CEDEFOP | European Centre for the Development of Vocational Training

EN

FUTURE SKILL NEEDS IN EUROPE

MEDIUM-TERM FORECAST
SYNTHESIS REPORT

CEDEFOP

Future skill needs in Europe
Medium-term forecast

Synthesis report

Luxembourg: Office for Official Publications of the European Communities, 2008

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.

Europe 123, GR-570 01 Thessaloniki (Pylea)
PO Box 22427, GR-551 02 Thessaloniki
Tel. (+30) 23 10 49 01 11, Fax (+30) 23 10 49 00 20
E-mail: info@cedefop.europa.eu
www.cedefop.europa.eu

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu).

Cataloguing data can be found at the end of this publication.

Luxembourg:
Office for Official Publications of the European Communities, 2008

ISBN 978-92-896-0500-7

© European Centre for the Development of Vocational Training, 2008
All rights reserved.

Designed by Colibri Ltd. - Greece
Printed in Greece

Acknowledgements

This analysis represents the result of a team effort and reflects the contributions of all those working on the project, in particular from:

- Cedefop, Manfred Tessaring and Alena Zukersteinova for the overall coordination and management of the project;
- the Institute for Employment Research (IER), University of Warwick, Rob Wilson for coordinating the core team and drafting the report, as well as producing expansion demand projections together with Ilias Livanos;
- Cambridge Econometrics, Ben Gardiner, Hector Pollitt and Unnada Chewpreecha for producing the sectoral employment projections;
- the Research Centre for Education and the Labour Market (ROA), University of Maastricht, Frank Cörvers and Ben Kriechel for producing the replacement demand projections.

Thanks are also due to expert members of Skillsnet, from individual countries across Europe, who reviewed and commented on many detailed and emerging findings, as well as provided additional data. They contributed enormously to the project. The list of experts is provided in Annex III.

Cedefop is also grateful to Olga Strietska-Ilina for her valuable contribution and helpful comments. The comments of Torsten Dunkel from Cedefop are also sincerely acknowledged.

Cedefop began and funded this work. However, the UK Sector Skills Development Agency and the UK Learning and Skills Council also contributed seed corn funding which helped to get the initial ideas underlying this project off the ground.

Finally, thanks are due to Peter Millar of IER who undertook much of the technical analysis required to process the European labour force survey data and linking it to the results from E3ME, and to Marena Zoppi from Cedefop for her technical support in preparing this publication.

Foreword

The need to improve transparency on European labour markets, increase the skill levels of populations and prevent skill mismatches make information about the future development of skills and competences indispensable. Relevant findings could help achieve the objectives set in European employment and lifelong learning strategies and are essential for developing a European knowledge-based society. Cedefop contributes to these objectives in two ways: the early identification of new skill needs; and anticipation of future skill needs.

New and changing skill needs are challenges for policy-making to achieve wider social and economic objectives of cohesion and competitiveness in the European Union. Lack of information on future skill needs and new skills emerging has been a long-standing concern in Europe. The need to anticipate skills and occupational needs is a priority in the Maastricht and Helsinki communiqués ([1]), the integrated guidelines for employment for 2005-2008 ([2]) the European Social Fund for 2008-2010 ([3]), and the Social partners' framework of actions for the lifelong development of competencies and qualifications ([4]). The recently adopted Council resolution on new skills for new jobs ([5]) draws attention to the practical steps that need to be taken in education and training to provide citizens with better opportunities to succeed on the labour market. The resolution singles out work done by Cedefop and its network Skillsnet as a major contribution to this process.

This publication presents – for the first time – a consistent and comprehensive medium-term forecast of employment and skill needs across the whole of Europe. It develops macroeconomic projections and alternative scenarios for each Member State ([6]) and aggregate results at European level. It provides data on future employment developments by economic sector, occupation and qualification until 2015 and uses comparative data for all Member States.

([1]) http://ec.europa.eu/education/policies/2010/vocational_en.html
http://ec.europa.eu/education/policies/2010/doc/helsinkicom_en.pdf
([2]) http://eur-lex.europa.eu/LexUriServ/site/en/oj/2005/l_205/l_20520050806en00210027.pdf
([3]) http://eur-lex.europa.eu/LexUriServ/site/en/oj/2006/l_210/l_21020060731en00120018.pdf
([4]) http://www.etuc.org/a/580
([5]) http://eur-lex.europa.eu/LexUriServ/site/en/oj/2007/c_290/c_29020071204en00010003.pdf
([6]) EU-25 plus Norway and Switzerland.

The results show that the trend of increasing skill requirements is unbroken, with high job gains for highly and medium skilled workers – including those with vocational qualifications, and substantial job losses for the lower skilled. However, the results differ by countries, sectors and occupations – thus requiring further research and analysis. Analysis should also indicate points of reference for proactive education and training policies to prevent undesired developments, such as possible skill mismatches.

I hope this publication will not only provide actors and participants in the labour market with relevant information and useful evidence on future skill needs trends and developments but will be an impetus for further research and activities to promote further a European system for early identification of skill needs.

Aviana Bulgarelli
Cedefop Director

Preface

Cedefop started work on early identification of skill needs, in close cooperation with research institutions from several European countries, in 2001/02. Many stakeholders attached high importance to this activity and asked Cedefop to enlarge and coordinate future action. In response, Cedefop established, in 2004, the European network on early identification of skill needs 'Skillsnet'. Its main aim is to make European activities more transparent and provide a platform for dialogue and information exchange. Skillsnet follows two strands of research: early identification of new and emerging skills, and anticipation of skill needs and supply.

Early identification of skill needs concerns research and analysis at national, regional, local, sectoral and occupational levels, as well as analysis of skill needs of specific target groups, such as the low skilled, those at risk, the disabled, minorities, and others. Approaches mainly include enterprise and labour force surveys at different levels, forecasting techniques, case studies, analyses of job advertisements, expert inquiries, scenarios, and observatories on skill developments.

Forecasting labour market skill needs – in a short, medium or longer term – refers to the expected future number of jobs available in an economy and its sectors, and their particular skill or qualification requirements ([7]). Such forecasts are carried out in several countries at national or regional levels or both. They are mostly based on macroeconometric projections of sectoral production, productivity and employment (jobs), broken down by occupations and/or skills/qualifications, using advanced methodologies. Often several variants or scenarios are calculated, which – based on alternative assumptions – provide a range of the number of future jobs and their particular skill requirements.

However, there are many caveats to skill needs forecasting. It is believed too economic and not to consider adequately political and behavioural aspects of all actors involved, or qualitative or social aspects. Further, forecasts provide results mainly at an aggregate level which may be too general for concrete policies or educational programmes. The longer the

([7]) Often, this forecast of demand is complemented by forecasts of the supply of workers with particular skills. By comparing demand and supply, indications for future imbalances or skill mismatches on labour markets can be drawn. Cedefop will explore skills supply in Europe in 2008.

forecasting period, the less accurate and robust are the results. These caveats must be taken seriously. Every forecast has to indicate clearly its assumptions and limitations to prevent misinterpretation. It should be pointed out that although forecasts are of particular value for economic, employment and education/training policies, they should be seen as a complementary information source.

National forecasts, undertaken in several European countries are mostly not comparable because different approaches, methods and data/classifications are used so they cannot be aggregated at European level. Following suggestions from policy-makers, Skillsnet organised in Cyprus in October 2005 an initial workshop to explore the feasibility of a core system of European skill needs forecasting. The workshop was attended by experts in forecasting occupations, skills and/or educational fields from 14 European countries. All participants agreed on the feasibility and urgency of a European skill needs forecasting exercise and asked Cedefop to coordinate further steps.

In 2006, Cedefop initiated a project to develop and carry out a medium-term forecast of occupational skill needs in Europe based on available data. This work has been carried out by the Institute for Employment Research (IER) at University of Warwick, Cambridge Econometrics (CE) and the Research Centre for Education and the Labour Market (ROA) in Maastricht in cooperation with Cedefop's Skillsnet network and country experts (see list in Annex III).

Three expert workshops were organised in 2006 and 2007 to support development of a medium-term forecast of occupational skill needs in Europe. The first workshop in autumn 2006 in Warwick explored a common approach to European skill needs forecasting in terms of methods and data including concrete suggestions for further practical steps and gradual involvement of all interested European countries. The second in Maastricht in May 2007 had the main objective of getting feedback from country experts on the interim results of the forecast. It presented interim results and discussed with experts related data quality issues, possible scenarios and approaches to modelling replacement demand. The third workshop, organised in Vienna in November 2007, presented the final results, including details of the methodology used, and discussed and verified with country experts the data quality, scenarios applied and outcomes of the medium-term forecast. In addition, participants discussed and identified obstacles, data gaps and possible ways to fill them in the future.

This European forecast – unique at European level – provides reliable results for Europe as a whole (EU-25 plus Norway and Switzerland) as well as for all individual countries. It has confirmed that general trends coincide with national forecasts. The forecasts for individual Member States are useful as a point of reference and comparison with national forecasts, as well as an additional source of information – especially in cases where national forecasting systems do not yet exist. At the same time forecasts at individual Member State level are sometimes problematic. This happens due to objective data limitations and problems which could not be solved in the current project.

The present publication is a result of intensive work by the entrusted research team (IER, ROA, Cambridge Econometrics) and Cedefop's network Skillsnet, including individual country experts. It must be underlined that such a challenging task, such as developing a European forecasting system cannot be accomplished and perfected in one year. We are at the end of one particular project phase which is only the beginning of a much longer and very demanding process.

Manfred Tessaring
Head of Area research and policy analysis

Alena Zukersteinova
Project manager

Table of contents

Acknowledgements V
Foreword 1
Preface 3
List of tables, figures and boxes 9
Summary 11
1. Introduction 17
    1.1. Rationale for producing quantitative skills projections 17
    1.2. Specific aims of the project 22
    1.3. General approach 22
    1.4. Approach of this project 23
2. Data issues and methodology 27
    2.1. Data issues 27
        2.1.1. Labour force surveys versus national accounts estimates: strengths and weaknesses 27
        2.1.2. Other data issues 29
        2.1.3. Country workbooks 29
    2.2. Module 1: macroeconomic and sectoral scenarios 30
        2.2.1. E3ME outline and review 30
        2.2.2. Development of alternative scenarios 32
    2.3. Modules 2 and 3: expansion demand by occupation and qualification 33
        2.3.1. Review of modules 2 and 3 33
        2.3.2. Modelling employment by occupation and qualification 34
    2.4. Module 4: replacement demands 35
        2.4.1. General approach 35
3. Prospects for changing skill needs in Europe 38
    3.1. Background 38
    3.2. Prospects by sector 39
        3.2.1. Benchmark macro and sectoral employment scenario 39
        3.2.2. Alternative scenarios by sector 43
    3.3. Prospects by occupation 45
        3.3.1. Prospects for occupations in the benchmark scenario 45

3.3.2. Alternative scenarios for occupational employment 51
3.4. Trends in replacement demand and total requirements by occupation 54
3.4.1. Replacement demand and total requirements in the benchmark scenario 54
3.4.2. Alternative scenarios for replacement demand and total requirements 56
3.5. Implications for qualifications 59
3.5.1. Implications for qualifications in the benchmark scenario 59
3.5.2. Implications for qualifications in alternative scenarios 61
4. Detailed results: cross country comparisons 66
4.1. Detailed results by country and sector 66
4.2. Detailed results by country and occupation 74
4.3. Results for replacement demand by country 81
5. Conclusions 84
5.1. Review 84
5.2. Key findings for Europe's future skill needs and policy implications 85
5.3. Problems and scope for further refinement 89
5.4. Continuing dialogue: importance of country expert involvement 89

Annex I: Detailed tables 90
Annex II: Classifications and aggregations used 104
Annex III: List of contributing country experts 114
Acronyms 117
Bibliography 118

List of tables, figures and boxes

Tables

1. Employment trends by industry, EU-25+ 41
2. Scenarios compared: trends by broad sector, EU-25+ 45
3. Employment trends by occupation, level and growth, EU-25+ 48
4. Scenarios compared: trends by broad occupation, 2006-15, EU-25+ 53
5. Replacement demands by occupation, broad groups, 2006-15, EU-25+ 56
6. Replacement demand by broad occupation based on LFS, EU-25+ 57
7. Implications for qualifications, broad groups, EU-25+ 60
8. Scenarios compared: expansion demand by qualification, EU-25+ 62
9. Scenarios compared: total requirements by qualification, EU-25+ 65
10. Changes in employment by country 67
11. Changes in employment by country, primary sector and utilities 68
12. Changes in employment by country, manufacturing 69
13. Changes in employment by country, construction 70
14. Changes in employment by country, distribution and transport 71
15. Changes in employment by country, business and other services 72
16. Changes in employment by country, non-marketed services 73
17. Occupational employment by country, 2006 (000s) 75
18. Occupational structure in each country, 2006 (row %) 76
19. Share of occupations within Europe, 2006 (column %) 77
20. Projected employment change by country and occupation, 2006-15 (000s) 78
21. Projected employment change by country and occupation, 2006-15 (%) 79
22. Projected employment growth, 2006-2015 (annual %) 80
23. Replacement demands by country and occupation, 2006-2015 (000s) 82
24. Total job openings by country and occupation, 2006-15 (000s) 83
25. Employment trends by broad sector, EU-25+ 90
26. Employment trends by industry, EU-25+ 91
27. Employment trends by industry, change, EU-25+ 92

28. Employment trends (level) by occupation, EU-25+ 93
29. Employment trends (share) by occupation, EU-25+ 94
30. Employment trends (growth) by occupation, EU-25+ 95
31. Employment trends (change) by occupation, EU-25+ 96
32. Replacement demand by occupation, broad group, EU-25+ 97
33. Implications for qualifications, broad groups, EU-25+ 99
34. Employment by sector, occupation and qualification, 1996-2015, EU-25+ 100

Figures

1. Review of the modular approach to skills forecasting (the framework) 25
2. Employment trends by broad sector, in 000s, EU-25+ 42
3. Employment trends by broad sector, shares in %, EU-25+ 42
4. Employment trends by broad sector, change in 000s, EU-25+ 42
5. Scenarios compared, trends by broad sector, EU-25+ 44
6. Employment trends by broad occupation, EU-25+ 50
7. Employment trends by broad occupation, share in %, EU-25+ 50
8. Employment trends by broad occupation, change in 000s, EU-25+ 51
9. Scenarios compared: trends by broad occupation, 2006-15, EU-25+ 52
10. Scenarios compared: total requirements by broad occupation, EU-25+ 58
11. Implications for qualifications, broad groups, EU-25+ 60
12. Implications for qualifications, broad groups, share in %, EU-25+ 61
13. Implications for qualifications, broad groups, change in 000s, EU-25+ 61
14. Scenarios compared: expansion demands by qualification, 2006-15, EU-25+ 63
15. Scenarios compared: total requirements by qualification, 2006-15, EU-25+ 64

Boxes

1. Arguments for and against employment and skill needs forecasting 18
2. Measuring employment in the LFS and national accounts 27

Summary

Overview

This publication provides a synthesis ([8]) of the results of Cedefop's Skillsnet project on developing a medium-term forecast of occupational skill needs in Europe. It summarises the key findings and details the approach adopted. It also highlights many data and technical problems the research team faced and sets out the solutions adopted. The overall aim was to develop a new system for producing regular detailed and consistent, quantitative projections ([9]) of future skill needs across the whole of Europe. Given the difficulties faced, a certain amount of pragmatism was required, but this set of results provides a sound foundation to take the debate on the changing pattern of demand for skills in Europe to a new level.

Background

The Lisbon agenda and other recent policy documents stressed the need for Europe to place more emphasis on anticipating changing skill needs. Globalisation, technological change and demographic developments (including ageing and migration) are posing huge challenges, offering both risks and opportunities.

The need for regular forward looking assessments has received further impetus following the setting of employment targets and related policies as part of the Lisbon strategy (recent examples include Council resolution on news skills for new jobs and revised integrated guidelines for employment for 2008-10). Such results can help inform active labour market policies to retrain the unemployed or reintegrate individuals who are economically inactive. It is also becoming increasingly important given the rising levels of migration flows between countries. Labour mobility between European countries is, if anything, likely to increase further. International labour mobility can help resolve labour market bottlenecks and deal with surpluses.

([8]) A more detailed background report will be available later in 2008/09.
([9]) The terms 'projection', 'forecast', 'anticipation' and 'prediction' are used synonymously.

Information on future skill needs in Europe can help, therefore, orientate and guide policy, as well as inform individuals of future developments. Many countries are already undertaking this kind of work. This project offers a pan-European perspective, providing consistent estimates for all members of the EU.

While it is generally accepted that in a market economy it is not possible to predict the future precisely, the need to make strategic plans and choices which can influence and shape the future path taken by the economy and labour market is widely accepted. Such plans need to be guided by robust labour market information and intelligence (LMII), including a forward looking element. This needs to be based on regular, systematic and quantitative approaches to forecasting and scenario development. Skills are a key part of the infrastructure of the economy, and the choices made by both policy-makers, enterprises and individuals on investment in education and skills can help to determine the path the economy takes. These choices need to be guided by good LMII.

A range of approaches to assessing future skill needs is required. These need to encompass both quantitative and qualitative methods and serve a range of audiences. The latter should include: policy-makers, stakeholders, social partners, sectoral organisations, practitioners and individuals. This project is concerned with developing quantitative models and projections. The results are aimed at all these audiences, across all the countries of the EU (plus some associated members). The present analysis covers EU-25 (before the accession of Bulgaria and Romania) plus Norway and Switzerland referred to henceforth as EU-25+.

Key findings

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 economy in general, and these trends are likely to continue to be a key feature over the coming decade. This applies both within individual countries and in the way in which things are changing between European countries. Although many newer members of the EU still rely to a much greater extent on agriculture and manufacturing for employment, 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 the changing political and economic situation. In some countries this is leading to changes in the opposite direction as some activities in manufacturing have been transferred eastwards and southwards within Europe. Overall, the results of this forecast suggest that these patterns of change will continue in the immediate future, and that these will be more of an evolutionary rather than revolutionary nature.

Substantial change is in prospect with over 13 million additional jobs being created between 2006 and 2015 in EU-25+. This is despite the loss of well over two million jobs in the primary sector and almost half a million in manufacturing. Distribution, transport, hotels and catering together are projected to see employment grow by 3.5 million over the next decade, while non-marketed services are expected to increase by only slightly less. Business and miscellaneous services have the best prospects, with almost 9 million additional jobs being created between 2006 and 2015.

The projected sectoral changes taking place 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 highly and medium-skilled workers as well as some lower skilled occupations. Almost 40% of people are currently employed in higher level jobs such as management, professional work of one kind or another or technical support for those activities. These areas are all expected to experience increased demand over the next decade. In contrast, jobs requiring traditional agricultural skilled workers, several other craft and related skills and clerical skills will decline in number. There will, however, be significant expansion in the numbers of jobs for many service workers, especially in retail and distribution, and also for some elementary occupations requiring little or no formal skills.

The latter has been characterised as polarisation of jobs. It raises concerns about job quality and mismatch, and related problems of social equality and exclusion for many European citizens. The structural and other changes taking place will if these trends continue create many jobs at higher levels but also large numbers at the lower end of the job spectrum, with low pay and poor terms and conditions. This will pose significant problems for policy-makers concerned with issues of equity and social cohesion. The study emphasises that even those areas where employment levels are expected to fall there will nevertheless be significant numbers of job openings and need for education and training. This affects both sectors and occupations.

Despite the structural changes projected it is important to emphasise that the primary and manufacturing sectors will remain viable sources of jobs and crucial components of the economy. Similarly there is significant replacement demand by occupation (to replace those leaving for retirement or other reasons) even for those occupations where employment levels are projected to fall sharply. It is important that policy-makers, education and training providers and individual citizens are aware that many of those occupations likely to see job losses will remain viable sources of employment and make important contributions to the economy for many years to come.

Of course the nature and skill requirements of these jobs will not remain unchanged and it is important also to understand the way in which they are evolving. This includes formal qualifications that are 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. The analysis focuses on three levels (high, medium and low qualifications). The results highlight the general increase in qualification levels across most jobs. At the broadest level the projected changes are even more dramatic than for occupations. In total, the net employment increase in Europe of over 13 million jobs between 2006 and 2015 comprises increases of almost 12.5 million jobs at the highest qualification level (ISCED levels 5 and 6) and almost 9.5 million jobs at medium level (ISCED level 3 and 4), offset by a sharp decline of 8.5 million jobs for those with no or few formal qualifications (ISCED levels 0 to 2). In part these changes reflect the expected continued growth in supply of people who have acquired formal qualifications. While some have argued there is a possibility of oversupply in some areas, there is also considerable evidence of increasing needs for, and even shortages of, formal qualifications in many areas.

Modular approach

The results described above have been developed by adopting a modular approach to anticipating Europe's future skill needs, involving four main elements. These include a multisectoral macroeconomic model, occupational and qualifications expansion demand modules and a replacement demand module. The advantages of a modular approach are that it helps independent development and improvement of different parts of the system. In combination, the modules provide a general framework for producing quantitative projections of changing skill needs regularly.

This project involved development of the basic database and tools required to produce a comprehensive and consistent set of skill projections for all countries in the EU plus Norway and Switzerland. It is based on data from Eurostat sources, adopting common methods and models. Together the database and models constitute the framework.

The framework has been designed to promote further development and customisation. In particular, it allows for refinement of modelling approaches used for projecting occupational, 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 other 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 assumptions.

Data sources and preferred employment estimates

A key issue addressed in the project is finding the best data for measuring the employment structure in Europe in a common framework. Historically, most countries have invested considerable resources in developing data for their national accounts (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. More recently, greater emphasis has been placed on estimates of employment based on the European labour force survey (LFS). These have the considerable advantage of being broadly consistent across countries and providing a measure of employment structure by skills (occupation and qualification) as well as gender and age, that is not available from NA based estimates.

The numbers presented by sector, as used in the multisectoral macroeconomic model, are based on Eurostat national accounts, rather than LFS based 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. Therefore, two sets of results have been developed, one based on a national

accounts basis and the other based on LFS data in order to benchmark sectoral estimates. The main emphasis in this report is on the former, although it also compares the two. In fact, in broad terms at least, the implications for changing patterns of skills in the future are not that different between the two alternatives.

Conclusions

The results presented in this publication 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 of the trends which emerge 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 within industries. This suggests that such projections can provide valuable and robust information to a broad range of users, from individuals making career choices, enterprises that invest 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 a national level. Rather they can complement these, offering for the first time a broad and consistent overview for the whole of Europe. While this might 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 and in-depth analyses can be compared. Further, they require more qualitative analyses of the complex nature of skills, competences and knowledge – and requirements.

There are of course data issues, which are especially severe for some of the smaller countries where sample sizes in the LFS are often inadequate to provide robust estimates on detailed/disaggregated employment structures. Even for many of the larger countries there are difficulties arising from changes in classification and other technical issues many of which can only be addressed by detailed dialogue between individual country experts and the relevant statistical authorities at national and international levels. One conclusions of this project 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.

CHAPTER 1

Introduction

1.1. Rationale for producing quantitative skills projections

The Lisbon agenda has stressed the need to place more emphasis on anticipating changing skill and competence needs in Europe. Climate change, globalisation, technological change and demographic developments (including migration) pose huge challenges. These represent risks and threats, as well as opportunities. Identification of key trends and provision of accurate and timely labour market information and intelligence (LMII) to those making choices and decisions are crucial to identifying possible new jobs for Europe, as well as those under threat from structural change. The most recent revision of the integrated employment guidelines (October 2007) states that anticipation of future skill needs should be a top priority if Europe is to respond successfully to the challenges it faces, both externally (to compete successfully in world markets) and internally (to ensure all its population shares the benefits of economic growth). The recently adopted Council resolution (15 November 2007) launched a large-scale activity on new skills for new jobs, as well as reemphasising the need to improve available LMII to help guide the decisions of both policy-makers and individual citizens in all Member States. Identification of key trends and provision of accurate and timely LMII to those making choices and decisions is crucial to identifying possible new jobs in Europe, as well as those threatened by structural change.

