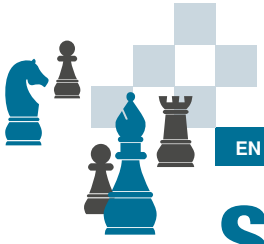

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SKILLS SUPPLY AND DEMAND IN EUROPE

MEDIUM-TERM FORECAST UP TO 2020

Europe must focus more on skills than ever before. Skills to adapt and to shape the jobs of tomorrow are essential for Europe's citizens and businesses to speed up economic recovery. Equally, adequate skills are needed to respond to long-term challenges – to compete in the global market, sustain innovation in ageing societies and address climate change. But will the skills that Europe's citizens have match those needed?

Cedefop's new skill demand and supply forecast up to 2020 sets the scene for anticipating future trends. The aim of this report is to provide policy-makers, employers, skills providers, employment services and individual learners with better information to make more informed decisions. Europe is on its way to an economy where services and knowledge- and skill-intensive occupations will prevail. But even in occupations that are decreasing, substantial employment opportunities will remain as older generations leave the labour market and need to be replaced. It is evident from the forecast that Europe not only needs to step up investment in education and training, but also encourage employers to use better the skills and talents of their staff. The forecast suggests that aggregate demand and supply trends across countries are converging in the medium to longer term, but we need to dig deeper to grasp what is really going on. Changing skill needs, job polarisation and skill mismatch interact in complex ways. The forecasts in this report shed some light on these phenomena, but better data are urgently needed for more analysis.

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