Nobody can predict the future precisely, but everyone can plan to make the most of the opportunities they face, and avoid the worst problems. Projections can serve as an early warning system which fosters strategies to prevent or alleviate future problems. Such individual strategic plans and choices will shape the future path taken by Europe as a whole. These plans and choices need to be guided by robust LMII. The key question, therefore, is not whether we should try to anticipate the future, but rather how to go about it. Rather than relying on luck and individuals' own (possibly ill-informed) judgements, the philosophy underlying this project is that we should apply transparent, systematic scientific and quantitative methods consistently across the whole of Europe. This needs to be pan-European

because the problems are not confined within narrow national borders. The increasing mobility of labour across national boundaries, resulting from formation of the single market, and related issues such as migration emphasise the need for a pan-European perspective.

The case for and against quantitative employment projections has been debated for many years. Box 1 discusses some pros and cons associated with employment and skill forecasts. This also highlights some of their limitations. However, the preferences of governments and many other organisations across the world, who have invested considerable resources in such activities, suggest that they meet a very real need.

Box 1. **Arguments for and against employment and skill needs forecasting**

Against	For
National level employment planning is irrelevant because markets will respond of their own accord to ensure that the correct skills are produced.	The evidence of market failures (unemployment or skill shortages) and long time lags in training may lead to imbalances or mismatch in labour markets which could be prevented by policies based – among other things – on quantitative forecasts.
The fixed coefficient approach is invalid since it ignores the possibilities of substitution of skills and wage adjustments.	Skill substitution processes and wage structures change slowly. Improvements in methodology allow for explicit consideration of substitution in forecasting models.
Inaccuracies in the assumptions will be compounded, making the projections of little value.	Forecasting inaccuracy applies to any economic or other projection; employment forecasts are not significantly more inaccurate than others. Moreover, there is evidence that decision-makers have found these useful. These forecasts are not deterministic but indicate possible developments and thus ways to shape the future. Further, the modelling of alternative scenarios/ variants with different assumptions should indicate a plausible range of future developments.
Skill demand forecasts focus solely on economic considerations without reference to wider social implications.	Other disciplines have been introduced (e.g. in qualitative approaches). Interpretation of results should bear in mind that economic development is only one factor of influence among others. Quantitative and qualitative approaches are complements, not substitutes.

Against	For
Past imbalances (e.g. over-qualification, unemployment, shortages) are ignored and may be carried forward into the projections.	Although methodologies have been improved, this remains a crucial point. However, to consider imbalances within forecasts (if these are generally considered as useful), would imply the need to predict qualitative imbalances in the longer term. This would require assumptions which are as disputable as any others.
The approach does not allow for interaction between skill supply and demand factors.	This is a challenge to forecasters to improve methodologies. First attempts have already been made to do this. One of the problems is that adaptations to future imbalances will change both skill supply and demand and require endless iterations of the calculation which may – dependent on the elasticities on both sides – lead to a long-term equilibrium or to exploding imbalances.
Forecasts, once made public, could change the behaviour of actors and thus invalidate themselves.	If it is a policy goal to inform the public on possible future developments (risks or opportunities), forecast results should not be kept secret. However, results should be interpreted (by the media in particular) carefully. They should be presented as possible and not as inevitable futures, dependent on the underlying assumptions used to generate them. They should be treated as just one information set among many others. If a forecast warns against undesired developments and respective actions are taken, it may be desirable for the forecast to turn out to be incorrect if undesired outcomes are avoided.
Forecast categories are more or less large aggregates and cannot be used for specific decision-making (e.g. individual choice of education and training).	Forecasts are only one information set among others for individual training and occupational decisions, illustrating general trends in labour markets and thus helping to reduce uncertainty. They cannot predict the employment prospective for an individual, but can be used as one information tool for individual guidance, e.g. by pointing to the high risks of renouncing qualified education and training or by illustrating job opportunities in certain fields. Only in centrally planned economies can uncertainty be removed – at the expense of individual freedom, self-responsibility and social change.

Source: Cedefop (2001) with modifications.

The employment guidelines emphasise there is an urgent need for a regular and continuous process of anticipation, which all Member States need to take seriously. The present project is not a substitute for what needs

to be done by individual States but for the first time it presents a consistent attempt to assess skill needs across the whole of Europe.

Anticipation is not a one-off exercise. It needs to be a continuous and regular process. Only if this is the case can it properly inform policy-makers and citizens about the changes they are likely to face. Economic restructuring is itself a normal and continuous process, some sectors change more rapidly than others. We cannot 'hold back the economic tides' that cause this continual change, but we can help our citizens and other decision-makers learn to 'surf the waves' by anticipating likely future developments. Other aspects are also important. Ageing, and poorly qualified workforces militate against innovation, learning, networking and anticipation, but early warning and involvement of the social partners can help to oil the wheels of change. It is not practical to try to pick winners, but it is possible to create an environment conducive to change and which deals with the inevitable casualties. We need to create systems that encourage flexibility and adaptability, as well as entrepreneurship and innovation, and enable industries, companies (and individuals) to reinvent themselves and to contribute actively to shaping the future. For example, sectors that might appear to be 'dead ducks' can often have a second lease of life by restructuring themselves and developing new angles and niches at the higher end of the value-added spectrum. Anticipation is needed to foresee the problems and to act in good time, devising strategies, technologies, etc., to cope, often right down the supply chain. This is often best handled at subcountry or regional levels. There is a need for regions to be proactive; but with a strong sectoral focus. Safeguarding jobs often requires diversification. It also requires approaches to anticipation that recognise the importance of economic links.

There is no single solution to the question of how to anticipate. A multifaceted approach is required. Quantitative and qualitative approaches to anticipation are complements not substitutes or alternatives. Both are needed. Qualitative approaches, such as qualitative inquiry and scenario development, case studies and the like, are needed to gain more insight into underlying processes and aspects which lie beyond numerical and statistical modelling. Examples are 'soft skills' and competences, perceptions, interpersonal contacts, mentalities, expectations, etc., which influence the behaviour of people. Quantitative methods, such as those based on the types of formal models adopted here, are typically based on empirical evidence from past behaviour, using econometric analysis and statistically significant relationships (not simply extrapolations). Such quantitative

approaches can present a consistent view of one possible future that can be useful to a wide audience.

In combination, the two broad approaches can provide a comprehensive picture of future possibilities that is useful to a range of different users. It is important to emphasise that it is not just policy-makers that require this kind of information but also other stakeholders such as social partners, practitioners and individuals. Together, and in combination, qualitative and quantitative approaches offer the best hope of providing different audiences with the information they need to make rational and optimal choices. Skills are a key part of the infrastructure of the economy and the choices made by various actors on the labour market will help determine the path the economy takes.

It should be emphasised that such projections should not be seen as deterministic or prescriptive – structural changes and their implications for changing skill needs cannot be mechanistically predicted. Neither qualitative scenarios nor quantitative forecasts should be seen as precise predictions, rather they are more about preparation for what might come. From a policy perspective they are, themselves, 'enablers' of future opportunities. Questioning and discussing possible futures is a way of building them (making choices and shaping actions) and emphasises the need to assess and modify forecasts regularly and continuously.

It is possible using the methods deployed in this project to identify the main employment trends in Europe – where jobs may be created, as well as anticipating job losses due to restructuring. But it is important not to put too much emphasis on where jobs are disappearing, as there is a danger that lobbying from sectors in decline may result in a biased view of things (a falling tree makes a loud crash, while there is little sound as the forest grows!).

Obviously anticipation of skill needs is not a panacea. Policies relating to trade rules, finance, etc., are also crucially important to ensure that Europe can compete effectively in the 21st century (as are intellectual capital and property rights). But anticipation of changing skill needs, together with other aspects of economic and sectoral development can help policy-makers and others to recognise where skills are the crucial factor.

Therefore, the prime aim of anticipating changing skill needs is to build capacity and improve the capability to undertake such work across Europe regularly, as well as to improve understanding of the main drivers of change.

1.2. Specific aims of the project

This report sets out a systematic approach to analysing the changing skill needs in Europe, historically and over the medium-term future, using common models and data sources. It establishes a general framework that can act as a starting point for further development.

The Cedefop Skillsnet project has the following main objectives:

(a) to develop a robust and consistent occupational database and related projection models which enable production of benchmark projections by occupation, sector and qualification across EU-25 Member States (from 2006, before the accession of Bulgaria, Romania) plus Norway and Switzerland ([10]). These countries are referred to as EU-25+;

(b) to develop a full set of projections using these models and data looking up to 10 years ahead and also including a range of alternative scenarios using the established database and tools;

(c) to present these results to initiate and facilitate a process of systematic dialogue with individual country experts. The present publication represents the final step in the reporting process for disseminating projections.

The project was undertaken on behalf of Cedefop by a team involving the Warwick Institute for Employment Research (IER), Cambridge Econometrics (CE) and the Research Centre for Education and the Labour Market, Maastricht (ROA). Each group was responsible for particular aspects of the project. These are distinguished as separate modules.

1.3. General approach

Previous reviews (Wilson et al., 2004) suggest that when carrying out quantitative skill projections 'best practice' worldwide involves the use of large scale, multisectoral models. These provide an essential understanding of how structural economic and technological changes affect the demand for skills. The typical quantitative modelling approach, therefore, involves three main elements.

The first key component is a multisectoral macroeconomic model, usually built around a Leontief input-output table, which considers the links between

([10]) It is planned that the approach will be extended to include the most recent accession countries in future work.

sectors. Such models are usually estimated using complex and sophisticated econometric methods. The key output from these models as far as the present project is concerned are consistent projections of employment levels by sector/industry. Of course, in addition to providing projections of sectoral employment, such models can be used for a wide variety of other purposes, including more general macroeconomic policy analysis. This may be significant for future use of the new framework which this project has delivered.

The second key component is a module, or set of modules, which translate the employment projections from the multisectoral model into implications for the demand for skills. These elements vary considerably across countries. Most commonly, this aspect is much less sophisticated, mainly due to the more limited nature of data available on skills and to the high complexity of skill-related issues including interaction between skill supply and demand. Usually, the focus of attention is limited to occupational and qualification employment structures within sectors. The trends in such structures are often analysed using simple techniques rather than more sophisticated econometric methods. Forecasts of 'expansion demand' (net changes in occupational employment which can be negative) are based on an analysis of changing occupational patterns of employment within sectors.

The third key component is usually referred to as 'replacement demand'. On the demand side of the labour market it is important to make the distinction between demand that results from future changes in employment levels – expansion demand – and demand due to retirement and various types of mobility – replacement demand. Replacement demand arises when workers leave the employed workforce for whatever reason. The sum of expansion and replacement demand represents total number of new job openings.

1.4. Approach of this project

The project has adopted a modular approach to exploring skill needs focusing on the key components set out in Figure 1. Four separate modules can be distinguished:

Module 1: a set of multisectoral macroeconomic forecasts, based on the preferred macroeconomic model (E3ME);

Module 2: an occupational expansion demand model, (EDMOD), based on LFS data;

Module 3: a qualifications expansion demand module (QMOD), based on similar data sources;
Module 4: a replacement demand module, (RDMOD)

Module 1 (E3ME) is based around the existing pan-European multi-sectoral macroeconomic model (E3ME), developed by Cambridge Econometrics in collaboration with others. This is described in greater detail in Gardiner et al. (2007), along with the underlying assumptions made about the main external influences on the economy and the labour market. The model delivers a set of consistent sectoral employment projections. In addition two alternative scenarios are considered to demonstrate the sensitivity of the outcomes to different assumptions.

Module 2 (EDMOD) builds upon previous work by IER and ROA in their respective countries. It focuses on the factors influencing occupational structure within sectors. It delivers a comprehensive and consistent set of expansion demand estimates, based on LFS data from Eurostat.

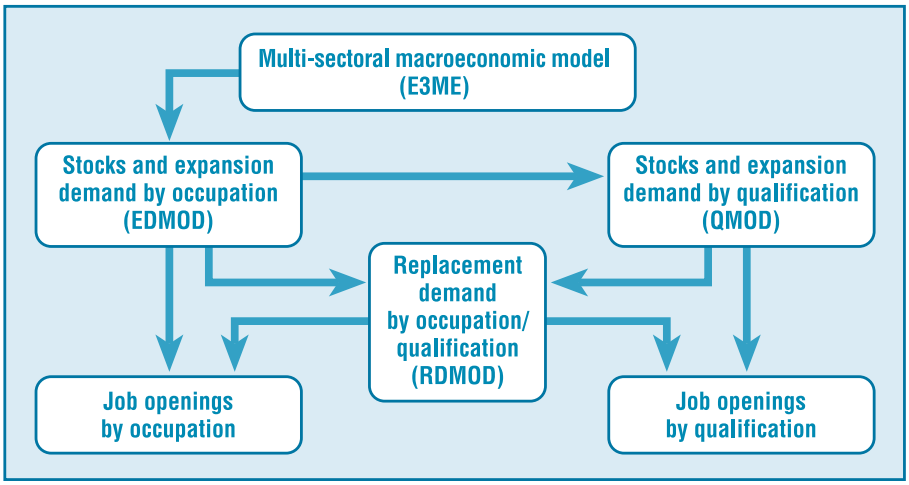
Module 3 (QMOD) focuses on the implications for formal qualifications, adopting similar procedures and data to EDMOD. The data available on qualifications are even weaker than for occupations, with many problems of consistency across countries and over time as well as many gaps. Modules 2 and 3 are described in detail in Livanos and Wilson (2007c).

Module 4 (RDMOD) is again based on building upon previous research efforts by ROA and IER for the Netherlands and the UK respectively. It delivers a set of replacement demand estimates. Without estimates of replacement demand projections of expansion demand are of little value. However, data on some aspects of replacement demand are in many respects weaker than those on occupational employment structure. Nevertheless, the analysis conducted by Kriechel and Cörvers (2007) suggests that sufficient information exists to provide at least a broad indication of the likely scale of replacement demand.

In combination, the four modules deliver a comprehensive, consistent, detailed picture of future skill needs and job openings across Europe. The latter are defined as the sum of expansion and replacement demand.

The advantage of a modular approach is that it facilitates independent development and improvement of parts of the system. In combination the modules represent a general framework, within which it is relatively easy to plug in alternative assumptions and parameters. The results are brought together in a set of country workbooks. These include a detailed and consistent set of historical data and a benchmark projection ([11]).

Figure 1. **Overview of the modular approach to skills forecasting (the framework)**



The aim of the present project is not to substitute national forecasts, nor to seek to criticise or undermine them. Rather it is to present an alternative view, set within a European context that puts individual country results into a broader perspective. The longer-term aim is to work with individual country experts to try to reach a consensus on historical patterns and the main underlying trends as well as on basic data and methods.

A key issue which the project has to address is what are the best data to use to measure changing employment structures? In particular, there is the issue of estimates based on national accounts (NA) and those based on the LFS. Following extensive debate between Cedefop and Skillsnet members, it was concluded that both alternatives had their merits as well as disadvantages. It was therefore decided to develop two alternative sets of projections based on the two data bases. These and other data related issues are discussed briefly in Section 2.1 of this publication ([12]).

Section 2.2 provides a brief review of Module 1, the macroeconomic model and the results it produces. This includes discussion on development of alternative scenarios. A criticism often made of quantitative projections is that they focus too much on a single point forecast. One way of dealing with

([11]) These workbooks have been made available to individual country experts via the Cedefop Skillsnet network.

([12]) The results presented in Chapters 3 and 4 are generally based on National Accounts. Only in sections on alternative scenarios a comparison is given with LFS data.

this criticism is to present a range of alternative views based on different sets of assumptions concerning alternative paths of economic development which can encompass the most likely outcomes. Gardiner et al. (2007) explore these issues in greater depth.

Section 2.3 focuses on Modules 2 and 3. These deal with modelling 'expansion demand'. Different approaches to modelling the changing occupational and qualification patterns within sectors are summarised, drawing on the more detailed discussion in Livanos and Wilson (2007c). This considers the ideal theoretical approach to such issues, as well as the limitations posed by data availability and other problems.

Section 2.4 deals with replacement demand. It is argued that this is at least as important as expansion demand. However, it is also recognised that there are many problems in producing robust estimates. Again data limitations constrain what is feasible. Replacement demand is dealt with in Module 4. Discussion on the overall approach to these issues, the problems and pitfalls faced by the research team and how these have been tackled is set out in more detail in Kriechel and Cörvers (2007).

Chapters 3 and 4 present the final results of the project. These draw on the most recent macroeconomic scenarios from E3ME, in combination with other assumptions from each of the other modules. They also reflect comments from individual country experts provided in autumn 2007. They represent another step closer to achieving consensus on some possible and plausible sets of futures for skills in Europe. The discussion also considers the sensitivity of the results to various other assumptions, including the choice of NA versus LFS sectoral employment estimates.

The final section sets out some key conclusions of the project, including findings on future skill needs as well as some outstanding issues and possible next steps in developing this approach further.

CHAPTER 2

Data issues and methodology

2.1. Data issues

2.1.1. Labour force surveys versus national accounts estimates: strengths and weaknesses

Labour force surveys (LFS) conducted across the EU provide an invaluable source of information on industry by occupation employment. They have the advantage of being conducted much more frequently than a typical census. They also adopt much more standardised sets of questions and systems of classification. While there are still some differences across countries, this source provides 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.

However, as described in more detail in Livanos and Wilson (2007a), the LFS is not without its faults. In many respects estimates of employment based on national accounts (NA) are more robust and more compatible with other economic indicators.

Box 2. **Measuring employment in the LFS and national accounts**

Estimates of employment in NA may differ from results of other statistics and surveys, in particular the LFS. There are differences due to integration of sources and due to conceptual reasons:

Differences due to integration:

- national accounts integrate information from many sources. All sources available (including LFS) are assessed and subsequently the best way of integrating them is decided. Each source may shed light on a part of the economy. Some countries make minor use of LFS in national accounts. The information is combined to provide the most complete and consistent estimate. As a consequence, each individual basic source may provide results that are different from the integrated NA estimates;
- in NA, employment figures must be consistent with other variables such as output and compensation of employees (wages, salaries and social contributions). Ensuring consistency between variables may result in adjustments.

Conceptual differences:

Geographical scope: European system of accounts (ESA95) acknowledges two employment concepts depending on the geographical coverage: resident persons in employment (the so-

called national concept of employment) and employment in resident production units irrespective of the place of residence of the employed person (domestic concept). The difference between them corresponds mainly to the net number of cross-border workers. The domestic concept is more appropriate when examining employment and gross domestic product together. LFS, on the other hand, covers resident households. Hence LFS gives information on the major part of the national concept. This means that:

- LFS data must be adjusted, mainly for cross-border workers, to align with the domestic concept normally used in national accounts;
- coverage differences: LFS does not cover persons living in institutional or collective households (e.g. conscripts), unpaid apprentices and trainees and/or persons on extended parental leave. They are all covered by ESA95 employment. Appropriate adjustments are therefore needed;
- recording thresholds: LFS results exclude persons below 15 years old from the definition of employment (in some countries the exclusion boundaries are below 16 years old and/or above 75 years old). National accounts do not exclude individuals from employment because of age. The difference is small in developed economies.

The size of these conceptual adjustments is modest, with the possible exception of conscripts, and cross-border workers for small countries.

Source: Eurostat, 2004.

The LFS data from Eurostat are sample data. For many countries the time series are short and the number of respondents in a particular cell is often low. This means that the estimates of occupational structure within sectors are not always precise or robust. These problems are even more serious when it comes to making estimates of replacement demand, which asks even more from the data. Nevertheless, LFS data are often the only data available. Moreover they have become well established in analytical and political discourse (European benchmarks and indicators), with the result that some are more familiar with these data than those based on national accounts.

Following detailed debate between Cedefop and country experts on the relative merits of the two sets of estimates no consensus could be reached. Two sets were therefore prepared. The first are based on the levels of employment by sector consistent with national accounts estimates, as used by E3ME. The occupational estimates are constrained to match the sectoral totals from E3ME, while the occupational shares within sectors reflect LFS data. This includes a benchmark scenario (Base 0) as well as two alternative macro/sectoral scenarios (High 1 and Low 2). The second set of results were produced linked to same benchmark scenario, but constrained to be

consistent with the sectoral estimates in the published LFS data (this is referred to as LFS base). These results, along with the outcomes from alternative macroeconomic scenarios, are discussed in Section 3.

2.1.2. Other data issues

There are several other issues relating to data comparability and quality which emerged in the course of the project. These are discussed in more detail in Livanos and Wilson (2007a and 2007c). They include variations in estimates in different vintages of both LFS and NA data sets, as well as differences between published LFS data and those available in the micro datasets provided by Eurostat for the econometric analysis.

Many of these data series are in principle from the same source but differ as a result of being collected, collated and published at different times. As a consequence there are several different versions of each of the data sets available at any one time and considerable care is required to avoid spurious comparisons.

The main problems with the data relate to the quality of the most detailed information by sector, occupation and qualification. There are particular problems of missing data for some cells in the industry by occupation by qualification arrays, as well as difficulties caused by changing systems of classification resulting in breaks in time series. In combination these can result in gaps or short time series of consistent estimates for analysis. Even where estimates do exist there are often concerns about precision and robustness. Work to improve the quality of these data should be a priority for future work.

2.1.3. Country workbooks

The project involved producing a series of separate country workbooks, plus a European review, in a standard format. Each workbook includes both historical data as well as a benchmark set of projections, including expansion demand and replacement demand for both occupations and qualifications. They also include facilities to enable users to customise results, including the ability to:

(a) incorporate alternative industry-employment assumptions (history and projections), instead of the E3ME scenario;
(b) use alternative industry by occupation data (as derived from own country data), including alternative projections;
(c) adopt alternative qualification assumptions;
(d) adopt alternative replacement demand assumptions.

Due to sensitivities about the data at a detailed level the country workbooks have been made available for use by project members, including those members of Skillsnet who have volunteered their time to comment on the detailed results ([13]).

2.2. Module 1: macroeconomic and sectoral scenarios

2.2.1. E3ME outline and review

Most countries have some macroeconomic modelling work at national level, and often this includes multisectoral and multiregional subcomponents. There have been a few attempts to develop cross country models within Europe. One of the most widely used is E3ME, developed by Cambridge Econometrics (CE) in collaboration with others in several European Commission research programmes. This is the model used to drive the current set of projections.

E3ME is an energy-environment-economy (E3) model of Europe. The economy element includes detailed treatment of sectoral employment. The model has been used for general macro analysis and for more focused analysis of policies relating to the environment, energy use, taxation and innovation, as well as employment forecasting. Its pan-European coverage is ideal for this project. It provides a detailed industry analysis for each country as well as region within Europe. Further details are given in Gardiner et al. (2007) and on the model website www.e3me.com.

E3ME combines the features of an annual short- and medium-term sectoral model estimated by formal econometric methods, with the detail and some of the methods of computable general equilibrium (CGE) models. It is essentially a dynamic simulation model, estimated by econometric methods.

The main endogenous variables in E3ME are determined from functions estimated on historical data about the economy. The econometric techniques used to specify the functional form of the equations are the concepts of cointegration and error-correction, particularly promoted by Engle and Granger (1987) and Hendry et al (1984) ([14]).

([13]) Others interested in obtaining access to the workbooks should contact Cedefop's Skillsnet coordination team (skillsnet-team@cedefop.europa.eu).

([14]) For further details and references see the model manual, available online at http://www.camecon-e3memanual.com/cgi-bin/EPW_CGI.

Compared to other models targeted at achieving the same goals, the advantage of the E3ME model lies in three areas:

(a) model disaggregation: the detailed nature of the model allows it to represent complex scenarios, in particular scenarios which are differentiated according to sector and to country. Similarly, the impact of any measure can be represented in a detailed way;
(b) econometric pedigree: the econometric grounding of the models gives it a better capability in representing and forecasting performance in the short to medium run. It, therefore, provides information which is closer to the time horizon of many policy-makers than pure CGE models;
(c) E3 links: an interaction (two-way feedback) between the economy, energy demand/supply and environmental emissions is an undoubted advantage over other models which may either ignore interaction completely or only assume a one-way causation.

In summary, the characteristics of E3ME are such that the model is:

(a) elaborated at European rather than national level, with the national economies being treated as regions of Europe;
(b) dealing with energy, the environment, population and the economy in one modelling framework;
(c) designed from the outset to address issues of central importance for employment, economic, energy and environmental policy at European level;
(d) capable of providing short- and medium-term economic and industrial forecasts for business and government;
(e) based on a system of dynamic equations estimated on annual data and calibrated to recent outcomes and short-term forecasts;
(f) focused on the contribution of research and development, and associated technological innovation, and on the dynamics of growth and change.

Of course, as with any model E3ME has some disadvantages and limitations. While one of the main advantages of using the E3ME model is its inbuilt structure of the national accounts, there are also disadvantages to using a fixed structure for the analysis. In particular, there is little flexibility in the definitions of the countries and sectors that are modelled and, while E3ME provides a relatively detailed sectoral breakdown of each EU-25 economy, this may miss key sectors of interest. For example, the communications industry, as defined in the model and at NACE 2-digit level, includes both postal services and telecoms, which are largely separate and

have different skills requirements. Likewise, the resources required to add Romania and Bulgaria to the model's classifications were too great to fit into the timescale of this project. Work to include these countries in the E3ME model is ongoing.

The other major disadvantage in combining detailed economic and labour market analysis is that the two branches of research are dependent on different data sources and are based on different definitions of employment. As discussed in Section 2 there are often significant differences between national accounts and European LFS data series, at both macroeconomic and sectoral levels. A key consideration in the project was how best to handle these discrepancies to produce an accurate and robust set of model results.

As an econometric model, E3ME's parameters are estimated empirically, using historical time series data covering the period 1970-2004. This means that behavioural relationships in the forecast are determined by past trends. There may be cases where this is not appropriate, in particular in new Member States where data series are shorter (1993-2004) and cover a period of transition. To compensate partially for this E3ME uses a system of shrinkage estimation for its long-term parameters. This assumes that in the long term there is convergence between the EU's new members and the previous EU-15 in terms of the key economic relationships and parameters embedded in the model. A key part of the project was the interaction between the project team and independent country experts to consider any expected future changes in policy that may affect demand in the labour market.

2.2.2. Development of alternative scenarios

E3ME has been set up to explore alternative scenarios. A key focus of the project was on developing a range of alternative macroeconomic and related scenarios. This includes broad assessment of the sensitivity of outcomes to some key external drivers, thus providing a tool to answer various policy orientated questions about the role of skills in Europe's strategic development.

It is important that projections are seen as part of a coherent European perspective rather than being based on projections and inputs from individual countries. Use of the macroeconomic model sets the macroeconomic context for the overall skill projections. E3ME provides consistent predictions of sectoral employment growth, considering factors such as output growth, as well as underlying changes in the components of aggregate demand, demographic changes, etc. A baseline forecast, constructed from a set of

accepted European Commission economic projections was developed as a benchmark (Base 0). Two alternative scenarios, one with a positive and one with a more negative outlook, were then developed (Low 2 and High 3). Further details on the underlying assumptions are given in relevant sections below. These scenarios are also described in more detail in Gardiner et al. (2007). Impacts on employment by country and sector were reported in terms of average growth rates and, for the scenarios, difference from baseline.

In addition to the three macro scenarios, a fourth scenario was also developed which focuses on differences between sectoral employment estimates in national accounts and the LFS. This adopts the same sectoral growth patterns as Base 0 but applied to LFS sectoral estimates for 2006. It is referred to as LFS (base).

2.3. Modules 2 and 3: expansion demand by occupation and qualifications

2.3.1. Review of Modules 2 and 3

Modules 2 and 3 are based on data on occupational employment shares by industry plus information on qualifications held, both taken from the European LFS harmonised by Eurostat. This avoids problems of incomparable systems of classification if country specific data were used.

Occupational employment patterns are only one way of measuring skills. From the point of view of training, and especially formal educational planning, the types of formal qualifications typically required are also important. Some (but by no means all) countries already include a qualification dimension in their quantitative projections. Review of the data available suggests that it is possible to create employment matrices by occupation cross-classified by qualification from the LFS. However, it is also clear that there are problems in comparability across countries in how qualifications are coded in the LFS.

Even with only weak data it is possible to begin to explore some implications for qualifications, although to ensure broad comparability this is limited to just three broad levels. These are:

Low qualification	At most lower secondary (ISCED 0-2)
Medium qualification	Upper secondary (ISCED 3-4)
High qualification	Tertiary (ISCED 5-6)

Focus is on the shares of people in employment who hold these as their highest qualification, without any reference to supply side developments. Ideally, in the longer term this approach would also be extended to include a much more comprehensive and explicit analysis of the supply side. However, there are some significant data limitations in many countries. For the present, therefore, this kind of development lies outside the remit of this project. A separate Cedefop project 'Medium-term forecast of skills supply in Europe' will address this issue directly in 2008.

2.3.2. Modelling employment by occupation and qualification

Previous research on expansion demand and occupational structure is limited, especially at a detailed level (see Livanos and Wilson, 2007c for a review). There is even less work on modelling qualifications from a demand perspective. There is a large gap between the ideal theoretical model and the typical specifications used in most national level skills projections.

The main reason is data limitations. Where detailed data have been available researchers have exploited them. More often than not, however, the paucity of information available has resulted in simple approaches based on time series methods based on a single variable (occupational share), rather than multivariate, behavioural approaches. Indeed often judgement rather than any formal model is a key element (see the approach adopted by the Bureau of Labor Statistics in the US [BLS, 1997]).

The ideal approach based on economic theories of what determines demand for skills would relate occupational and qualification structure to a range of economic and other determinants, including:

(a) technology and work organisation;
(b) cyclical indicators;
(c) price (wage) indicators;
(d) other economic factors such as trade performance, etc.

In practice many such models revert to simple extrapolative procedures (using linear or non-linear methods). Effectively, time is the only independent variable acting as a proxy for technological change and other factors. These issues are discussed in more detail in Livanos and Wilson (2007c).

A range of more and less sophisticated explanatory models have been explored. They cover both occupation and qualification dimensions. Focus is on employment patterns (shares) within sectors. Livanos and Wilson (2007c) describe both the data issues with which the project has had to grapple, and further refinement of the models used to explain changing employment structure by occupation and qualification.

The most robust results are obtained for some of the simplest models, involving some form of trend rather than more sophisticated models with behavioural content. Given the problems with current data this is probably not too surprising. As data are extended and improved in the future it may be possible to add in more economic content to this part of the modelling.

For the present set of results an algorithm was developed to select the preferred models to be used for projecting occupational and qualification shares within each sector. This choice depends upon the data available and how well the model fits and predicts the shares. The default model is a logistic specification, with time as the only independent variable, fitted on published LFS data for the period 1993-2006. Where data are unavailable, or inappropriate due to data missing or inconsistently classified due to changes in classification or other discontinuities, the estimation period is truncated accordingly. In a few cases this leads to a rather shorter period being available than would be ideal but in the absence of alternative data there is no choice. The algorithm also checks to see if the projected changes are plausible, censoring out shares that lie outside the range zero to unity and also where the projected change is exceptionally rapid (which usually arises as a result of idiosyncrasies in the data). Where there are problems of this kind the algorithm explored alternative specifications (log linear, linear and fixed shares) until a plausible outcome was achieved. Inevitably this relies to some extent on judgement. This applies to both shares of occupations within each sector and shares of qualifications within occupations.

2.4. Module 4: replacement demand

2.4.1. General approach

In addition to analysing changes in overall occupational employment levels it is important to consider replacement demand arising from retirement, net migration, movement into other occupations and in-service mortality. This is referred to as replacement demand.

Because of limited data on such flows, estimating replacement demand consistently across Europe is far from straightforward. The paper by Kriechel and Cörvers (2007) explains the approach adopted in detail.

Expansion demand (which can be negative) and replacement demand together comprise the job openings for newcomers to the labour market and can have different constellations:

(a) if both expansion and replacement demand are positive the total job openings are calculated as a sum of the two (ED + RD = job openings);
(b) if there is no expansion demand (ED=0) total job openings equal replacement demand (RD = job openings);
(c) if expansion demand is negative total job openings constitute replacement demand reduced by expansion demand (RD – ED = job openings). In this case part of the workforce leaving the labour market will not be replaced.

Estimating replacement demand is not straightforward and is sensitive to both the methods and the data sources used (Fox and Comerford, 2006). Replacement demand focuses on job openings arising because people leave the workforce, for whatever reason – assuming that this outflow will be replaced. Most previous work has tended to focus on what might be called permanent or semipermanent withdrawals from the employed workforce. These include:

(a) mortality;
(b) retirement (and other reasons for leaving the workforce, including family formation);
(c) emigration;
(d) interoccupational mobility.

To estimate such demands information on the age and gender structure is usually required because many flows, especially retirements and mortality, are age and gender specific. Age structures also vary significantly by occupation. Differences in age structure across occupations can clearly influence exits, with more older people retiring, but more younger people changing occupations. Age structure also affects mortality.

From the LFS, it is possible to analyse the demographic composition of each occupation. This makes it possible in principle to estimate specific rates of retirement and mortality for each occupational class. LFS data can also be used for making estimates of rates of outflow for other reasons. However, there are problems in obtaining robust data since, even for broad age categories, the samples are often small and sampling errors large.

Essentially replacement demand for a particular category (an occupation) depends on two things:

(a) the size of the category (stocks);
(b) the rate of outflow, which can in principle be separated to distinguish the various elements as described above (flows).

Replacement demand is simply the product of (a) and (b).

The replacement demand model (RDMOD) is based on similar data

sources to the occupational model. It adopts a modified cohort components approach as set out in greater detail in Kriechel and Cörvers (2007). The key rates of outflow are estimated by comparing estimates of the numbers of people in successive pseudo cohorts ([15]), defined by age, and based on LFS data. Estimates of replacement demand are driven in part by the occupational and qualification employment levels projected from Modules 2 and 3 (which give the underlying stocks), in combination with information on the probability of flowing out from employment due to retirement, mortality and migration derived from the cohort component model (which generates the flows).

Geographical mobility/migration is an important aspect of potential outflows in an EU context, with migration flows across national boundaries becoming an increasingly significant issue. However, obtaining robust estimates of these flows is not straightforward, since available data are rarely adequate. In much previous work researchers simply suggested that in particular circumstances such outflows might be significant, even though they may not have been able to measure them robustly. This is explored in much more detail in the project, although data limitations make this task difficult.

The replacement demand module produces three sets of replacement demand forecasts that together form total replacement demand. The first contains only replacement demand based on (early) retirement outflow. This is based on the size of the outflow of the highest age groups, which will retire over the next 10 years. The second contains all other replacement demand that is estimated through the outflow probability of the age groups not eligible for retirement. The third contains an additional component of workers that emigrate for those countries that consistently showed net out-migration.

While replacement demand estimates give a good impression of future skill needs, a caveat is necessary. All the results are based on information in Eurostat LFS data. While the set-up is consistent, there are several data problems. In addition to the data problems mentioned in Section 2.1.2 which are also crucial for estimates of replacement demand, it is important to note that the replacement demand estimate is sometimes based on short historical data series (Germany has micro-data only starting in 2002). Therefore, results for those countries will be less precise as outflow estimates are based on historic data.

([15]) People in successive pseudo cohorts are people with same birth year (or range of birth years) who are followed over time. E.g., people aged 20-25 in 2006 (born in 1981-1986) are aged 29-34 in 2015.

CHAPTER 3

Prospects for changing skill needs in Europe

3.1. Background

This section presents new estimates and projections of occupational employment at pan-European level. These are based on the macroeconomic scenarios produced by Cambridge Econometrics. There are already almost 100 000 basic time series projections of employment by industry and occupation and qualification, covering EU-25, plus Norway and Switzerland. It is not possible to do more than present a brief summary of all this information in this report.

The main set of results are based on sectoral employment estimates using Eurostat national accounts based information (as used in the multi-sectoral macroeconomic model), rather than LFS based estimates. There are some significant discrepancies between these two sources as noted earlier. Two alternative sets of results have therefore been generated. In the first (preferred estimates) occupational estimates are constrained to match the E3ME NA sectoral totals (although the shares of occupations within the sectors are all based on LFS data).

The second set constrains the base year sectoral employment numbers in each country from E3ME to match the LFS totals. Historical estimates are set to match published LFS data. The projections use the same overall sectoral growth rates but from this revised base level. The patterns of occupational shares within sectors are the same but because of the different sectoral 'weights' the overall projections of numbers by occupation across all sectors varies.

This chapter presents the main results using E3ME sectoral totals and goes on to consider the sensitivity of the results to some key assumptions. In particular it explores what difference the alternative macro scenarios make to the changing pattern of demand for skills as well as what difference it makes if sectoral data are constrained to match the LFS totals. This chapter presents a summary of the results across all EU-25 Member States (as of December 2006), plus Norway and Switzerland. This group is referred to throughout as EU-25+.

Chapter 4 presents a selection of the more detailed results, covering and comparing all the individual countries.

3.2. Prospects by sector

3.2.1. Benchmark macro and sectoral employment scenario

Figures 2-4 and Table 1 illustrate trends by broad sectors for EU-25+ in the period 1996-2015. They show both the relative importance of the different sectors (in terms of employment levels and shares of the total), as well as the recent historical trends and projected future prospects.

Within Europe as a whole the primary sector and utilities ([16]) now (2006) only accounts for just under 12 million jobs, down from over 15 million a decade earlier. This broad sector includes agriculture, which remains a significant area of employment in some Member States, although in all cases trends are downwards and further job losses are expected over the next decade. Employment is projected to decrease to 9.6 million by 2015 implying net job losses of almost 2.3 million. The share of this broad sector decreases from 5.7% (in 2006) to 4.3%.

Manufacturing has also seen negative employment trends in the past decade, but still accounts for around 35 million jobs and in many respects lies at the heart of the economies in many parts of Europe. In some countries there are positive employment trends, largely reflecting the restructuring of employment within Europe as some activities have been transferred eastwards from older to newer Member States. There are also a few industries within manufacturing (engineering) where demand for output is outstripping productivity gains thus leading to employment increases, but often employment levels are tending to decline. Construction sector has experienced positive employment trends in the past decade but tends to stagnate between 2006 and 2015. Across Europe as a whole, the projections suggest little change in total employment in the manufacturing and construction sectors between 2006 and 2015 in the benchmark scenario.

Services now account for the vast bulk of employment in Europe and have generally seen positive trends, especially among business and miscellaneous services:

(a) distribution, transport, etc., currently accounts for the largest share of employment, although trends in many countries have shown signs of flattening out as these sectors have matured. In total more than 3 million

([16]) Utilities comprise producers and suppliers of gas, electricity and water.

additional jobs are projected across the EU-25+ between 2006 and 2015. Some 2 million of these are in distribution and a further 1.5 million in hotels and catering;

(b) industries within the business and miscellaneous services category, which include many services aimed at consumers, have shown the most rapid growth in recent years for most countries and this looks likely to continue. This broad sector is likely to become the largest category. It is projected to grow by around 2% per annum in total over the period 2006-2015, creating almost 9 million additional jobs in EU-25+ as a whole;

(c) non-marketed services, which include education and health as well as public administration is currently the second largest category, although trends here are also showing signs of reaching a plateau in many countries. Across EU-25+ as a whole over 3 million additional jobs are projected in the benchmark scenario between 2006 and 2015.

Underlying these broad trends is a more complex picture of changing fortunes for different industries in different parts of Europe. The analysis provides similar information to that discussed here at the more detailed 16-industry and 41-industry levels. Some results at the 16-industry level are illustrated in Table 1 and in Annex I. Again these highlight the significance of the different industries in terms of numbers of jobs and shares of total employment, as well as changes over time in both proportionate and absolute terms. The declining shares of employment in agriculture and many manufacturing industries is apparent. The construction and distribution sectors have maintained a constant share of total employment but transport has seen its share of employment decline. Hotels and catering has in contrast benefited from the growing demand for its services (from both businesses and consumers) as have other business services and miscellaneous services. Banking and insurance have seen declining employment shares despite rising output levels as technology has reduced the number of jobs in many areas. Public administration has also seen declining shares in contrast to areas such as health and education which although also often provided publicly have seen large increases in demand for the services they provide. At the even more detailed 41-industry level it is possible to identify more subtle changes that reflect the combination of key drivers influencing the patterns of demand for different goods and services and the ways in which these are provided (both in terms of technologies used and the international division of labour). These results are available in the detailed country workbooks ([17]).

([17]) Available upon request from the Cedefop's Skillsnet coordination team (skillsnet-team@cedefop.europa.eu).

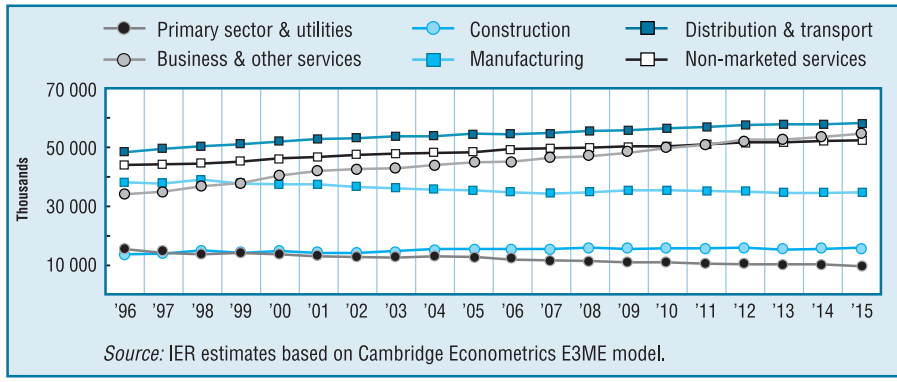
General trends at the broad sectoral level are broadly similar across most countries, although the significance of the different sectors obviously varies considerably in some cases, with marked contrasts between groups such as: the older Member States (OMS, EU-15); the new Member States; Nordic countries; south European countries and east European countries. The full database enables a more detailed exploration of these differences than is possible in this report. Chapter 4 below provides a broad review of country differences.

Table 1. **Employment trends by industry, EU-25+**

	Levels (000s)			Growth (% p.a.)	
	1996	2006	2015	1996-2006	2006-15
Primary sector and utilities	15 052	11 917	9 629	-2.3	-2.3
Agriculture, etc.	12 230	9 753	7 764	-2.2	-2.5
Mining and quarrying	1 005	651	500	-4.3	-2.9
Electricity, gas and water	1 817	1 514	1 364	-1.8	-1.2
Manufacturing	37 802	34 871	34 414	-0.8	-0.1
Food, drink and tobacco	5 012	4 781	4 632	-0.5	-0.4
Engineering	7 943	7 502	7 542	-0.6	0.1
Rest of manufacturing	24 847	22 588	22 241	-0.9	-0.2
Construction	13 729	15 141	15 583	1.0	0.3
Distribution and transport	48 356	54 242	57 740	1.2	0.7
Distribution	28 945	32 153	34 031	1.1	0.6
Hotels and catering	7 891	9 932	11 547	2.3	1.7
Transport and telecommunications	11 520	12 157	12 162	0.5	0.0
Business and other services	34 022	4 568	54 559	3.0	2.0
Banking and insurance	5 743	6 014	6 032	0.5	0.0
Other business and defence	17 424	26 140	33 079	4.1	2.7
Miscellaneous services	10 855	13 485	15 448	2.2	1.5
Non-marketed services	43 753	48 846	52 011	1.1	0.7
Public administration and defence	13 837	14 258	14 432	0.3	0.1
Education	12 896	14 507	15 574	1.2	0.8
Health and social work	17 020	20 081	22 005	1.7	1.0
All industries	**192 714**	**210 656**	**223 936**	**0.9**	**0.7**

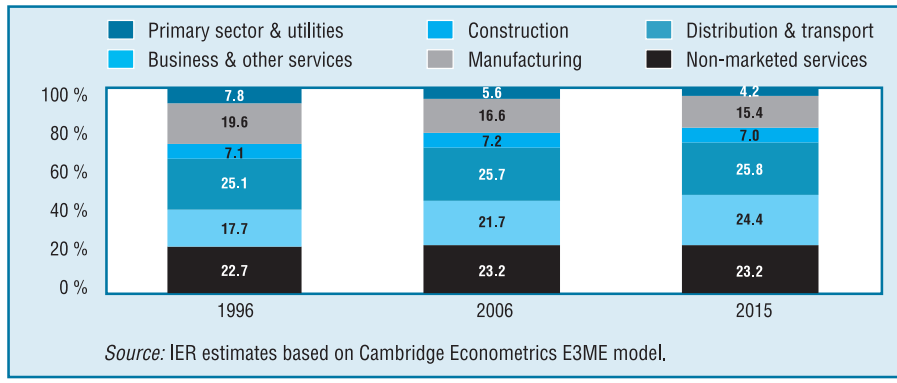
Source: IER estimates based on Cambridge Econometrics E3ME Model.

Figure 2. **Employment trends by broad sector, in 000s, EU-25+**



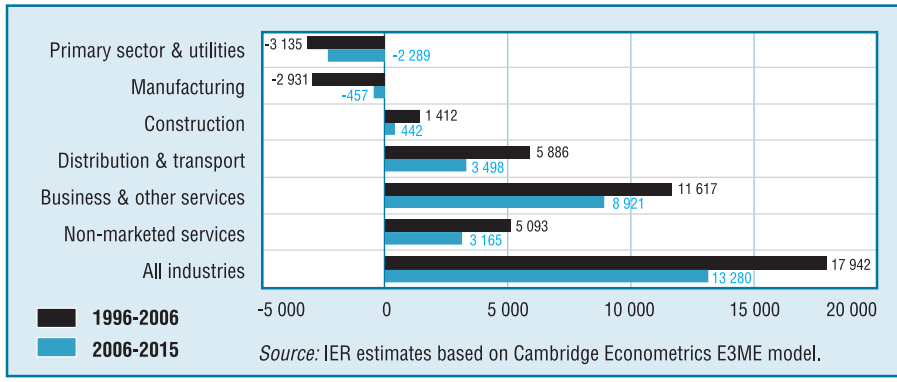
Source: IER estimates based on Cambridge Econometrics E3ME model.

Figure 3. **Employment trends by broad sector, shares in %, EU-25+**



Source: IER estimates based on Cambridge Econometrics E3ME model.

Figure 4. **Employment trends by broad sector, change in 000s, EU-25+**



Source: IER estimates based on Cambridge Econometrics E3ME model.

3.2.2. Alternative scenarios by sector

This section presents an analysis of the sensitivity of the results to the alternative macroeconomic scenarios developed by Cambridge Econometrics, as well as exploring the impact of using LFS based employment estimates as the basis for projections rather than national accounts. The latter adopt the same growth rates by sector as in the national accounts based results, but constrained to match LFS estimates of the sectoral totals in the base year.

Table 2 and Figure 5 compare across the scenarios by broad sector for EU-25+ ([18]). The results are based on the three scenarios developed by Cambridge Econometrics (Base 0, High 1 and Low 2) based on NA. The other case is the Base 0 scenario, but with sectoral totals now constrained to match the published LFS totals. This is referred to as LFS (base).

The results from the scenarios provide a set of boundaries within which the baseline forecast lies. This gives a measure of sensitivity and uncertainty in the forecasts to the general macro-economic environment, indicating the sectors where employment levels are most influenced by the factors listed below.

The scenarios aimed to give three alternative views of developments in global and European growth patterns. In the optimistic (High 1) scenario, Europe remains competitive in a relatively benign global environment. This allows governments to reduce domestic tax rates and increase spending; conversely in the pessimistic (Low 2) scenario poor domestic performance in adverse global trading conditions forces governments to cut spending and increase taxes.

Detailed discussion of the three macro scenarios is given in Gardiner et al. (2007), so only a summary is presented here. Changes were made to:

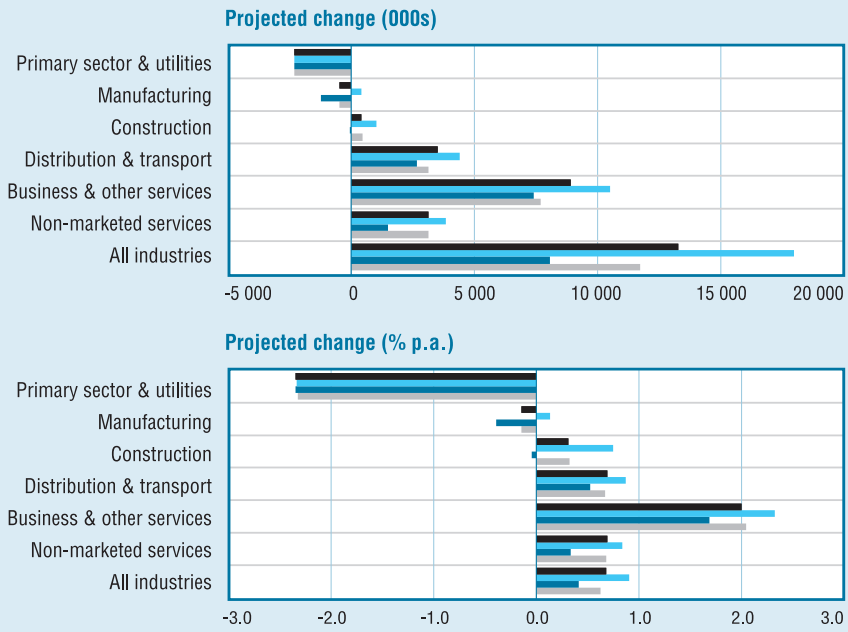
(a) direct tax rates;
(b) R&D spending;
(c) government spending;
(d) public sector employment;
(e) global economic growth;
(f) oil prices;
(g) trade barriers;
(h) interest rates;
(i) exchange rates.

([18]) Similar information could be generated for more detailed 16-industry and 41-industry breakdowns but this is not attempted here for reasons of space. Similarly more detailed comparisons are possible for individual countries.

The focus in the remainder of the discussion here is on the differences in projected employment patterns. Focusing on the three macro scenarios, at this broad level there is little difference in the results for the primary sector and utilities which are projected to decline significantly in all cases. Manufacturing shows a shift from employment decline in the more pessimistic scenario to some employment growth in the optimistic high scenario. For the other broad sectors, the pattern is one of projected job growth, and within this the high scenario projected to generate substantially more jobs and the low one rather fewer.

Comparing the LFS base with the national accounts variant in base 0, the differences are not huge and the patterns across sectors are broadly similar.

Figure 5. **Scenarios compared: trends by broad sector, EU-25+**



	All industries		Non-marketed services		Business & other services		Distribution & transport		Construction		Manufacturing		Primary sector & utilities	
	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.
LFS (Base) scenario	11 735	**0.6**	3 159	**0.7**	7 717	**2.1**	3 136	**0.7**	477	**0.3**	-470	**-0.1**	-2 284	**-2.3**
Low 2 scenario	8 054	**0.4**	1 494	**0.3**	7 439	**1.7**	2 660	**0.5**	-53	**0.0**	-1 198	**-0.4**	-2 288	**-2.3**
High 1 scenaro	17 961	**0.9**	3 835	**0.8**	10 521	**2.3**	4 410	**0.9**	1 052	**0.7**	431	**0.1**	-2 287	**-2.3**
Base 0 scenario	13 280	**0.7**	3 165	**0.7**	8 921	**2.0**	3 498	**0.7**	442	**0.3**	-457	**-0.1**	-2 289	**-2.3**

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 2. **Scenarios compared: trends by broad sector, EU-25+**

Sectors	National accounts				Labour force survey	
	Level in 2006	Change 2006-2015			Level in 2006	Change 2006-15 LFS (base) scenario
		Base 0 scenario	High 1 scenario	Low 2 scenario		
Levels and net change (000s)						
Primary sector and utilities	11 917	-2 289	-2 287	-2 288	11 990	-2 284
Manufacturing	34 871	-457	431	-1 198	36 493	-470
Construction	15 141	442	1 052	-53	16 017	477
Distribution and transport	54 242	3 498	4 410	2 660	50 431	3 136
Business and other services	45 638	8 921	10 521	7 439	38 440	7 717
Non-marketed services	48 846	3 165	3 835	1 494	49 792	3 159
All industries	210 656	13 280	17 961	8 054	203 163	11 735
Growth (% p.a.)						
Primary sector and utilities		-2.3	-2.3	-2.3		-2.3
Manufacturing		-0.1	0.1	-0.4		-0.1
Construction		0.3	0.7	0.0		0.3
Distribution and transport		0.7	0.9	0.5		0.7
Business and other services		2.0	2.3	1.7		2.1
Non-marketed services		0.7	0.8	0.3		0.7
All industries		0.7	0.9	0.4		0.6

Source: IER estimates based on Cambridge Econometrics E3ME model.

3.3. Prospects by occupation

3.3.1. Prospects for occupations in the benchmark scenario

The often dramatic changes in the sectoral structure of employment outlined above have significant implications for the demand for skills. Different sectors have different occupational structures and requirements. The shifts from primary and manufacturing towards services would by itself result in significant changes in occupational employment patterns, reducing demand for both skilled and unskilled workers in these sectors, and increasing demand for the kinds of skills needed to deliver the diverse range of services

demanded in a modern economy. These can be termed 'industry effects' (industry effects indicate the change in occupational employment that would have taken place if the occupational structure in each sector did not change).

These industry effects are combined with changes in the ways work is organised and changes to the tasks undertaken within jobs in each sector as a result of technological and other changes taking place. Information and communication technologies have been the key driver in recent years and this is expected to continue. These factors affect the occupational employment structure within industries (these are often referred to as 'occupational effects') ([19]).

Figures 6, 7 and 8 illustrate the overall implications for trends by broad occupation (9 groups based on ISCO classification). Similar information is available for a more detailed 27 category breakdown as shown in Table 3 and in Annex I.

The figures and table again show both the relative importance of the different occupations (in terms of employment levels and shares of the total), as well as the recent historical trends and projected future prospects within EU-25+ as a whole. At the broad major group level several trends stand out. Skilled agricultural and fishery workers still accounted for almost 10 million jobs in 1996 but this is declining steadily and by 2015 is likely to be not much more than half that figure. Craft and related workers employed in other activities still account for almost 29 million jobs in 2006, but their numbers are declining as a consequence primarily of declining employment in the manufacturing sector and the impact of new technologies which often substitute machinery for traditional crafts. Clerks are another group where technology (especially ICT) has at last begun to bite. However, despite many apocalyptic projections of the impact of ICT on clerical employment in the late 1970s and early 1990s, job numbers continued to rise until recently. For EU-25+ the numbers of clerks appears to have peaked in 2000 and is now projected to show a steady decline, although even by 2015 well over 22 million people will still be employed in such jobs. Employment of plant and machine operators and assemblers will remain rather stable, at around 17-18 million jobs.

In contrast to these groups many other occupations have shown strong positive employment trends which are expected to be maintained. Technicians, professionals and associate professionals fall into this category, as do managers found in the legislators, senior officials and managers group.

([19]) Shift-share analysts often define scale and other interactive effects as well.

Overall it seems likely that there will be a significant increased demand for skilled workers. However, there are also significant increases in job numbers for less skilled groups including service workers and shop and market sales workers, as well as elementary occupations (for whom the entry education and training requirements are generally low). This seems to confirm some fears that there is a continuing polarisation of the demand for labour, with increased job numbers at both ends of the skill spectrum. This raises some policy concerns about equality and social inclusion, and possible mismatches between skills and requirements.

The more detailed results focusing on qualifications discussed in Section 3.5 suggest that the numbers with higher level qualifications are rising in most occupations. This is often a reflection of rising skill requirements (also in elementary occupations and service workers) but it also reflects the fact that supply of those with higher level qualifications is rising rapidly and that people with such qualifications sometimes work in jobs that do not require such formal credentials albeit on a temporary basis. In other cases people may be unable to find permanent work in jobs commensurate with the qualifications they hold, leading to some concerns about possible overqualification.

Tables in Annex I illustrate this story in greater detail, again showing both the relative importance of the different two-digit level occupations (in terms of employment levels and shares of the total), as well as the recent historical trends and projected future prospects within Europe as a whole. The strong growth for corporate managers, various professionals and associate professionals stands out, as does rapid decline for office clerks.

Again, while there are some similarities across countries, there are many differences. The basic data exhibit some discontinuities even at this level (especially around 2000/2001 when several countries apparently changed systems of classification). The methods used to project occupational shares within sectors over such an extended period can also result in some extreme results in a few cases. Efforts have been made to adjust such results in the light of detailed feedback from country experts.

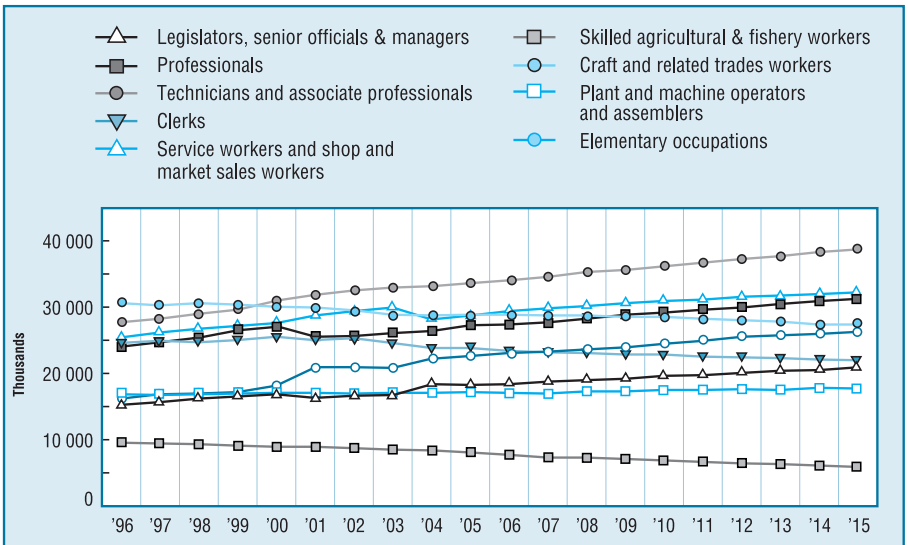
Table 3. **Employment trends by occupation, level and growth, EU-25+**

	Levels (000s)			Growth (% p.a.)	
	1996	2006	2015	1996-06	2006-15
Legislators, senior officials and managers	15 394	18 405	21 076	1.8	1.5
11 legislators and senior officials	484	495	596	0.2	2.1
12 corporate managers	8 349	9 920	12 346	1.7	2.5
13 managers of small enterprises	8 349	7 990	8 135	2.0	0.2
Professionals	24 220	27 349	31 111	1.2	1.4
21 physical, mathematical and engineering science professionals	5 518	6 401	7 452	1.5	1.7
22 life science and health professionals	3 698	3 551	3 658	-0.4	0.3
23 teaching professionals	7 862	8 464	8 736	0.7	0.4
24 other professionals	7 143	8 933	11 265	2.3	2.6
Technicians and associate professionals	27 643	33 952	38 691	2.1	1.5
31 physical and engineering science associate professionals	6 911	7 715	8 129	1.1	0.6
32 life science and health associate professionals	4 807	5 618	5 800	1.6	0.4
33 teaching associate professionals	2 126	2 660	3 315	2.1	2.7
34 other associate professionals	13 799	18 013	21 446	2.7	2.0
Clerks	24 632	23 317	22 044	-0.5	-0.6
41 office clerks	20 840	18 795	16 944	-1.0	-1.1
42 customer services clerks	3 792	4 522	5 100	1.8	1.3
Service workers and shop and market sales workers	25 385	29 490	32 017	1.5	0.9
51 personal and protective services workers	15 408	18 848	21 361	2.0	1.4
52 models, salespersons and demonstrators	9 977	10 642	10 656	0.6	0.0
Skilled agricultural and fishery workers	9 829	7 789	6 082	-2.3	-2.7

	Levels (000s)			Growth (% p.a.)	
	1996	2006	2015	1996-06	2006-15
Craft and related trades workers	30 641	28 845	27 420	-0.6	-0.6
71 extraction and building trades workers	11 205	12 597	12 718	1.2	0.1
72 metal, machinery and related trades workers	11 976	10 466	9 555	-1.3	-1.0
73 precision, handicraft, craft printing and related trades workers	1 865	1 444	1 171	-2.5	-2.3
74 other craft and related trades workers	5 595	4 338	3 977	-2.5	-1.0
Plant and machine operators and assemblers	17 069	17 314	17 850	0.1	0.3
81 stationary plant and related operators	2 034	2 103	2 079	0.3	-0.1
82 machine operators and assemblers	6 622	6 498	6 596	-0.2	0.2
83 drivers and mobile plant operators	8 414	8 713	9 175	0.4	0.6
Elementary occupations	16 655	22 980	26 480	3.3	1.6
91 sales and services elementary occupations	10 408	15 568	18 630	4.1	2.0
92 agricultural, fishery and related labourers	1 269	1 249	1 116	-0.2	-1.3
93 labourers in mining, construction, manufacturing and transport	4 978	6 163	6 735	2.2	1.0
All industries	192 714	210 656	223 936	0.9	0.7

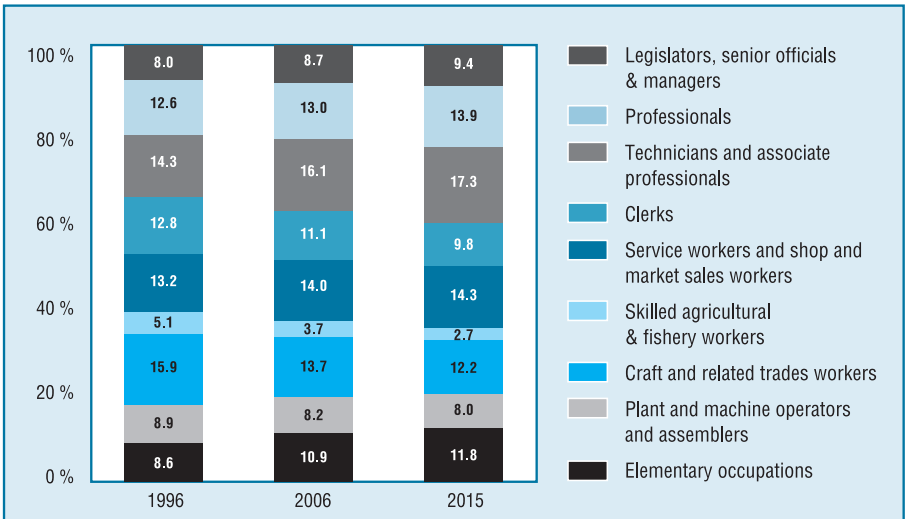
Source: IER estimates based on Cambridge Econometrics E3ME model.

Figure 6. **Employment trends by broad occupation, EU-25+**



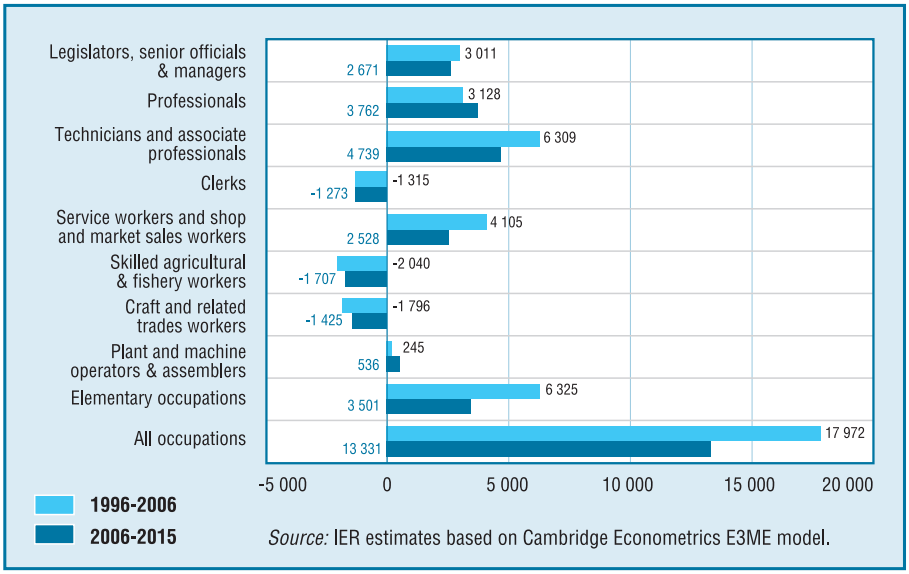
Source: IER estimates based on Cambridge Econometrics E3ME model.

Figure 7. **Employment trends by broad occupation, shares in %, EU-25+**



Source: IER estimates based on Cambridge Econometrics E3ME model.

Figure 8. **Employment trends by broad occupation, change in 000s, EU-25+**



Source: IER estimates based on Cambridge Econometrics E3ME model.

3.3.2. Alternative scenarios for occupational employment

Figure 9 illustrates similar trends in the alternative scenarios by broad occupation (9 groups). Analogous information is available for a more detailed 27 category breakdown.

No attempt has been made to calculate different scenarios for occupational shares within industries (which drive expansion demand estimates). The same shares within sectors are used in all four cases. In principle these shares might be expected to show some variation in the different scenarios, with perhaps faster growth for some higher level occupations in the high scenario, for example. These issues need to be explored further in future work.

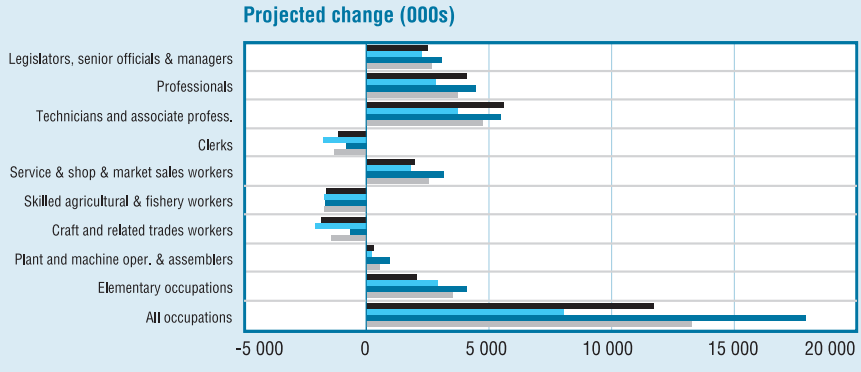
As might be expected from the discussion for sectors, at this broad level all occupations benefit from the more optimistic scenario and all suffer from the more pessimistic one. Elementary occupations show particular sensitivity, but in percentage terms there is not that much variation for most occupations.

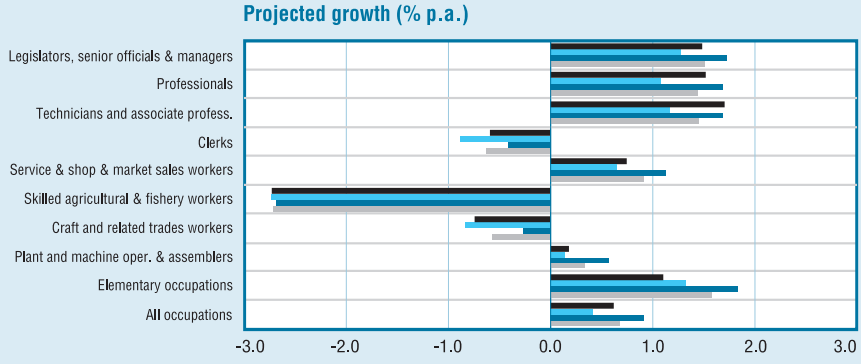
Comparing the LFS base with the national accounts variant in Base 0, there are some notable differences. This reflects the different base year sector weights in the two variants. Elementary occupations are projected to

grow less rapidly in the LFS variant. This is partially offset by slightly more optimistic prospects for some other occupations such as technicians, etc. However, the differences in shares and patterns of change are not huge.

In total the LFS based scenario has 1.5 million fewer jobs by 2015 than the Base 0 scenario. This is largely simply a reflection of the difference in the base year levels.

Figure 9. **Scenarios compared: trends by broad occupation, 2006-15, EU-25+**





	All occupations		Elementary occupations		Plant and machine oper. & assemblers		Craft and related trades workers		Skilled agricultural & fishery workers		Service & shop & market sales workers		Clerks		Technicians and associate profess.		Professionals		Legislators, senior officials & managers	
	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.	000s	% p.a.
LFS (Base) scenario	11 735	**0.6**	2 043	**1.1**	283	**0.2**	-1 836	**-0.7**	-1 654	**-2.7**	1 973	**0.8**	-1 160	**-0.6**	5 563	**1.7**	4 101	**1.5**	2 476	**1.5**
Low 2 scenario	8 054	**0.4**	2 901	**1.3**	212	**0.1**	-2 081	**-0.8**	-1 720	**-2.7**	1 819	**0.7**	-1 770	**-0.9**	3 729	**1.2**	2 813	**1.1**	2 238	**1.3**
High 1 scenaro	17 961	**0.9**	4 091	**1.8**	918	**0.6**	-686	**-0.3**	-1 693	**-2.7**	3 146	**1.1**	-826	**-0.4**	5 511	**1.7**	4 457	**1.7**	3 079	**1.7**
Base 0 scenaro	13 280	**0.7**	3 501	**1.6**	536	**0.3**	-1 425	**-0.6**	-1 707	**-2.7**	2 528	**0.9**	-1 273	**-0.6**	4 739	**1.5**	3 762	**1.4**	2 671	**1.5**

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 4. **Scenarios compared: trends by broad occupation, 2006-15, EU-25+**

Occupations	National accounts				Labour force survey	
	Level in 2006	Change 2006-2015			Level in 2006	Change 2006-15 LFS (base) scenario
		Base 0 scenario	High 1 scenario	Low 2 scenario		
Levels and net change (000s)						
Legislators, senior officials and managers	18 405	2 671	3 079	2 238	17 326	2 476
Professionals	27 349	3 762	4 457	2 813	27 994	4 101
Technicians and associate professionals	33 952	4 739	5 511	3 729	33 752	5 563
Clerks	23 317	-1 273	-826	-1 770	22 388	-1 160
Service workers and shop and market sales workers	29 490	2 528	3 146	1 819	28 025	1 973
Skilled agricultural and fishery workers	7 789	-1 707	-1 693	-1 720	7 507	-1 654
Craft and related trades workers	28 845	-1 425	-686	-2 081	28 362	-1 836
Plant and machine operators and assemblers	17 314	536	918	212	17 056	283
Elementary occupations	22 980	3 501	4 091	2 901	19 509	2 043
All occupations	210 656	13 280	17 961	8 054	203 163	11 735
Total change (%)						
Legislators, senior officials and managers		14.5	16.7	12.2		14.3
Professionals		13.8	16.3	10.3		14.6
Technicians and associate professionals		14.0	16.2	11.0		16.5
Clerks		-5.5	-3.5	-7.6		-5.2
Service workers and shop and market sales workers		8.6	10.7	6.2		7.0
Skilled agricultural and fishery workers		-21.9	-21.7	-22.1		-22.0
Craft and related trades workers		-4.9	-2.4	-7.2		-6.5

Occupations	National accounts				Labour force survey	
	Level in 2006	Change 2006-2015			Level in 2006	Change 2006-15 LFS (base) scenario
		Base 0 scenario	High 1 scenario	Low 2 scenario		
Plant and machine operators and assemblers		3.1	5.3	1.2		1.7
Elementary occupations		15.2	17.8	12.6		10.5
All occupations		6.3	8.5	3.8		5.8
Growth (% p.a.)						
Legislators, senior officials and managers		1.5	1.7	1.3		1.5
Professionals		1.4	1.7	1.1		1.5
Technicians and associate professionals		1.5	1.7	1.2		1.7
Clerks		-0.6	-0.4	-0.9		-0.6
Service workers and shop and market sales workers		0.9	1.1	0.7		0.8
Skilled agricultural and fishery workers		-2.7	-2.7	-2.7		-2.7
Craft and related trades workers		-0.6	-0.3	-0.8		-0.7
Plant and machine operators and assemblers		0.3	0.6	0.1		0.2
Elementary occupations		1.6	1.8	1.3		1.1
All occupations		0.7	0.9	0.4		0.6

Note: Total also includes Armed forces.
Source: IER estimates based on Cambridge Econometrics E3ME Model.

3.4. Trends in replacement demand and total requirements by occupation

3.4.1. Replacement demand and total requirements in the benchmark scenario

Projections of changing occupational employment levels tell only part of the story. Even in cases such as the office clerks, where the projection displays continuing job losses, there will still be large numbers of people required in

such jobs for many years to come (around 4.5 million in Europe as a whole by 2015 for this particular occupational group). It is, therefore, crucial when assessing implications for education and training and job opportunities to recognise the replacement demand that will arise as people retire or leave the workforce for other reasons.

Detailed estimates of replacement demand have been developed based on the cohort component approach as described in Section 2.4.1 and in Kriechel and Cörvers (2007). The estimates reflect the particular occupational structures within each country, as revealed by LFS data. However, the rates of outflow used to estimate replacement demand are not customised to reflect detailed sectoral differences. Replacement demand was not calculated for past periods 1996-2006.

Aggregate replacement demand by qualification has also been calculated by Kriechel and Cörvers (2007). These do not differ by occupation and have not therefore been used in the country workbooks. Estimates of detailed replacement demand by occupation and qualification combined were unstable as the disaggregation implied significant decreases in the number of historical observations available for estimation.

Outflow rates depend upon the age structure of the particular group of workers, as well as other specific factors such as mortality, etc. Not least among the latter are factors relating to migration flows between countries which have become of much greater significance in recent years. While the general framework developed here allows for these differences to be taken into account, its application in this report is based on a simpler set of assumptions. The present set of results should, therefore, be regarded as illustrative. The assumptions in the workbooks do allow these various components of replacement demand to be modified by the user.

Table 5 summarises the results at the broad one-digit level. The table illustrates again the broad trends and patterns, but now presenting estimates of replacement demand to be added to the expansion demand element. Together these two components sum to give the total requirement (or new job openings) in the final column. This is expressed both in absolute terms as well as in percentage.

Over the nine-year period replacement demand amounts to almost one quarter (24.2 %) of total employment levels in the base year (2006) ([20]). This dwarfs the expansion demand elements (6.3 % across all occupations).

([20]) If anything, the cohort component method may tend to result in somewhat conservative estimates as some outflows may not be fully recorded. This estimate may therefore be towards the lower end of the possible range of likely estimates.

Although expansion demand is negative for a few occupations (notably clerks and skilled agricultural and fishery workers), in all cases replacement demand outweighs this and leads to significant positive total requirements. If expansion demand is negative, not all outflows (or job reductions) will be replaced, the total requirements are then lower than replacement demand.

Table 5. **Replacement demand by occupation, broad groups, 2006-15, EU-25+**

	2006 level	Change 2006-15 (000s)			Change 2006-15 (% of the 2006 level)		
		Expansion demand	Replacement demand	Total requirement	Expansion demand	Replacement demand	Total requirement
Legislators, senior officials and managers	18 405	2 671	4 362	7 034	14.5	23.7	38.2
Professionals	27 349	3 762	5 747	9 509	13.8	21.0	34.8
Technicians and associate professionals	33 952	4 739	6 857	11 596	14.0	20.2	34.2
Clerks	23 317	-1 273	5 772	4 498	-5.5	24.8	19.3
Service workers and shop & market sales workers	29 490	2 528	8 039	10 567	8.6	27.3	35.8
Skilled agricultural and fishery workers	7 789	-1 707	2 201	494	-21.9	28.3	6.3
Craft and related trades workers	28 845	-1 425	7 493	6 067	-4.9	26.0	21.0
Plant and machine operators & assemblers	17 314	536	4 048	4 584	3.1	23.4	26.5
Elementary occupations	22 980	3 501	6 188	9 689	15.2	26.9	42.2
All occupations	**210 656**	**13 280**	**51 001**	**64 281**	**6.3**	**24.2**	**30.5**

Note: Total also includes Armed forces; expansion demand = net change.
Source: IER estimates based on Cambridge Econometrics E3ME model.

3.4.2. Alternative scenarios for replacement demand and total requirements

As for expansion demand, replacement calculations have not been varied between the macro scenarios although in principle there might be a case for introducing some differences. Since replacement demand is based on the opening stock values, there is no variation between the three macro

scenarios. The main macroeconomic indicator that may affect replacement demand (ignoring policy changes for a moment) is that affecting labour market participation rates. Fluctuations in participation due to business cycles are not modelled in replacement demand (RD) estimates but structural differences in participation might be expected to have some impact.

Policy changes that affect retirement behaviour (extending mandatory retirement ages to say 67 instead of 65), or factors that might result in increases in the participation of women in the labour market (free child care during the day-time, tax changes making dual-income household more attractive, etc.) could also affect replacement demand.

However, these effects are usually not large (and adjustment processes are often slow).

For replacement demand, as noted above, there is no difference between the three macroeconomic scenarios, but the LFS base variant shows around two million fewer replacement demands because of the smaller base year starting level (Table 6). Differences between occupations are negligible.

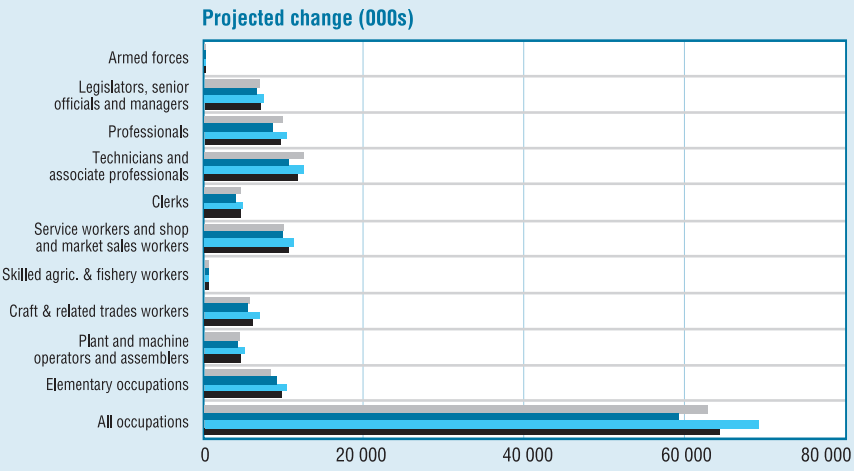
Total requirements show some variation because of the difference in expansion demand (Table 5 and Figure 10). Further, there are differences in total requirements due to different starting levels of NA and LFS (Figure 10 and Table 6). However, the main message that comes across is of broad similarity of results across the scenarios rather than any differences.

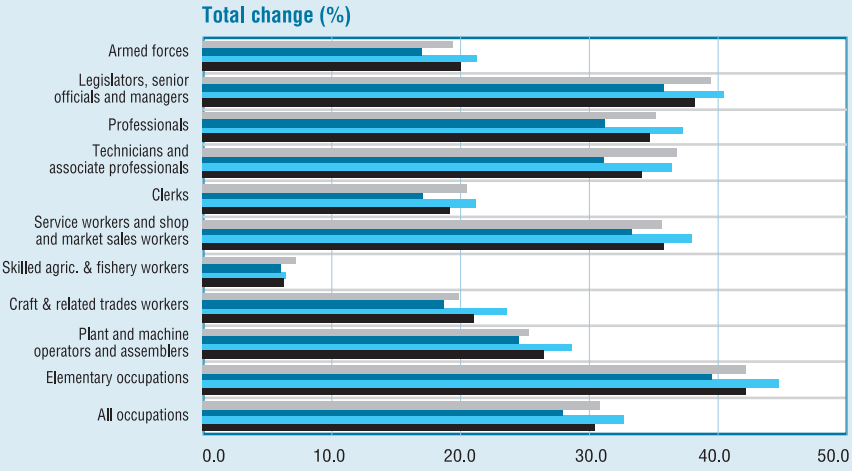
Table 6. **Replacement demand by broad occupation based on LFS, EU-25+**

Occupations	Level in 2006	Change 2006-2015		
		000s	%	% p.a.
Legislators, senior officials and managers	17 326	4 362	25.2	2.5
Professionals	27 994	5 747	20.5	2.1
Technicians and associate professionals	33 752	6 857	20.3	2.1
Clerks	22 388	5 772	25.8	2.6
Service workers and shop and market sales workers	28 025	8 039	28.7	2.8
Skilled agricultural and fishery workers	7 507	2 201	29.3	2.9
Craft and related trades workers	28 362	7 493	26.4	2.6
Plant and machine operators and assemblers	17 056	4 048	23.7	2.4
Elementary occupations	19 509	6 188	31.7	3.1
All occupations	**203 163**	**51 001**	**25.1**	**2.5**

Notes: There are no differences between the Base 0, High 1 and Low 2 scenarios for replacement demands.
Source: IER estimates based on Cambridge Econometrics E3ME Model.

Figure 10. **Scenarios compared: total requirements by broad occupation, EU-25+**





	All occupations		Elementary occupations		Plant and machine oper. and assemblers		Craft and related trades workers		Skilled agricultural and fishery workers		Service & shop and market sales workers		Clerks		Technicians and associate profess.		Professionals		Legislators, senior officials & managers		Armed forces	
	000s	%	000s	%	000s	%	000s	%	000s	%	000s	%	000s	%	000s	%	000s	%	000s	%	000s	%
LFS (Base)	62 736	**30.9**	8 232	**42.2**	4 331	**25.4**	5 656	**19.9**	547	**7.3**	10 012	**35.7**	4 611	**20.6**	12 420	**36.8**	9 847	**35.2**	6 838	**39.5**	242	**19.4**
Low 2	59 055	**28.0**	9 090	**39.6**	4 261	**24.6**	5 412	**18.8**	482	**6.2**	9 858	**33.4**	4 002	**17.2**	10 585	**31.2**	8 559	**31.3**	6 600	**35.9**	207	**17.0**
High 1	68 962	**32.7**	10 280	**44.7**	4 966	**28.7**	6 807	**23.6**	508	**6.5**	11 185	**37.9**	4 945	**21.2**	12 367	**36.4**	10 203	**37.3**	7 441	**40.4**	259	**21.3**
Base 0	64 281	**30.5**	9 689	**42.2**	4 584	**26.5**	6 067	**21.0**	494	**6.3**	10 567	**35.8**	4 498	**19.3**	11 596	**34.2**	9 509	**34.8**	7 034	**38.2**	244	**20.1**

3.5. Implications for qualifications

3.5.1. Implications for qualifications in the benchmark scenario

Another important aspect of changing skill requirements is the formal qualifications that are typically needed to undertake different jobs. While there is no simple one to one relationship between occupation and qualification it is possible to explore how these patterns are changing over time. A second potentially important aspect relates to key, core and generic skills or competences which have received considerable emphasis from employers in recent years when interrogated about their skill requirements. In many respects these aspects are much harder to measure, and this dimension is not covered in the present project. However, it may be possible to introduce it in future work by linking it to other projects funded by the EU and the OECD such as PIAAC ([21]).

Concerning formal qualifications and given existing data, it is possible at present to undertake only a broad brush analysis at pan-European level, focusing on three levels (high, medium and low). These are defined as follows:

Low qualification	At most lower secondary (ISCED 0-2)
Medium qualification	Upper secondary (ISCED 3-4)
High qualification	Tertiary (ISCED 5-6)

The results (Table 7 and Figures 11, 12 and 13) highlight the general increase in qualification levels. At the broadest level the projected changes are even more dramatic than for occupations. Total employment in Europe is projected to grow by over 13 million jobs between 2006 and 2015. This comprises increases of almost 12.5 million jobs at the highest qualification level (roughly ISCED levels 5 and 6) and a further 9.5 million jobs at medium level (ISCED 3 and 4). This is offset by a projected decline of 8.5 million jobs for those with no or few formal qualifications. Much more detailed results are available that show implications for qualifications within both occupations and sectors (Table 34 in Annex I).

It is important to recognise that, in part, these changes also reflect the expected continued increase of people's qualification levels (supply) and partly increased qualification requirements of jobs. The present exercise has made no attempt to separate supply and demand influences, but extrapolating forward the historical patterns of qualifications within occupations. However,

([21]) OECD Programme for international assessment of adult competencies (PIAAC).

this issue will be addressed in a follow-up study ([22]). There is evidence that the demand for skills and formal qualifications is rising in many higher level occupations and there is some indication of increasing qualification requirements also in more elementary jobs. However, the importance of supply and demand factors in these cases remains to be established.

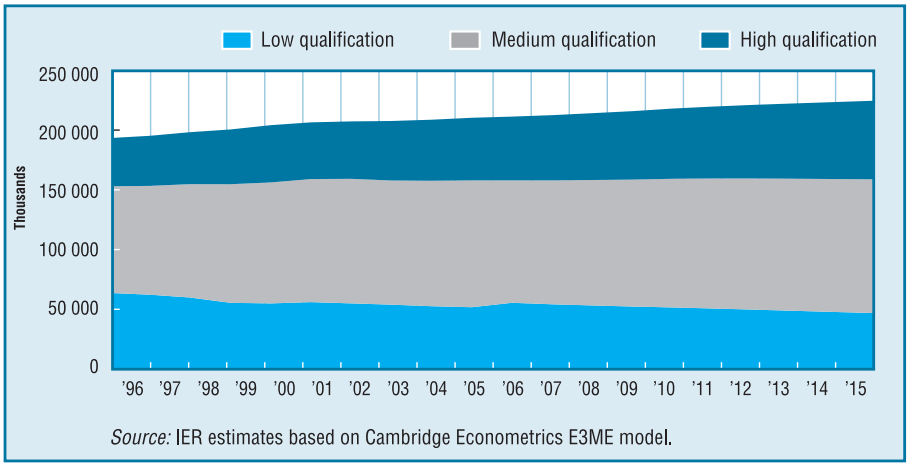
While some have argued that there is a possibility of oversupply of people with formal qualifications in some areas, there is also considerable evidence of the changing nature of job requirements (see the discussion for the UK case in Wilson and Bosworth, 2007). This suggests that there is an increasing need for formal qualifications in many jobs. This is an area where there is a clear need for further research.

Table 7. **Implications for qualifications, broad groups, EU-25+**

	Levels (000s)			Growth (% p.a.)	
	1996	2006	2015	1996-06	2006-15
Low qualification	63 339	55 104	46 516	-1.4	-1.9
Medium qualification	89 127	102 291	111 752	1.4	1.0
High qualification	40 248	53 261	65 668	2.8	2.4
All qualifications	**192 714**	**210 656**	**223 936**	**0.9**	**0.7**

Source: IER estimates based on Cambridge Econometrics E3ME model.

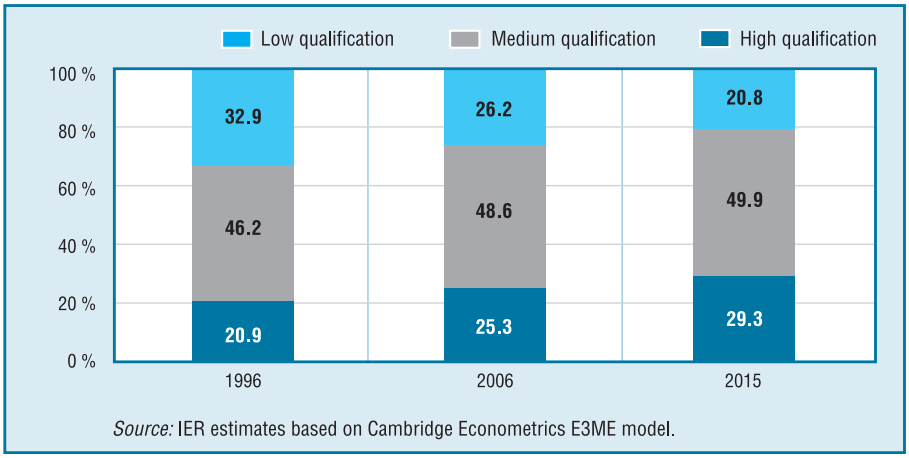
Figure 11. **Implications for qualifications, broad groups, EU-25+**



Source: IER estimates based on Cambridge Econometrics E3ME model.

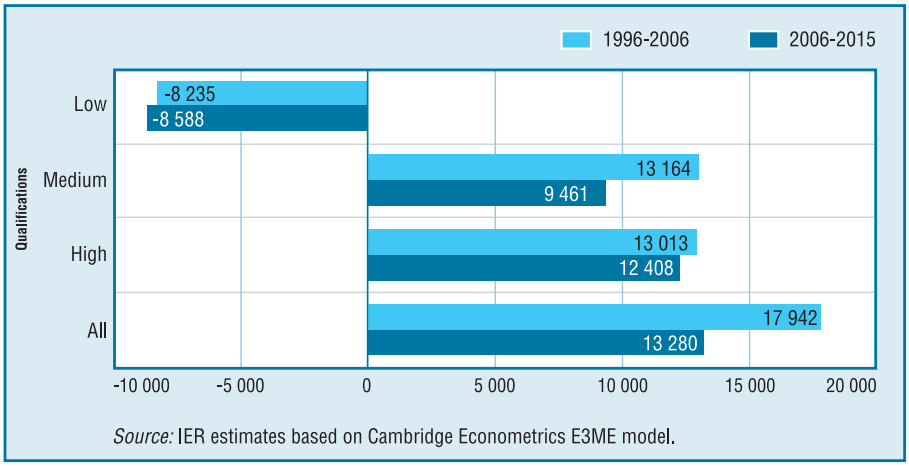
([22]) New Cedefop project, Medium-term forecast of skills supply in Europe to be carried out in 2008.

Figure 12. **Implications for qualifications, broad groups, share in %, EU-25+**



Source: IER estimates based on Cambridge Econometrics E3ME model.

Figure 13. **Implications for qualifications, broad groups, change in 000s, EU-25+**



Source: IER estimates based on Cambridge Econometrics E3ME model.

3.5.2. Implications for qualifications in alternative scenarios

This section presents a summary of the results for qualifications across the alternative scenarios. Again, expansion demand and replacement demand elements have not been varied across the scenarios so any differences simply reflect the sectoral variations assumed. Note that replacement demand is not differentiated by qualification level but just by occupation (the

rate of replacement needs are common within an occupational group regardless of qualifications held).

While there are some obvious differences between the three scenarios, with all qualification levels benefiting from the more optimistic scenarios, the differences are not huge, either for expansion demand or for total requirements. In broad terms these results seem robust across alternative scenarios.

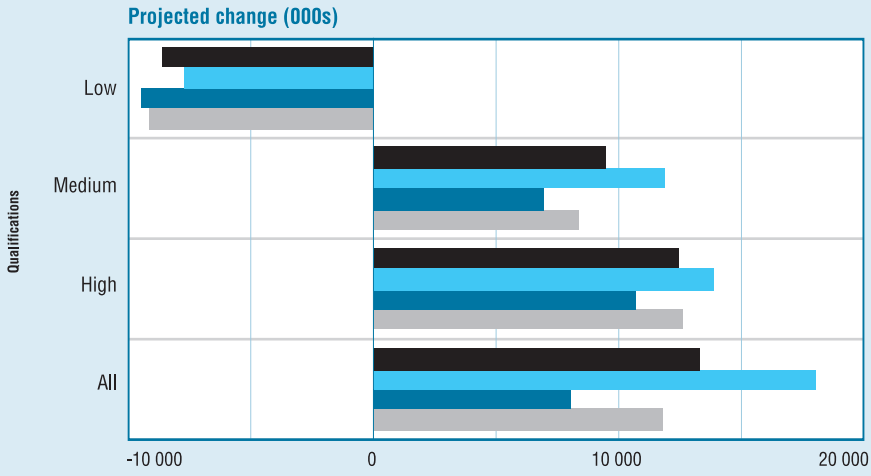
The LFS base scenario suggests a smaller overall increase in employment (because of lower starting level) but the results for higher level qualifications are almost identical to the NA based Base 0 scenario. It is the medium qualification group that loses out most, although the low qualification category also sees almost a million fewer job losses in the LFS variant.

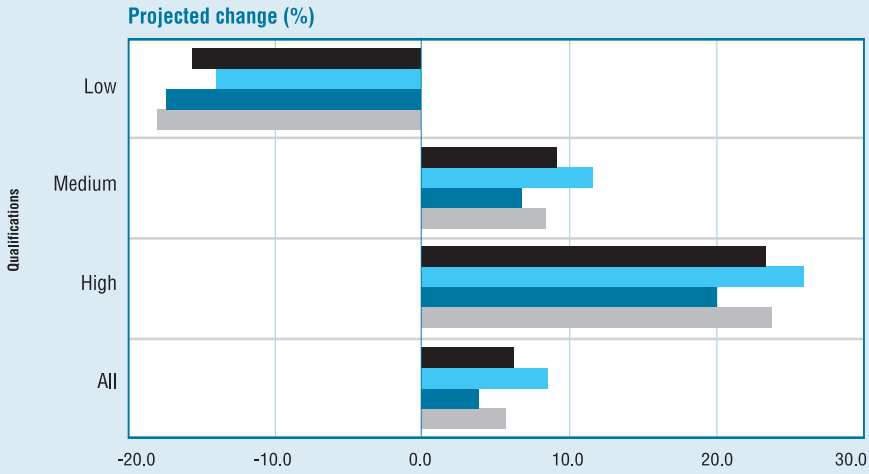
Table 8. **Scenarios compared: expansion demand by qualification, EU-25+**

Qualifications	National accounts				Labour force survey	
	Level in 2006	Change 2006-2015			Level in 2006	Change 2006-15 LFS (base) scenario
		Base 0 scenario	High 1 scenario	Low 2 scenario		
Levels and net change (000s)						
Low qualification	55 104	-8 588	-7 692	-9 503	51 174	-9 151
Medium qualification	102 291	9 461	11 853	6 898	98 967	8 327
High qualification	53 261	12 408	13 801	10 660	53 022	12 559
All qualifications	210 656	13 280	17 961	8 054	203 163	11 735
Changes (%)						
Low qualification		-15.6	-14.0	-17.2		-17.9
Medium qualification		9.2	11.6	6.7		8.4
High qualification		23.3	25.9	20.0		23.7
All qualifications		6.3	8.5	3.8		5.8

Source: IER estimates based on Cambridge Econometrics E3ME Model.

Figure 14. **Scenarios compared: expansion demand by qualification, 2006-15, EU-25+**

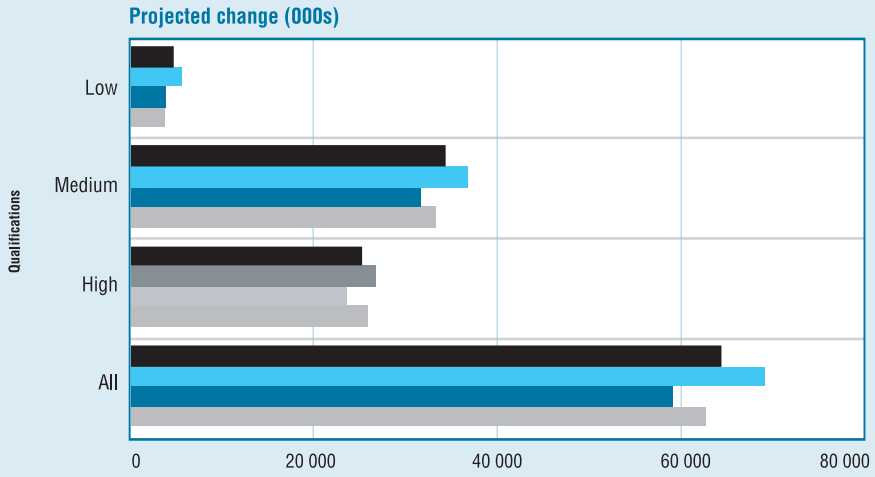


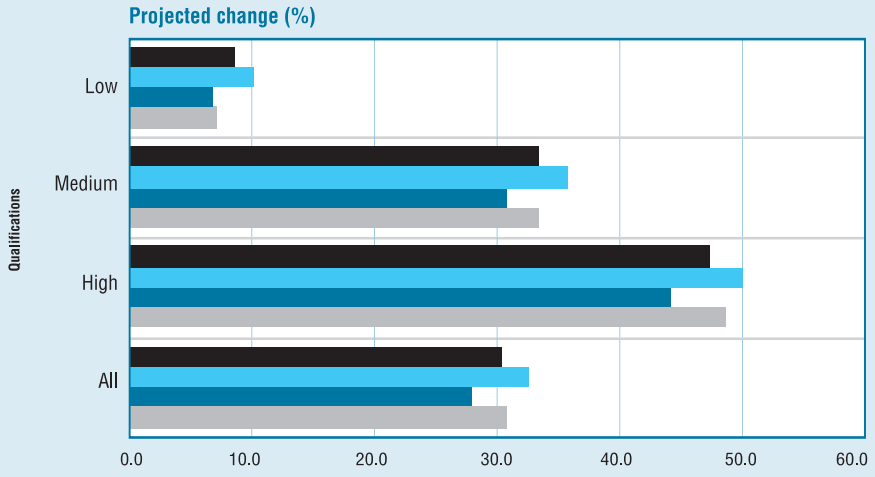


	All qualifications		High qualification		Medium qualification		Low qualification	
	000s	%	000s	%	000s	%	000s	%
LFS (Base)	11 735	**5.8**	12 559	**23.7**	8 237	**8.4**	-9 151	**-17.9**
Low 2	8 054	**3.8**	10 660	**20.0**	6 898	**6.7**	-9 503	**-17.2**
High 1	17 961	**8.5**	13 801	**25.9**	11 853	**11.6**	-7 692	**-14.0**
Base 0	13 280	**6.3**	12 408	**23.3**	9 461	**9.2**	-8 588	**-15.6**

Source: IER estimates based on Cambridge Econometrics E3ME model.

Figure 15. **Scenarios compared: total requirements by qualification, 2006-15, EU-25+**





	All qualifications		High qualification		Medium qualification		Low qualification	
	000s	%	000s	%	000s	%	000s	%
LFS (Base)	62 736	**30.9**	25 870	**48.8**	33 171	**33.5**	3 695	**7.2**
Low 2	59 055	**28.0**	23 554	**44.2**	31 663	**31.0**	3 838	**7.0**
High 1	68 962	**32.7**	26 695	**50.1**	36 618	**35.8**	5 649	**10.3**
Base 0	64 281	**30.5**	25 302	**47.5**	34 226	**33.5**	4 753	**8.6**

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 9. **Scenarios compared: total requirements by qualification, EU-25+**

Qualifications	National accounts				Labour force survey	
	Level in 2006	Change 2006-2015			Level in 2006	Change 2006-15 LFS (base) scenario
		Base 0 scenario	High 1 scenario	Low 2 scenario		
Levels and net change (000s)						
Low qualification	55 104	4 753	5 649	3 838	51 174	3 695
Medium qualification	102 291	34 226	36 618	31 663	98 967	33 171
High qualification	53 261	25 302	26 695	23 554	53 022	25 870
All qualifications	210 656	64 281	68 962	59 055	203 163	62 736
Changes (%)						
Low qualification		8.6	10.3	7.0		7.2
Medium qualification		33.5	35.8	31.0		33.5
High qualification		47.5	50.1	44.2		48.8
All qualifications		30.5	32.7	28.0		30.9

Source: IER estimates based on Cambridge Econometrics E3ME Model.

CHAPTER 4

Detailed results: cross country comparisons

The results discussed so far have focused on the whole of Europe (EU-25+). This section presents a range of results which compare all the 27 European countries covered in the present analysis, highlighting some of the similarities and differences. As well as the EU-25 Member States as of December 2006, this includes Norway and Switzerland (referred to as EU-25+). More detailed information is available using the 27 occupations and 41 industries distinguished in the full database. The focus here is on broader industry and occupational categories. The tables in this section are intended to provide a taste of the detail available. The text provides some general guidance on interpretation but does not discuss the results in detail.

4.1. Detailed results by country and sector

Table 10 provides an overall summary of the employment estimates and projections by country. The table illustrates the relative sizes of the 27 countries in terms of total employment and shares of total European employment, as well as overall trends in each case (showing net and % changes over the two subperiods distinguished).

Tables 11 to 16 enable comparisons to be made across countries at sectoral level, focusing on six broad sectors. It is clear that, even at this broad level, there are some significant variations across countries, reflecting existing sectoral specialisation and their stages of economic development. Despite this, many common themes emerge in terms of changes over time at this broad level, notably the declining shares of primary and manufacturing sectors and the growth in services, especially business and other services.

Space does not permit a more detailed analysis by the 16 industries presented earlier or the 41 detailed industries which underlie those. These results illustrate more diverse patterns, with some countries benefiting from reallocation of activities within Europe. These in turn have different implications for skill requirements across countries.

Table 10. **Changes in employment by country**

All industries	Levels (000s)				Share of EU-25+ total (%)				Change 2006-2010			Change 2010-2015		
	1996	2006	2010	2015	1996	2006	2010	2015	000s	%	% p.a.	000s	%	% p.a.
Belgium	3 881	4 256	4 420	4 556	2.0	2.0	2.0	2.0	163	3.8	0.9	137	3.1	0.6
Czech Republic	5 195	5 076	5 148	5 247	2.7	2.4	2.4	2.3	72	1.4	0.4	99	1.9	0.4
Denmark	2 584	2 776	2 824	2 828	1.3	1.3	1.3	1.3	48	1.7	0.4	4	0.1	0.0
Germany	37 270	38 095	39 014	40 068	19.3	18.1	17.9	17.9	918	2.4	0.6	1 054	2.7	0.5
Estonia	609	634	614	610	0.3	0.3	0.3	0.3	-20	-3.2	-0.8	-4	-0.6	-0.1
Greece	3 805	4 203	4 398	4 522	2.0	2.0	2.0	2.0	195	4.6	1.1	125	2.8	0.6
Spain	13 744	19 181	19 892	20 453	7.1	9.1	9.2	9.1	711	3.7	0.9	561	2.8	0.6
France	22 780	25 135	25 993	26 913	11.8	11.9	12.0	12.0	858	3.4	0.8	920	3.5	0.7
Ireland	1 330	1 982	2 095	2 229	0.7	0.9	1.0	1.0	113	5.7	1.4	134	6.4	1.2
Italy	21 968	24 369	25 198	25 996	11.4	11.6	11.6	11.6	829	3.4	0.8	799	3.2	0.6
Cyprus	300	375	408	458	0.2	0.2	0.2	0.2	34	9.0	2.2	50	12.2	2.3
Latvia	944	1 034	1 057	1 053	0.5	0.5	0.5	0.5	22	2.1	0.5	-4	-0.4	-0.1
Lithuania	1 496	1 482	1 522	1 543	0.8	0.7	0.7	0.7	40	2.7	0.7	21	1.4	0.3
Luxembourg	220	311	328	351	0.1	0.1	0.2	0.2	17	5.5	1.3	23	7.0	1.4
Hungary	3 605	3 925	3 985	4 099	1.9	1.9	1.8	1.8	60	1.5	0.4	115	2.9	0.6
Malta	142	150	157	164	0.1	0.1	0.1	0.1	7	4.4	1.1	8	4.9	1.0
Netherlands	7 307	8 265	8 596	8 867	3.8	3.9	4.0	4.0	331	4.0	1.0	271	3.1	0.6
Norway	2 152	2 399	2 478	2 552	1.1	1.1	1.1	1.1	80	3.3	0.8	74	3.0	0.6
Austria	3 904	4 102	4 218	4 389	2.0	1.9	1.9	2.0	116	2.8	0.7	171	4.1	0.8
Poland	13 745	13 356	13 758	14 032	7.1	6.3	6.3	6.3	402	3.0	0.7	274	2.0	0.4
Portugal	4 555	5 025	5 132	5 345	2.4	2.4	2.4	2.4	106	2.1	0.5	213	4.2	0.8
Switzerland	3 957	4 252	4 517	4 551	2.1	2.0	2.1	2.0	265	6.2	1.5	34	0.8	0.2
Slovenia	894	904	943	977	0.5	0.4	0.4	0.4	39	4.3	1.1	34	3.6	0.7
Slovakia	2 156	2 086	2 116	2 104	1.1	1.0	1.0	0.9	30	1.4	0.4	-12	-0.6	-0.1
Finland	2 084	2 385	2 391	2 408	1.1	1.1	1.1	1.1	5	0.2	0.1	18	0.7	0.1
Sweden	4 066	4 311	4 364	4 407	2.1	2.0	2.0	2.0	53	1.2	0.3	43	1.0	0.2
United Kingdom	28 021	30 584	31 835	33 212	14.5	14.5	14.6	14.8	1251	4.1	1.0	1 377	4.3	0.9
EU-25+	192 714	210 656	217 399	223 936	100.0	100.0	100.0	100.0	6743	3.2	0.8	6 537	3.0	0.6
EU-25	186 604	204 005	210 403	216 832	96.8	96.8	96.8	96.8	6399	3.1	0.8	6 429	3.1	0.6

Source: IER estimates based on Cambridge Econometrics E3ME Model.

Table 11. **Changes in employment by country, primary sector and utilities**

Primary sector and utilities	Levels (000s)				Share of EU-25+ total (%)				Change 2006-2010			Change 2010-2015		
	1996	2006	2010	2015	1996	2006	2010	2015	000s	%	% p.a.	000s	%	% p.a.
Belgium	137	110	100	89	0.9	0.9	0.9	0.9	-10	-8.8	-2.3	-11	-10.7	-2.2
Czech Republic	495	303	293	281	3.3	2.5	2.7	2.9	-11	-3.6	-0.9	-11	-3.8	-0.8
Denmark	133	114	102	95	0.9	1.0	1.0	1.0	-13	-11.2	-2.9	-7	-6.7	-1.4
Germany	1 541	1 197	1 063	953	10.2	10.0	10.0	9.9	-134	-11.2	-2.9	-110	-10.4	-2.2
Estonia	75	47	43	36	0.5	0.4	0.4	0.4	-4	-9.1	-2.4	-7	-16.1	-3.4
Greece	798	607	564	518	5.3	5.1	5.3	5.4	-43	-7.0	-1.8	-46	-8.2	-1.7
Spain	1 211	1 104	916	734	8.0	9.3	8.6	7.6	-189	-17.1	-4.6	-182	-19.9	-4.3
France	1 247	1 082	1 041	1 076	8.3	9.1	9.8	11.2	-40	-3.7	-0.9	34	3.3	0.6
Ireland	158	133	119	110	1.1	1.1	1.1	1.1	-14	-10.7	-2.8	-9	-7.9	-1.6
Italy	1 458	1 046	963	801	9.7	8.8	9.0	8.3	-83	-7.9	-2.0	-162	-16.8	-3.6
Cyprus	23	18	18	18	0.2	0.2	0.2	0.2	0	0.0	0.0	0	0.0	0.0
Latvia	182	139	122	99	1.2	1.2	1.1	1.0	-17	-12.1	-3.2	-23	-18.8	-4.1
Lithuania	346	215	165	123	2.3	1.8	1.5	1.3	-50	-23.3	-6.4	-42	-25.4	-5.7
Luxembourg	6	6	6	5	0.0	0.0	0.1	0.1	0	-1.8	-0.4	0	-7.1	-1.5
Hungary	424	274	256	239	2.8	2.3	2.4	2.5	-18	-6.5	-1.7	-17	-6.6	-1.4
Malta	7	6	5	5	0.0	0.0	0.1	0.1	0	-5.3	-1.3	0	-3.7	-0.8
Netherlands	343	301	290	277	2.3	2.5	2.7	2.9	-11	-3.6	-0.9	-13	-4.4	-0.9
Norway	145	122	106	89	1.0	1.0	1.0	0.9	-17	-13.5	-3.6	-17	-16.0	-3.4
Austria	637	534	515	487	4.2	4.5	4.8	5.1	-19	-3.5	-0.9	-28	-5.5	-1.1
Poland	3 380	2 752	2 263	2 018	22.5	23.1	21.2	21.0	-490	-17.8	-4.8	-245	-10.8	-2.3
Portugal	587	534	510	483	3.9	4.5	4.8	5.0	-24	-4.4	-1.1	-27	-5.4	-1.1
Switzerland	215	176	151	130	1.4	1.5	1.4	1.3	-26	-14.6	-3.9	-21	-13.7	-2.9
Slovenia	143	106	90	74	0.9	0.9	0.8	0.8	-16	-15.4	-4.1	-15	-17.1	-3.7
Slovakia	234	125	113	102	1.6	1.1	1.1	1.1	-12	-9.6	-2.5	-11	-9.6	-2.0
Finland	179	134	121	110	1.2	1.1	1.1	1.1	-13	-9.8	-2.5	-10	-8.5	-1.8
Sweden	164	143	136	129	1.1	1.2	1.3	1.3	-6	-4.6	-1.2	-7	-5.4	-1.1
United Kingdom	784	590	598	548	5.2	4.9	5.6	5.7	8	1.3	0.3	-50	-8.4	-1.7
EU-25+	15 052	11 917	10 667	9 629	100.0	100.0	100.0	100.0	-1 251	-10.5	-2.7	-1038	-9.7	-2.0
EU-25	14 692	11 619	10 411	9 410	97.6	97.5	97.6	97.7	-1 208	-10.4	-2.7	-1000	-9.6	-2.0

Source: IER estimates based on Cambridge Econometrics E3ME Model.

Table 12. **Changes in employment by country, manufacturing**

Manufacturing	Levels (000s)				Share of EU-25+ total (%)				Change 2006-2010			Change 2010-2015		
	1996	2006	2010	2015	1996	2006	2010	2015	000s	%	% p.a.	000s	%	% p.a.
Belgium	669	596	568	538	1.8	1.7	1.6	1.6	-28	-4.7	-1.2	-30	-5.3	-1.1
Czech Republic	1 458	1 356	1 394	1 445	3.9	3.9	4.0	4.2	38	2.8	0.7	51	3.7	0.7
Denmark	456	409	387	381	1.2	1.2	1.1	1.1	-22	-5.4	-1.4	-6	-1.6	-0.3
Germany	8 212	7 400	7 637	7 285	21.7	21.2	21.7	21.2	237	3.2	0.8	-352	-4.6	-0.9
Estonia	148	135	141	144	0.4	0.4	0.4	0.4	6	4.3	1.1	4	2.6	0.5
Greece	626	566	568	558	1.7	1.6	1.6	1.6	2	0.4	0.1	-10	-1.8	-0.4
Spain	2 513	3 071	3 051	2 990	6.6	8.8	8.7	8.7	-20	-0.6	-0.2	-61	-2.0	-0.4
France	3 678	3 392	3 314	3 230	9.7	9.7	9.4	9.4	-78	-2.3	-0.6	-85	-2.5	-0.5
Ireland	256	270	263	262	0.7	0.8	0.7	0.8	-7	-2.8	-0.7	-1	-0.3	-0.1
Italy	5 005	4 971	4 985	4 933	13.2	14.3	14.1	14.3	14	0.3	0.1	-52	-1.1	-0.2
Cyprus	42	37	38	39	0.1	0.1	0.1	0.1	1	3.2	0.8	1	1.6	0.3
Latvia	179	164	164	148	0.5	0.5	0.5	0.4	0	-0.1	0.0	-16	-9.9	-2.1
Lithuania	278	256	248	234	0.7	0.7	0.7	0.7	-8	-3.2	-0.8	-15	-5.9	-1.2
Luxembourg	31	32	33	33	0.1	0.1	0.1	0.1	1	3.5	0.9	0	1.2	0.2
Hungary	851	869	838	805	2.3	2.5	2.4	2.3	-32	-3.6	-0.9	-32	-3.9	-0.8
Malta	33	29	29	28	0.1	0.1	0.1	0.1	0	-0.3	-0.1	0	-0.4	-0.1
Netherlands	1 051	969	1 000	950	2.8	2.8	2.8	2.8	31	3.2	0.8	-50	-5.0	-1.0
Norway	304	280	284	285	0.8	0.8	0.8	0.8	4	1.4	0.3	1	0.5	0.1
Austria	685	644	626	612	1.8	1.8	1.8	1.8	-18	-2.7	-0.7	-15	-2.3	-0.5
Poland	3 096	2 637	3 065	3 091	8.2	7.6	8.7	9.0	429	16.3	3.8	25	0.8	0.2
Portugal	989	879	845	854	2.6	2.5	2.4	2.5	-33	-3.8	-1.0	9	1.0	0.2
Switzerland	742	661	702	698	2.0	1.9	2.0	2.0	42	6.3	1.5	-5	-0.7	-0.1
Slovenia	269	242	244	246	0.7	0.7	0.7	0.7	3	1.0	0.3	2	0.9	0.2
Slovakia	590	498	499	447	1.6	1.4	1.4	1.3	1	0.2	0.1	-52	-10.4	-2.2
Finland	417	417	402	394	1.1	1.2	1.1	1.1	-16	-3.7	-0.9	-8	-2.0	-0.4
Sweden	742	702	708	727	2.0	2.0	2.0	2.1	6	0.9	0.2	19	2.7	0.5
United Kingdom	4 480	3 391	3 223	3 060	11.9	9.7	9.1	8.9	-168	-4.9	-1.3	-163	-5.1	-1.0
EU-25+	37 802	34 871	35 256	34 414	100.0	100.0	100.0	100.0	385	1.1	0.3	-842	-2.4	-0.5
EU-25	36 755	33 931	34 270	33 431	97.2	97.3	97.2	97.1	339	1.0	0.2	-838	-2.4	-0.5

Source: IER estimates based on Cambridge Econometrics E3ME Model.

Table 13. **Changes in employment by country, construction**

Construction	Levels (000s)				Share of EU-25+ total (%)				Change 2006-2010			Change 2010-2015		
	1996	2006	2010	2015	1996	2006	2010	2015	000s	%	% p.a.	000s	%	% p.a.
Belgium	233	247	258	263	1.7	1.6	1.7	1.7	11	4.5	1.1	5	1.8	0.4
Czech Republic	508	432	415	395	3.7	2.9	2.7	2.5	-17	-3.9	-1.0	-20	-4.9	-1.0
Denmark	148	174	181	177	1.1	1.1	1.2	1.1	7	4.0	1.0	-5	-2.5	-0.5
Germany	3 126	2 139	2 087	2 024	22.8	14.1	13.4	13.0	-52	-2.4	-0.6	-64	-3.0	-0.6
Estonia	35	58	47	43	0.3	0.4	0.3	0.3	-11	-19.7	-5.3	-3	-7.3	-1.5
Greece	252	348	396	402	1.8	2.3	2.5	2.6	48	13.9	3.3	6	1.5	0.3
Spain	1 243	2 383	2 487	2 392	9.1	15.7	15.9	15.3	104	4.4	1.1	-95	-3.8	-0.8
France	1 426	1 601	1 661	1 657	10.4	10.6	10.6	10.6	60	3.7	0.9	-4	-0.2	0.0
Ireland	101	251	259	268	0.7	1.7	1.7	1.7	9	3.4	0.8	9	3.3	0.6
Italy	1 469	1 831	1 801	1 765	10.7	12.1	11.5	11.3	-29	-1.6	-0.4	-36	-2.0	-0.4
Cyprus	28	37	41	48	0.2	0.2	0.3	0.3	5	12.5	3.0	7	16.0	3.0
Latvia	51	90	98	105	0.4	0.6	0.6	0.7	8	8.8	2.1	7	7.2	1.4
Lithuania	99	146	195	205	0.7	1.0	1.2	1.3	49	33.3	7.4	10	5.1	1.0
Luxembourg	24	30	31	33	0.2	0.2	0.2	0.2	1	4.7	1.2	2	6.1	1.2
Hungary	218	319	355	408	1.6	2.1	2.3	2.6	37	11.6	2.8	52	14.7	2.8
Malta	6	8	9	10	0.0	0.1	0.1	0.1	1	14.1	3.4	1	9.0	1.7
Netherlands	445	499	524	557	3.2	3.3	3.4	3.6	25	4.9	1.2	33	6.2	1.2
Norway	120	145	148	152	0.9	1.0	0.9	1.0	3	2.0	0.5	4	2.4	0.5
Austria	297	267	265	263	2.2	1.8	1.7	1.7	-2	-0.7	-0.2	-2	-0.9	-0.2
Poland	843	678	812	802	6.1	4.5	5.2	5.1	134	19.8	4.6	-11	-1.3	-0.3
Portugal	398	462	472	484	2.9	3.1	3.0	3.1	9	2.0	0.5	12	2.5	0.5
Switzerland	314	306	313	300	2.3	2.0	2.0	1.9	7	2.3	0.6	-13	-4.0	-0.8
Slovenia	58	66	74	82	0.4	0.4	0.5	0.5	8	12.1	2.9	8	10.4	2.0
Slovakia	158	138	154	161	1.2	0.9	1.0	1.0	16	11.4	2.7	7	4.6	0.9
Finland	123	166	170	175	0.9	1.1	1.1	1.1	4	2.2	0.6	5	2.9	0.6
Sweden	209	248	211	202	1.5	1.6	1.4	1.3	-38	-15.1	-4.0	-9	-4.3	-0.9
United Kingdom	1 797	2 073	2 136	2 216	13.1	13.7	13.7	14.2	62	3.0	0.7	81	3.8	0.7
EU-25+	13 729	15 141	15 598	15 583	100.0	100.0	100.0	100.0	457	3.0	0.7	-15	-0.1	0.0
EU-25	13 295	14 690	15 137	15 131	96.8	97.0	97.0	97.1	447	3.0	0.8	-6	0.0	0.0

Source: IER estimates based on Cambridge Econometrics E3ME Model.

Table 14. **Changes in employment by country, distribution and transport**

Distribution and transport	Levels (000s)				Share of EU-25+ total (%)				Change 2006-2010			Change 2010-2015		
	1996	2006	2010	2015	1996	2006	2010	2015	000s	%	% p.a.	000s	%	% p.a.
Belgium	982	1 050	1 094	1107	2.0	1.9	1.9	1.9	43	4.1	1.0	13	1.2	0.2
Czech Republic	1 259	1 287	1 324	1364	2.6	2.4	2.4	2.4	37	2.8	0.7	40	3.0	0.6
Denmark	661	719	729	724	1.4	1.3	1.3	1.3	10	1.4	0.3	-4	-0.6	-0.1
Germany	9 326	9 482	9 645	9758	19.3	17.5	17.2	16.9	162	1.7	0.4	113	1.2	0.2
Estonia	160	170	160	155	0.3	0.3	0.3	0.3	-10	-6.2	-1.6	-4	-2.7	-0.5
Greece	1 027	1 272	1 382	1490	2.1	2.3	2.5	2.6	110	8.7	2.1	109	7.9	1.5
Spain	3 747	5 333	5 775	6194	7.7	9.8	10.3	10.7	442	8.3	2.0	419	7.3	1.4
France	5 169	5 933	6 131	6322	10.7	10.9	10.9	10.9	198	3.3	0.8	191	3.1	0.6
Ireland	322	518	545	579	0.7	1.0	1.0	1.0	27	5.2	1.3	34	6.3	1.2
Italy	5 346	5 937	6 013	6102	11.1	10.9	10.7	10.6	77	1.3	0.3	89	1.5	0.3
Cyprus	104	133	144	156	0.2	0.2	0.3	0.3	10	7.6	1.8	13	8.9	1.7
Latvia	217	287	295	298	0.4	0.5	0.5	0.5	9	3.0	0.8	3	1.0	0.2
Lithuania	325	387	424	466	0.7	0.7	0.8	0.8	37	9.4	2.3	43	10.1	1.9
Luxembourg	62	83	88	96	0.1	0.2	0.2	0.2	5	5.8	1.4	8	8.5	1.6
Hungary	922	1 029	1 053	1070	1.9	1.9	1.9	1.9	24	2.3	0.6	17	1.6	0.3
Malta	38	41	45	49	0.1	0.1	0.1	0.1	3	7.7	1.9	5	10.3	2.0
Netherlands	1 873	2 168	2 237	2308	3.9	4.0	4.0	4.0	69	3.2	0.8	71	3.2	0.6
Norway	568	617	633	656	1.2	1.1	1.1	1.1	16	2.6	0.6	23	3.6	0.7
Austria	1 047	1 135	1 159	1191	2.2	2.1	2.1	2.1	24	2.1	0.5	32	2.7	0.5
Poland	2 954	2 997	3 116	3229	6.1	5.5	5.6	5.6	119	4.0	1.0	113	3.6	0.7
Portugal	1 014	1 275	1 393	1506	2.1	2.4	2.5	2.6	118	9.3	2.2	113	8.1	1.6
Switzerland	1 153	1 158	1 139	1123	2.4	2.1	2.0	1.9	-20	-1.7	-0.4	-16	-1.4	-0.3
Slovenia	194	200	216	226	0.4	0.4	0.4	0.4	16	7.8	1.9	10	4.5	0.9
Slovakia	494	584	564	557	1.0	1.1	1.0	1.0	-21	-3.6	-0.9	-6	-1.1	-0.2
Finland	476	557	559	563	1.0	1.0	1.0	1.0	2	0.3	0.1	4	0.7	0.1
Sweden	902	958	976	995	1.9	1.8	1.7	1.7	18	1.9	0.5	18	1.9	0.4
United Kingdom	8 014	8 931	9 243	9457	16.6	16.5	16.5	16.4	313	3.5	0.9	213	2.3	0.5
EU-25+	48 356	54 242	56 078	57740	100.0	100.0	100.0	100.0	1 836	3.4	0.8	1 662	3.0	0.6
EU-25	46 635	52 466	54 306	55961	96.4	96.7	96.8	96.9	1 840	3.5	0.9	1 655	3.0	0.6

Source: IER estimates based on Cambridge Econometrics E3ME Model.

Table 15. **Changes in employment by country, business and other services**

Business and other services	Levels (000s)				Share of EU-25+ total (%)				Change 2006-2010			Change 2010-2015		
	1996	2006	2010	2015	1996	2006	2010	2015	000s	%	% p.a.	000s	%	% p.a.
Belgium	808	1 021	1 111	1 213	2.4	2.2	2.2	2.2	90	8.8	2.1	102	9.2	1.8
Czech Republic	646	831	867	914	1.9	1.8	1.7	1.7	35	4.2	1.0	47	5.4	1.1
Denmark	414	525	561	563	1.2	1.1	1.1	1.0	37	7.0	1.7	2	0.3	0.1
Germany	6 748	9 005	9 452	10 367	19.8	19.7	19.0	19.0	447	5.0	1.2	915	9.7	1.9
Estonia	65	89	91	99	0.2	0.2	0.2	0.2	2	2.5	0.6	7	8.1	1.6
Greece	432	641	690	724	1.3	1.4	1.4	1.3	50	7.7	1.9	34	4.9	1.0
Spain	2 290	3 761	4 011	4 330	6.7	8.2	8.1	7.9	250	6.7	1.6	320	8.0	1.5
France	4 587	5 920	6 413	6 900	13.5	13.0	12.9	12.6	492	8.3	2.0	488	7.6	1.5
Ireland	209	392	452	510	0.6	0.9	0.9	0.9	60	15.4	3.6	58	12.9	2.5
Italy	4 329	6 042	6 726	7 474	12.7	13.2	13.6	13.7	684	11.3	2.7	748	11.1	2.1
Cyprus	50	78	95	118	0.1	0.2	0.2	0.2	16	20.7	4.8	23	24.4	4.5
Latvia	101	139	150	158	0.3	0.3	0.3	0.3	11	8.1	2.0	8	5.3	1.0
Lithuania	120	159	173	189	0.4	0.3	0.3	0.3	14	8.6	2.1	16	9.4	1.8
Luxembourg	60	108	117	128	0.2	0.2	0.2	0.2	8	7.8	1.9	12	9.9	1.9
Hungary	382	546	591	664	1.1	1.2	1.2	1.2	45	8.3	2.0	73	12.3	2.4
Malta	24	29	32	34	0.1	0.1	0.1	0.1	2	7.5	1.8	2	7.3	1.4
Netherlands	1 889	2 267	2 444	2 607	5.6	5.0	4.9	4.8	178	7.8	1.9	163	6.7	1.3
Norway	291	409	451	491	0.9	0.9	0.9	0.9	42	10.4	2.5	39	8.7	1.7
Austria	507	691	783	917	1.5	1.5	1.6	1.7	92	13.3	3.2	134	17.1	3.2
Poland	1 195	1 693	1 866	2 212	3.5	3.7	3.8	4.1	173	10.2	2.5	346	18.5	3.5
Portugal	692	835	875	987	2.0	1.8	1.8	1.8	40	4.8	1.2	112	12.8	2.4
Switzerland	768	1 009	1 252	1 316	2.3	2.2	2.5	2.4	243	24.1	5.6	64	5.1	1.0
Slovenia	101	130	151	166	0.3	0.3	0.3	0.3	21	16.3	3.8	15	9.9	1.9
Slovakia	233	287	325	354	0.7	0.6	0.7	0.6	38	13.2	3.1	29	8.8	1.7
Finland	303	426	451	482	0.9	0.9	0.9	0.9	25	5.9	1.4	31	6.9	1.3
Sweden	718	885	979	1 043	2.1	1.9	2.0	1.9	94	10.6	2.6	64	6.6	1.3
United Kingdom	6 060	7 722	8 519	9 601	17.8	16.9	17.2	17.6	797	10.3	2.5	1 082	12.7	2.4
EU-25+	34 022	45 638	49 626	54 559	100.0	100.0	100.0	100.0	3 988	8.7	2.1	4 933	9.9	1.9
EU-25	32 962	44 220	47 922	52 753	96.9	96.9	96.6	96.7	3 702	8.4	2.0	4 831	10.1	1.9

Source: IER estimates based on Cambridge Econometrics E3ME Model.

Table 16. **Changes in employment by country, non-marketed services**

Non-marketed services	Levels (000s)				Share of EU-25+ total (%)				Change 2006-2010			Change 2010-2015		
	1996	2006	2010	2015	1996	2006	2010	2015	000s	%	% p.a.	000s	%	% p.a.
Belgium	1 053	1 232	1 289	1 347	2.4	2.5	2.6	2.6	57	4.6	1.1	58	4.5	0.9
Czech Republic	828	866	856	848	1.9	1.8	1.7	1.6	-10	-1.1	-0.3	-8	-0.9	-0.2
Denmark	772	836	865	889	1.8	1.7	1.7	1.7	29	3.5	0.9	24	2.8	0.6
Germany	8 317	8 871	9 129	9 682	19.0	18.2	18.2	18.6	258	2.9	0.7	553	6.1	1.2
Estonia	125	135	133	133	0.3	0.3	0.3	0.3	-2	-1.6	-0.4	0	-0.2	0.0
Greece	671	770	798	831	1.5	1.6	1.6	1.6	28	3.6	0.9	33	4.1	0.8
Spain	2 740	3 530	3 653	3 814	6.3	7.2	7.3	7.3	123	3.5	0.9	161	4.4	0.9
France	6 673	7 207	7 433	7 729	15.3	14.8	14.8	14.9	226	3.1	0.8	296	4.0	0.8
Ireland	284	418	457	500	0.6	0.9	0.9	1.0	39	9.3	2.3	43	9.5	1.8
Italy	4 361	4 543	4 709	4 921	10.0	9.3	9.4	9.5	167	3.7	0.9	212	4.5	0.9
Cyprus	54	71	73	79	0.1	0.1	0.1	0.2	2	2.3	0.6	7	9.5	1.8
Latvia	214	216	227	245	0.5	0.4	0.5	0.5	11	5.3	1.3	17	7.5	1.5
Lithuania	328	319	318	327	0.7	0.7	0.6	0.6	-1	-0.2	0.0	9	2.8	0.6
Luxembourg	36	52	54	56	0.1	0.1	0.1	0.1	1	2.7	0.7	2	3.5	0.7
Hungary	809	889	892	914	1.8	1.8	1.8	1.8	3	0.4	0.1	22	2.4	0.5
Malta	34	37	38	38	0.1	0.1	0.1	0.1	0	1.3	0.3	0	0.8	0.2
Netherlands	1 706	2 061	2 102	2 168	3.9	4.2	4.2	4.2	40	2.0	0.5	66	3.1	0.6
Norway	724	826	857	881	1.7	1.7	1.7	1.7	31	3.7	0.9	24	2.8	0.6
Austria	731	832	870	921	1.7	1.7	1.7	1.8	38	4.6	1.1	51	5.8	1.1
Poland	2 277	2 599	2 636	2 681	5.2	5.3	5.3	5.2	37	1.4	0.4	45	1.7	0.3
Portugal	875	1 042	1 037	1 032	2.0	2.1	2.1	2.0	-5	-0.4	-0.1	-5	-0.5	-0.1
Switzerland	765	943	961	985	1.7	1.9	1.9	1.9	19	2.0	0.5	24	2.5	0.5
Slovenia	130	160	168	183	0.3	0.3	0.3	0.4	8	5.1	1.3	14	8.6	1.7
Slovakia	445	453	462	483	1.0	0.9	0.9	0.9	8	1.8	0.5	22	4.7	0.9
Finland	586	685	688	684	1.3	1.4	1.4	1.3	4	0.5	0.1	-4	-0.6	-0.1
Sweden	1 331	1 375	1 354	1 311	3.0	2.8	2.7	2.5	-22	-1.6	-0.4	-43	-3.2	-0.6
United Kingdom	6 886	7 878	8 117	8 331	15.7	16.1	16.2	16.0	239	3.0	0.7	215	2.6	0.5
EU-25+	43 753	48 846	50 175	52 011	100.0	100.0	100.0	100.0	1 329	2.7	0.7	1 837	3.7	0.7
EU-25	42 265	47 078	48 357	50 145	96.6	96.4	96.4	96.4	1 279	2.7	0.7	1 789	3.7	0.7

Source: IER estimates based on Cambridge Econometrics E3ME Model.

4.2. Detailed results by country and occupation

Tables 17 to 22 illustrate how occupational employment structures vary across Europe, as well as showing how changes over time compare. Tables 17 to 19 focus on overall level, shares within Europe and occupational structures within countries. The last three tables show the projected changes in absolute, percentage and annual percentage terms.

As for sectors there are many common themes but also many differences, especially at the more detailed levels.

These results are crucially dependent upon:

(a) the original LFS data (however LFS has only been used for shares, absolute numbers have been taken from NA);
(b) the method used for projections.

Livanos and Wilson (2007c) discuss these points in some detail. In the present set of results the preferred models for projecting occupational and qualification shares within each sector are based on time series extrapolations. The data available in each country on a consistent basis vary considerably and this limits the level of sophistication that can be adopted. In some cases only short time series are available. In others there are more years but discontinuities which prevent them all being used.

The default model is a logistic specification, with time as the only independent variable, fitted on published LFS data for the period 1993-2006. Where data are unavailable, or inappropriate due to data missing or inconsistently classified due to changes in classification or other discontinuities, the estimation period is truncated accordingly. It is clear that there is considerable room for improvement in the basic data for many countries and this should be a priority for future research.

Despite these problems, at a broad level the results are robust and show many similar patterns across countries and over time. Table 18 presents row % which shows the occupational structure at the broad one-digit level for all 27 countries. The dependence of some countries on skilled agricultural jobs is clear, as is the importance of service workers or professionals in others. Some countries are clearly much further down the road towards a knowledge intensive economy than others.

It is also apparent that there are still some peculiarities in classification between countries. The UK for example apparently employs far more managers than most other countries. This may reflect differences in coding practices and classification rather than real structural differences when compared to similar economies. The share of managers in total employment

Table 17. **Occupational employment by country, 2006 (000s)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	30	489	884	498	645	451	90	412	349	408	4256
Czech Republic	16	339	559	1 119	352	631	79	891	785	305	5 076
Denmark	16	220	420	578	269	437	70	297	172	298	2 776
Germany	193	2 162	5 025	7 963	4 687	5 124	671	5 639	2 602	4 031	38 095
Estonia	4	80	98	79	28	77	12	103	96	57	634
Greece	43	430	475	313	455	594	529	634	351	380	4 203
Spain	101	1 322	2 038	2 018	1 689	3 069	553	3 198	1 811	3 382	19 181
France	279	2 082	3 382	4 341	3 020	3 122	946	2 926	2 220	2 816	25 135
Ireland	6	320	308	126	260	318	15	286	174	168	1 982
Italy	237	2 153	1 925	4 845	2 549	3 027	488	4 169	2 183	2 793	24 369
Cyprus	4	12	42	44	57	66	10	50	25	64	375
Latvia	0	137	117	143	50	113	66	170	108	130	1 034
Lithuania	6	135	254	129	58	167	136	289	145	164	1 482
Luxembourg	1	24	51	45	47	29	4	39	22	48	311
Hungary	17	298	525	535	359	566	116	708	478	323	3 925
Malta	1	13	18	25	18	21	2	17	16	20	150
Netherlands	33	848	1 391	1 396	1 061	1 186	122	787	470	971	8 265
Norway	11	152	262	567	183	585	68	253	179	141	2 399
Austria	10	275	375	760	468	520	453	502	252	489	4 102
Poland	61	889	2 094	1 530	1 010	1 287	2 125	2 129	1 228	1 003	13 356
Portugal	34	400	484	492	521	708	470	929	385	603	5 025
Switzerland	4	280	727	836	560	604	156	641	214	230	4 252
Slovenia	4	63	145	152	73	90	69	108	137	62	904
Slovakia	11	131	245	404	138	314	22	345	298	177	2 086
Finland	12	233	391	393	158	397	104	297	192	206	2 385
Sweden	9	211	735	859	408	821	99	427	463	279	4 311
United Kingdom	71	4 703	4 377	3 762	4 194	5 168	313	2 603	1 960	3 433	30 584
EU-25+	1 215	18 405	27 349	33 952	23 317	29 490	7 789	28 845	17 314	22 980	210 656
EU-25	1 200	17 973	26 360	32 549	22 574	28 301	7 565	27 952	16 921	22 608	204 005

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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 18. **Occupational structure in each country, 2006 (row %)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	0.7	11.5	20.8	11.7	15.2	10.6	2.1	9.7	8.2	9.6	100.0
Czech Republic	0.3	6.7	11.0	22.0	6.9	12.4	1.6	17.5	15.5	6.0	100.0
Denmark	0.6	7.9	15.1	20.8	9.7	15.7	2.5	10.7	6.2	10.7	100.0
Germany	0.5	5.7	13.2	20.9	12.3	13.4	1.8	14.8	6.8	10.6	100.0
Estonia	0.6	12.6	15.5	12.5	4.4	12.1	1.9	16.3	15.1	9.0	100.0
Greece	1.0	10.2	11.3	7.5	10.8	14.1	12.6	15.1	8.4	9.0	100.0
Spain	0.5	6.9	10.6	10.5	8.8	16.0	2.9	16.7	9.4	17.6	100.0
France	1.1	8.3	13.5	17.3	12.0	12.4	3.8	11.6	8.8	11.2	100.0
Ireland	0.3	16.2	15.6	6.4	13.1	16.0	0.8	14.4	8.8	8.5	100.0
Italy	1.0	8.8	7.9	19.9	10.5	12.4	2.0	17.1	9.0	11.5	100.0
Cyprus	1.1	3.3	11.1	11.8	15.2	17.6	2.7	13.3	6.7	17.2	100.0
Latvia	0.0	13.3	11.3	13.8	4.9	11.0	6.3	16.4	10.5	12.6	100.0
Lithuania	0.4	9.1	17.1	8.7	3.9	11.3	9.1	19.5	9.8	11.1	100.0
Luxembourg	0.2	7.8	16.6	14.4	15.2	9.3	1.3	12.5	7.2	15.5	100.0
Hungary	0.4	7.6	13.4	13.6	9.2	14.4	3.0	18.0	12.2	8.2	100.0
Malta	0.7	8.9	11.7	16.8	12.1	13.7	1.2	11.5	10.4	13.0	100.0
Netherlands	0.4	10.3	16.8	16.9	12.8	14.3	1.5	9.5	5.7	11.7	100.0
Norway	0.5	6.3	10.9	23.6	7.6	24.4	2.8	10.5	7.5	5.9	100.0
Austria	0.2	6.7	9.1	18.5	11.4	12.7	11.0	12.2	6.1	11.9	100.0
Poland	0.5	6.7	15.7	11.5	7.6	9.6	15.9	15.9	9.2	7.5	100.0
Portugal	0.7	8.0	9.6	9.8	10.4	14.1	9.4	18.5	7.7	12.0	100.0
Switzerland	0.1	6.6	17.1	19.7	13.2	14.2	3.7	15.1	5.0	5.4	100.0
Slovenia	0.5	7.0	16.0	16.9	8.0	10.0	7.7	12.0	15.1	6.8	100.0
Slovakia	0.5	6.3	11.8	19.4	6.6	15.0	1.1	16.5	14.3	8.5	100.0
Finland	0.5	9.8	16.4	16.5	6.6	16.7	4.4	12.4	8.1	8.7	100.0
Sweden	0.2	4.9	17.0	19.9	9.5	19.0	2.3	9.9	10.7	6.5	100.0
United Kingdom	0.2	15.4	14.3	12.3	13.7	16.9	1.0	8.5	6.4	11.2	100.0
EU-25+	0.6	8.7	13.0	16.1	11.1	14.0	3.7	13.7	8.2	10.9	100.0
EU-25	0.6	8.8	12.9	16.0	11.1	13.9	3.7	13.7	8.3	11.1	100.0

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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 19. **Share of occupations within Europe, 2006 (column %)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	2.5	2.7	3.2	1.5	2.8	1.5	1.2	1.4	2.0	1.8	2.0
Czech Republic	1.3	1.8	2.0	3.3	1.5	2.1	1.0	3.1	4.5	1.3	2.4
Denmark	1.3	1.2	1.5	1.7	1.2	1.5	0.9	1.0	1.0	1.3	1.3
Germany	15.9	11.7	18.4	23.5	20.1	17.4	8.6	19.5	15.0	17.5	18.1
Estonia	0.3	0.4	0.4	0.2	0.1	0.3	0.2	0.4	0.6	0.2	0.3
Greece	3.6	2.3	1.7	0.9	1.9	2.0	6.8	2.2	2.0	1.7	2.0
Spain	8.4	7.2	7.5	5.9	7.2	10.4	7.1	11.1	10.5	14.7	9.1
France	22.9	11.3	12.4	12.8	13.0	10.6	12.1	10.1	12.8	12.3	11.9
Ireland	0.5	1.7	1.1	0.4	1.1	1.1	0.2	1.0	1.0	0.7	0.9
Italy	19.5	11.7	7.0	14.3	10.9	10.3	6.3	14.5	12.6	12.2	11.6
Cyprus	0.4	0.1	0.2	0.1	0.2	0.2	0.1	0.2	0.1	0.3	0.2
Latvia	0.0	0.7	0.4	0.4	0.2	0.4	0.8	0.6	0.6	0.6	0.5
Lithuania	0.5	0.7	0.9	0.4	0.2	0.6	1.7	1.0	0.8	0.7	0.7
Luxembourg	0.0	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1
Hungary	1.4	1.6	1.9	1.6	1.5	1.9	1.5	2.5	2.8	1.4	1.9
Malta	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Netherlands	2.7	4.6	5.1	4.1	4.6	4.0	1.6	2.7	2.7	4.2	3.9
Norway	0.9	0.8	1.0	1.7	0.8	2.0	0.9	0.9	1.0	0.6	1.1
Austria	0.8	1.5	1.4	2.2	2.0	1.8	5.8	1.7	1.5	2.1	1.9
Poland	5.0	4.8	7.7	4.5	4.3	4.4	27.3	7.4	7.1	4.4	6.3
Portugal	2.8	2.2	1.8	1.4	2.2	2.4	6.0	3.2	2.2	2.6	2.4
Switzerland	0.3	1.5	2.7	2.5	2.4	2.0	2.0	2.2	1.2	1.0	2.0
Slovenia	0.4	0.3	0.5	0.4	0.3	0.3	0.9	0.4	0.8	0.3	0.4
Slovakia	0.9	0.7	0.9	1.2	0.6	1.1	0.3	1.2	1.7	0.8	1.0
Finland	1.0	1.3	1.4	1.2	0.7	1.3	1.3	1.0	1.1	0.9	1.1
Sweden	0.8	1.1	2.7	2.5	1.8	2.8	1.3	1.5	2.7	1.2	2.0
United Kingdom	5.8	25.6	16.0	11.1	18.0	17.5	4.0	9.0	11.3	14.9	14.5
EU-25*	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EU-25	98.8	97.7	96.4	95.9	96.8	96.0	97.1	96.9	97.7	98.4	96.8

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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 20. **Projected employment change by country and occupation, 2006-15 (000s)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	-10	66	48	128	1	26	-11	-59	93	19	300
Czech Republic	1	-3	22	193	-7	2	-13	-136	171	-58	171
Denmark	0	20	88	86	-55	-24	-14	-26	-25	0	52
Germany	8	-83	518	325	-576	856	-144	135	-36	967	1 972
Estonia	1	-8	-1	-8	-1	15	-7	-25	3	7	-24
Greece	3	7	29	107	22	144	-96	-16	37	82	320
Spain	27	10	230	915	-160	538	-302	-233	-83	329	1 272
France	-37	333	317	455	-317	138	0	-181	-57	1 127	1 778
Ireland	-3	62	71	48	7	50	-5	11	-6	12	247
Italy	-5	571	358	1 262	239	250	-232	-773	-228	185	1 628
Cyprus	-1	3	13	16	17	-3	-3	4	2	35	84
Latvia	0	38	14	7	6	9	-30	-9	-17	-2	18
Lithuania	10	-25	74	10	-19	26	-64	27	0	23	61
Luxembourg	0	2	15	10	0	7	-1	-7	2	11	40
Hungary	-13	92	66	-11	28	36	-15	-104	54	42	175
Malta	1	4	-3	4	-2	4	0	2	-3	6	14
Netherlands	-11	-100	117	96	136	139	-28	-38	-22	312	602
Norway	-4	-40	62	114	-34	101	-34	3	-5	-11	153
Austria	0	26	64	186	-7	20	-32	-52	-51	133	287
Poland	1	183	586	137	97	-212	-624	361	88	59	676
Portugal	-9	45	197	4	34	15	-21	-78	69	63	319
Switzerland	0	62	222	80	-41	7	-39	-19	27	-1	299
Slovenia	0	19	58	40	-18	-5	-25	10	-13	8	73
Slovakia	5	10	26	31	-31	45	-2	-43	-6	-17	18
Finland	-2	120	23	45	-62	33	-30	-31	-28	-44	23
Sweden	-5	20	30	38	-45	69	4	-51	5	31	96
United Kingdom	-6	1 235	516	420	-484	238	61	-98	564	181	2 629
EU-25+	-51	2 671	3 762	4 739	-1 273	2 528	-1 707	-1 425	536	3 501	13 280
EU-25	-47	2 649	3 477	4 545	-1 198	2 419	-1 634	-1 410	514	3 512	12 828

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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 21. **Projected employment change by country and occupation, 2006-15 (%)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	-33.5	13.5	5.4	25.7	0.1	5.8	-12.6	-14.4	26.5	4.6	7.0
Czech Republic	3.9	-1.0	3.9	17.3	-2.0	0.3	-17.0	-15.2	21.7	-19.1	3.4
Denmark	-0.5	9.2	21.0	14.9	-20.5	-5.4	-20.6	-8.7	-14.3	0.1	1.9
Germany	4.3	-3.8	10.3	4.1	-12.3	16.7	-21.4	2.4	-1.4	24.0	5.2
Estonia	24.2	-10.4	-1.1	-10.5	-3.7	19.8	-59.7	-24.4	3.6	12.9	-3.8
Greece	6.3	1.7	6.1	34.1	4.9	24.2	-18.2	-2.5	10.6	21.6	7.6
Spain	26.4	0.8	11.3	45.3	-9.5	17.5	-54.6	-7.3	-4.6	9.7	6.6
France	-13.3	16.0	9.4	10.5	-10.5	4.4	0.0	-6.2	-2.6	40.0	7.1
Ireland	-44.4	19.2	23.1	37.9	2.7	15.7	-33.4	3.7	-3.7	7.4	12.4
Italy	-2.2	26.5	18.6	26.1	9.4	8.3	-47.5	-18.5	-10.4	6.6	6.7
Cyprus	-19.6	28.6	32.1	36.2	29.2	-4.1	-25.1	7.8	6.8	53.8	22.3
Latvia	0.0	27.7	12.1	5.2	12.4	8.4	-45.7	-5.3	-15.5	-1.2	1.7
Lithuania	165.6	-18.9	29.3	8.0	-32.9	15.6	-47.3	9.2	-0.1	13.9	4.1
Luxembourg	-31.4	7.4	30.0	21.3	0.0	24.8	-12.5	-17.3	9.3	23.2	12.8
Hungary	-80.4	30.9	12.5	-2.0	7.7	6.4	-13.3	-14.7	11.3	13.1	4.4
Malta	110.7	30.4	-16.2	17.7	-10.6	21.6	3.1	11.1	-17.3	28.9	9.5
Netherlands	-34.7	-11.8	8.4	6.9	12.8	11.8	-22.9	-4.8	-4.6	32.1	7.3
Norway	-32.7	-26.3	23.7	20.2	-18.4	17.3	-50.6	1.3	-3.0	-7.7	6.4
Austria	4.0	9.6	16.9	24.4	-1.5	3.9	-7.1	-10.4	-20.1	27.2	7.0
Poland	1.5	20.6	28.0	8.9	9.6	-16.5	-29.3	17.0	7.2	5.8	5.1
Portugal	-28.1	11.3	40.8	0.8	6.6	2.1	-4.5	-8.4	18.0	10.5	6.4
Switzerland	-4.1	22.2	30.6	9.6	-7.4	1.2	-24.8	-2.9	12.4	-0.2	7.0
Slovenia	-7.0	29.8	39.7	26.1	-25.0	-5.8	-35.5	9.6	-9.6	13.2	8.1
Slovakia	45.6	7.6	10.6	7.6	-22.3	14.5	-8.3	-12.4	-2.1	-9.8	0.9
Finland	-15.1	51.5	5.9	11.4	-39.5	8.2	-29.2	-10.4	-14.8	-21.3	1.0
Sweden	-58.7	9.6	4.0	4.5	-11.1	8.4	4.3	-12.0	1.0	11.1	2.2
United Kingdom	-8.5	26.3	11.8	11.2	-11.5	4.6	19.5	-3.8	28.8	5.3	8.6
EU-25*	-4.2	14.5	13.8	14.0	-5.5	8.6	-21.9	-4.9	3.1	15.2	6.3
EU-25	-3.9	14.7	13.2	14.0	-5.3	8.5	-21.6	-5.0	3.0	15.5	6.3

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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 22. **Projected employment growth, 2006-15 (annual %)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	-4.4	1.4	0.6	2.6	0.0	0.6	-1.5	-1.7	2.6	0.5	0.8
Czech Republic	0.4	-0.1	0.4	1.8	-0.2	0.0	-2.1	-1.8	2.2	-2.3	0.4
Denmark	-0.1	1.0	2.1	1.6	-2.5	-0.6	-2.5	-1.0	-1.7	0.0	0.2
Germany	0.5	-0.4	1.1	0.4	-1.4	1.7	-2.6	0.3	-0.2	2.4	0.6
Estonia	2.4	-1.2	-0.1	-1.2	-0.4	2.0	-9.6	-3.1	0.4	1.4	-0.4
Greece	0.7	0.2	0.7	3.3	0.5	2.4	-2.2	-0.3	1.1	2.2	0.8
Spain	2.6	0.1	1.2	4.2	-1.1	1.8	-8.4	-0.8	-0.5	1.0	0.7
France	-1.6	1.7	1.0	1.1	-1.2	0.5	0.0	-0.7	-0.3	3.8	0.8
Ireland	-6.3	2.0	2.3	3.6	0.3	1.6	-4.4	0.4	-0.4	0.8	1.3
Italy	-0.2	2.6	1.9	2.6	1.0	0.9	-6.9	-2.3	-1.2	0.7	0.7
Cyprus	-2.4	2.8	3.1	3.5	2.9	-0.5	-3.2	0.8	0.7	4.9	2.3
Latvia	0.0	2.8	1.3	0.6	1.3	0.9	-6.6	-0.6	-1.9	-0.1	0.2
Lithuania	11.5	-2.3	2.9	0.9	-4.3	1.6	-6.9	1.0	0.0	1.5	0.5
Luxembourg	-4.1	0.8	3.0	2.2	0.0	2.5	-1.5	-2.1	1.0	2.3	1.3
Hungary	-16.6	3.0	1.3	-0.2	0.8	0.7	-1.6	-1.7	1.2	1.4	0.5
Malta	8.6	3.0	-1.9	1.8	-1.2	2.2	0.3	1.2	-2.1	2.9	1.0
Netherlands	-4.6	-1.4	0.9	0.7	1.3	1.2	-2.8	-0.5	-0.5	3.1	0.8
Norway	-4.3	-3.3	2.4	2.1	-2.2	1.8	-7.5	0.1	-0.3	-0.9	0.7
Austria	0.4	1.0	1.8	2.5	-0.2	0.4	-0.8	-1.2	-2.5	2.7	0.8
Poland	0.2	2.1	2.8	1.0	1.0	-2.0	-3.8	1.8	0.8	0.6	0.6
Portugal	-3.6	1.2	3.9	0.1	0.7	0.2	-0.5	-1.0	1.9	1.1	0.7
Switzerland	-0.5	2.3	3.0	1.0	-0.8	0.1	-3.1	-0.3	1.3	0.0	0.8
Slovenia	-0.8	2.9	3.8	2.6	-3.1	-0.7	-4.8	1.0	-1.1	1.4	0.9
Slovakia	4.3	0.8	1.1	0.8	-2.8	1.5	-1.0	-1.5	-0.2	-1.1	0.1
Finland	-1.8	4.7	0.6	1.2	-5.4	0.9	-3.8	-1.2	-1.8	-2.6	0.1
Sweden	-9.3	1.0	0.4	0.5	-1.3	0.9	0.5	-1.4	0.1	1.2	0.2
United Kingdom	-1.0	2.6	1.2	1.2	-1.4	0.5	2.0	-0.4	2.8	0.6	0.9
EU-25+	-0.5	1.5	1.4	1.5	-0.6	0.9	-2.7	-0.6	0.3	1.6	0.7
EU-25	-0.4	1.5	1.4	1.5	-0.6	0.9	-2.7	-0.6	0.3	1.6	0.7

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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

in the UK employment is just over 15% (Table 18), which is one of the highest (only exceeded by Ireland where this group accounts for 16%). In most other countries the corresponding share in 2006 was well below 10%. Some variations in occupational structure are of course to be expected across countries.

4.3. Results for replacement demands by country

Estimates of replacement demand by occupation reflect the specific age structure within each occupation, combined with typical outflow rates for that occupation. Differences across countries and occupations can in principle be attributed to either one, or a combination of these attributes. Note that the age structure is sometimes affected by changes in the classification of occupations.

Underlying the occupation specific outflow rates are differences in retirement age, (child) care leave, occupational mobility, and mortality across gender and age groups, to name just some of the main drivers of outflow rates. These outflow rates also differ across countries, and within countries across occupations, due to the institutional setting within which workers are operating. For further discussion see Kriechel and Cörvers (2007).

Table 23 illustrates how replacement demand (RD) varies across countries. It compares directly with Table 20 which shows analogous expansion demand (ED). Together they serve to emphasise the importance of RD compared to ED, showing that on average RDs are four times the size of EDs ([23]).

Table 24 provides a summary of the total number of job openings across Europe. These are the sum of ED plus RD. The results again highlight the crucial importance of considering replacement demand as well as expansion demand. The total number of job openings is usually many times larger than the expansion demand. The tables provide a general guide to orders of magnitude of these various elements.

([23]) The relative change of RD and ED (in %) can be calculated by relating Tables 23 and 24 to Table 17.

Table 23. **Replacement demand by country and occupation, 2006-15 (000s)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	7	87	170	97	144	130	22	129	86	106	980
Czech Republic	4	66	119	239	80	199	26	267	211	85	1 296
Denmark	5	60	110	128	98	164	23	100	47	113	849
Germany	63	543	1 093	1 434	837	965	163	1 058	520	966	7 641
Estonia	1	18	26	24	8	22	4	25	25	16	169
Greece	11	77	74	65	108	192	155	171	76	73	1 001
Spain	23	244	226	252	397	781	133	667	339	887	3 950
France	61	434	659	895	722	881	261	746	517	717	5 893
Ireland	2	69	64	23	89	86	3	74	39	39	488
Italy	63	857	378	966	620	802	117	1 304	560	680	6 347
Cyprus	1	3	11	9	18	21	5	12	7	15	101
Latvia	0	27	25	37	11	32	20	55	24	40	271
Lithuania	2	21	46	21	9	39	33	67	32	47	316
Luxembourg	0	6	11	11	18	10	2	13	6	13	89
Hungary	5	76	127	152	114	158	29	145	122	90	1 015
Malta	0	6	8	11	8	9	1	7	7	8	65
Netherlands	6	228	427	354	384	493	36	212	93	426	2 659
Norway	3	29	51	92	49	165	17	47	39	43	535
Austria	4	60	74	145	146	164	108	180	61	105	1 047
Poland	3	265	484	350	285	388	629	693	310	286	3 691
Portugal	9	86	76	87	111	181	173	244	77	140	1 184
Switzerland	2	135	351	404	271	292	75	309	103	111	2 054
Slovenia	1	13	27	32	18	32	16	29	39	16	223
Slovakia	0	25	51	91	37	78	5	85	67	46	486
Finland	3	76	86	94	45	107	36	83	57	63	650
Sweden	2	54	153	174	115	230	29	104	117	92	1 069
United Kingdom	13	798	820	671	1 028	1 419	82	667	469	964	6 932
EU-25+	294	4 362	5 747	6 857	5 772	8 039	2 201	7 493	4 048	6 188	51 001
EU-25	289	4 198	5 345	6 360	5 452	7 582	2 109	7 136	3 906	6 034	48 411

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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 24. **Total job openings by country and occupation, 2006-15 (000s)**

Occupation major group	0	1	2	3	4	5	6	7	8	9	All
Belgium	-3	153	219	225	145	156	11	70	179	125	1 280
Czech Republic	4	63	141	432	73	201	13	131	381	27	1 466
Denmark	5	80	198	214	43	141	8	75	23	114	900
Germany	71	461	1 611	1 759	260	1 821	20	1 193	485	1 933	9 613
Estonia	2	9	25	16	7	37	-3	0	28	23	144
Greece	13	84	104	171	130	335	59	156	113	155	1 320
Spain	50	254	456	1 166	237	1 319	-168	434	256	1 216	5 221
France	24	767	976	1 350	405	1 019	261	565	460	1 844	7 671
Ireland	-1	131	135	71	96	136	-2	84	33	52	735
Italy	58	1 428	736	2 229	859	1 052	-115	531	332	865	7 975
Cyprus	0	6	24	25	35	18	3	16	9	50	185
Latvia	0	65	39	44	17	42	-10	46	7	39	289
Lithuania	12	-5	120	31	-10	65	-31	93	31	70	377
Luxembourg	0	7	27	21	18	17	1	6	8	24	129
Hungary	-9	168	192	141	141	194	14	41	176	132	1 190
Malta	2	10	5	15	6	13	1	9	4	14	80
Netherlands	-5	128	544	450	519	633	8	174	71	738	3 260
Norway	0	-11	113	207	16	266	-17	50	34	32	689
Austria	4	86	138	331	139	184	76	128	10	238	1 334
Poland	4	448	1 070	487	381	176	5	1054	398	344	4 368
Portugal	-1	131	273	91	146	196	152	166	146	203	1 503
Switzerland	2	198	573	484	229	299	37	291	130	111	2 354
Slovenia	1	31	85	71	0	27	-9	39	26	24	296
Slovakia	6	35	77	121	6	123	3	43	61	28	504
Finland	1	196	109	139	-17	140	6	52	29	19	673
Sweden	-4	74	183	212	70	299	33	53	121	123	1 165
United Kingdom	7	2 034	1 337	1 092	544	1657	143	569	1 033	1 145	9 561
EU-25+	244	7 034	9 509	11 596	4 498	10 567	494	6 067	4 584	9 689	64 281
EU-25	242	6 847	8 822	10 905	4 254	10 002	475	5 727	4 420	9 547	61 239

Note: Total also includes armed forces.

Source: IER estimates based on Cambridge Econometrics E3ME model.

Occupation major group:

0 armed forces
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

CHAPTER 5

Conclusions

The future development of skills – both skill needs and supply – on European labour markets ranks high on the current policy agenda. The relaunched Lisbon agenda (2005) emphasises human capital and related investments in education and training as important policy levers to foster growth, employment and competitiveness, together with innovation, research and development. Consequently, the integrated guidelines for growth and jobs 2005-08, as well as 2008-10, ask for better anticipation of skill needs, labour market shortages and bottlenecks to improve matching of labour market needs. The 2007 Council Resolution 'New skills for new jobs' also stresses the need to anticipate skill needs – and skill gaps – emerging in the European labour markets, among other things explicitly by strengthening Cedefop's network for the early identification and forecast of skill needs (Skillsnet). That is why Cedefop has developed, proactively, the skill needs forecast the results of which have been presented in this publication.

This forecast is not the end of the story. Cedefop will continue this work with regular updates and further methodological and data improvement, as well as complementary forecasts of skills supply and detailed analyses of possible imbalances between supply and demand. The identification and analysis of future skill trends and its implications will provide sound evidence for policy-making to prevent or alleviate possible future distortions on labour markets – skill shortages or gaps, or other forms of skills mismatch such as oversupply or overqualification of workforces.

5.1. Review

This publication presents – for the first time in Europe – consistent and comprehensive medium-term projections of employment and skill needs across the whole of Europe (EU-25 plus Switzerland and Norway – EU-25^{+}). Starting point is the macroeconomic projection based on the E3ME model for assessing sectoral employment prospects across Europe, using national accounts data. These data are combined with data from the European LFS to break down sectoral employment trends by occupation and qualification.

In addition, various alternative sets of employment projections by

occupation and (formal) qualification have been produced. These alternative scenarios cover a range of possible economic situations Europe may face over the next 5-10 years and their implications for employment and skill needs. The scenarios also consider the impact of using LFS data as opposed to national accounts based employment estimates. However, net employment change – or expansion demand – alone, as estimated by conventional employment projections, is of only limited value to assess future job openings. Total requirements have also to consider replacement of workers leaving the workforce for various reasons. Replacement demands will in many occupations far outnumber expansion demand.

This project was concerned with developing sound historical and projections database, including basic data for all individual countries and related software needed to produce projections of the demand for skills in a replicable fashion. A key objective was developing a framework in which to consider alternative possibilities. While there may still be some concerns about the quality of some of the data for individual countries or for particular sectors or occupations, this framework enables better data to be easily incorporated to improve the quality of analysis and projections.

The project involved producing a set of benchmark projections that can be the foundation for ongoing dialogue about such issues across Europe. Detailed results for individual countries were presented in country workbooks to promote a continuing process of dialogue with country experts in order to try to improve the quality and robustness of the basic data and results, by taking note of local knowledge

The project has initiated dialogue between individual country experts and relevant statistical authorities. As this process continues it is hoped that the quality and reliability of the relevant data and estimates will gradually be improved. While these results have their limitations, they provide a useful starting point for thinking about likely future developments in employment structure across the continent.

5.2. Key findings for Europe's future skill needs and policy implications

Europe has experienced considerable structural change over the past few decades, reflecting both economic and political factors. In terms of employment patterns this has resulted in continuing shifts away from primary industries (especially agriculture) and from traditional manufacturing

industries towards services and knowledge-intensive jobs. The results of the present forecast suggest that these trends are likely to remain a key feature over the coming decade, both within individual countries and in the way in which the division of labour is changing between countries.

The recent enlargement of the EU resulted in increasing diversity in sectoral employment patterns, with many of the newer Member States relying to a much greater extent on agriculture and manufacturing for employment than was the case among older members. But there is evidence that often this is changing rapidly, with a 'catching up process for many countries' and significant restructuring away from these areas into services. In part, this is an internal process, particular to each country, but it also reflects shifting patterns of activities and people across borders, as capital and labour adjust to the new political and economic situation. The results suggest that this process of change will continue in the foreseeable future, but that in the main it will continue to be an evolutionary rather than revolutionary process.

Nevertheless, substantial change is in prospect. In total, Europe (the 25 Member States as of December 2006 plus Switzerland and Norway) is expected to see more than 13 million additional jobs (net change) by 2015. This is despite the loss of well over two million jobs in the primary sector and half a million in manufacturing industries. Distribution, transport, etc. (which includes hotels and catering) is projected to see over three million more jobs over the next decade, while employment in non-marketed services (which includes health and education) is projected to grow by only slightly less. It is, however, in business and miscellaneous services that the best prospects for employment lie, with almost nine million additional jobs being created between 2006 and 2015. This is the central view.

The alternative scenarios explored suggest that the overall employment change might range between a low of an increase of 7.5 million and a high of 17.5 million. The broad patterns by sector are not too sensitive to these alternatives, manufacturing being the most sensitive sector with job losses of 1.3 million in the more pessimistic scenario but modest growth in the most optimistic one. All these results point to the enormous challenges policy is facing to cope with this structural change and the resulting sectoral and occupational mobility needs. This includes adaptation of workforces and their skills to new skill requirements by retraining, continuing training – in particular adults and people at risk of unemployment. Against this background implementation of lifelong learning strategies and policies to reconcile flexibility and security becomes a new dimension.

However, despite the significant changes expected it is also important to emphasise that the primary and manufacturing sectors will remain important areas of employment – although skill requirements will also change here. In the central scenario the primary sector will still employ around 10 million people by 2015 and manufacturing 35 million. It is important that policy-makers, education and training providers and individual citizens are aware that these sectors will remain viable sources of jobs, and crucial components of the economy.

By themselves these structural changes and shifts of sectoral employment would have significant implications for skills needed in the future. These trends are likely to be reinforced by changes in the way work is organised and jobs are done as a result of technological change and other factors. The implications for occupational employment are not only for continuing growth in demand for many highly and medium-skilled workers but also for some lower skilled categories. In 2006 it is estimated that just under 80 million of the 210 million people employed in Europe were doing higher level jobs such as management, professional work of one kind or another or technical support of those activities. These areas are all expected to experience increased demand over the next decade.

In contrast, jobs requiring traditional agricultural skilled workers, jobs for several other craft and related skills and jobs requiring clerical skills are expected to decline in number. If the trends observed over recent years continue there will, however, be significant expansion in the numbers of jobs for many service workers, especially in retail and distribution, and also for some elementary occupations which up until now typically require little or no formal training. The latter, in particular, raises concerns about issues of job quality and related problems of social equality and exclusion for many European citizens. Technological and other changes are tending to polarise the demand for skills, creating many jobs at higher levels and at the lower end of the job spectrum, with low pay and poor terms and conditions. These results reinforce the need to explore in more detail working conditions, skill and competence requirements and profiles of these precarious job segments. They equally emphasise the need for policy-making to initiate measures in time to prevent or at least alleviate these risks of skills mismatch.

As noted earlier it is important to recognise that even in those areas where declining employment levels are expected there will nevertheless be significant numbers of job openings and needs for education and training. This is reflected in estimates of replacement demand by occupation. While

the projections suggest (net) job losses for several occupational categories, in all cases these losses are more than offset by the need to replace those leaving because of retirement or other reasons. Concluding, it is important that policy-makers, education and training providers and individual citizens are aware that many of those occupations are likely to experience job losses will remain viable sources of employment and make important contributions to the economy for many years to come. Of course the nature and skill requirements of these jobs will not remain unchanged, and it is important to also understand the way in which they are evolving.

A key aspect is the formal qualifications typically required. Another aspect relates to key core and generic skills which are in many respects much harder to measure, but this dimension is not covered in the present project. While there is no simple one to one relationship between occupations and qualifications, it is possible to explore how these are changing over time. As far as (formal) qualifications are concerned it is possible at pan-European level to undertake only a broad brush analysis focusing on three qualification levels (high, medium and low).

The results highlight a general increase in qualification levels across most jobs. At the broadest level the projected changes are even more dramatic than for occupations. Total employment in Europe is projected to grow by more than 13 million jobs between 2006 and 2015. This comprises increases of almost 12.5 million jobs at the highest qualification level (roughly ISCED levels 5 and 6) and almost 9.5 million jobs at medium level (ISCED level 3 and 4). On the other hand, there is a decline of over 8.5 million jobs for those with no or few formal qualifications (ISCED levels 0-2). Some of these changes reflect the expected continued growth in supply of people with formal qualifications. Another part refers to increasing skill requirements and preferences of employers to recruit people with higher qualifications – for whatever reason. However, the present exercise makes no attempt to separate supply and demand influences ([24]). While some have argued that there is a possibility of oversupply in some areas, there is considerable evidence of the changing nature of job requirements which increases the need for formal qualifications in many areas. This is an area where there is a clear need for further research.

([24]) This issue will be addressed in a follow-up study by Cedefop, in a medium-term forecast of skills supply in Europe, to be carried out in 2008.

5.3. Problems and scope for further refinement

Detailed examination of results for individual countries reveals several outstanding problems and questions. These are especially severe for some smaller countries where the sample sizes in the European LFS are inadequate to provide robust estimates. Even for many larger countries there are problems with the data which can probably only be addressed by further detailed dialogue between individual country experts and the relevant statistical authorities.

However, as noted above, the framework developed does allow for alternative data and assumptions to be incorporated with relative ease. Therefore, given cooperation with the countries concerned, such issues can, in principle, be resolved.

It is also important to emphasise that there is considerable scope for improvement of the methods used to forecast occupational and qualification structures, as well as to estimate replacement demands. Data limitations and other technical problems have limited the sophistication of some of the modelling work, but there is good potential for further refinement and improvement offered by the framework. The modular approach adopted and presentation of material in separate country workbooks enables such developments to take place at individual country level as well as pan-European level.

5.4. Continuing dialogue: importance of country expert involvement

The present set of projections was put together with the voluntary involvement of many individual country experts (see list in Annex III). It is clear from the issues raised in connection with these preliminary results that such involvement is crucial to ensuring credibility of the results for individual countries and for improving both estimates and methods.

As with all quantitative projections, a considerable amount of judgement is needed to develop robust and credible results. This must involve individuals from individual countries who can bring their unique knowledge and expertise of data, trends and political strategies on employment and socioeconomic development in their own countries. The feedback obtained so far suggests that with such an input it will be possible to develop a much more robust database. All experts and stakeholders are invited to join in this mission.

ANNEX I

Detailed tables

Table 25. **Employment trends by broad sector, EU-25+**

Levels (000s)	1996	2001	2006	2010	2015
Primary sector and utilities	15 052	13 446	11 917	10 667	9 629
Manufacturing	37 802	37 297	34 871	35 256	34 414
Construction	13 729	14 514	15 141	15 598	15 583
Distribution and transport	48 356	52 566	54 242	56 078	57 740
Business and other services	34 022	41 627	45 638	49 626	54 559
Non-marketed services	43 753	46 394	48 846	50 175	52 011
All industries	192 714	205 844	210 656	217 399	223 936
Shares (%)	**1996**	**2001**	**2006**	**2010**	**2015**
Primary sector and utilities	7.8	6.5	5.7	4.9	4.3
Manufacturing	19.6	18.1	16.6	16.2	15.4
Construction	7.1	7.1	7.2	7.2	7.0
Distribution and transport	25.1	25.5	25.7	25.8	25.8
Business and other services	17.7	20.2	21.7	22.8	24.4
Non-marketed services	22.7	22.5	23.2	23.1	23.2
All industries	100.0	100.0	100.0	100.0	100.0
Growth (% p.a.)	**1996-01**	**2001-06**	**2006-10**	**2010-15**	**2006-15**
Primary sector and utilities	-2.2	-2.4	-2.7	-2.0	-2.3
Manufacturing	-0.3	-1.3	0.3	-0.5	-0.1
Construction	1.1	0.8	0.7	0.0	0.3
Distribution and transport	1.7	0.6	0.8	0.6	0.7
Business and other services	4.1	1.9	2.1	1.9	2.0
Non-marketed services	1.2	1.0	0.7	0.7	0.7
All industries	1.3	0.5	0.8	0.6	0.7
Change (000s)	**1996-01**	**2001-06**	**2006-10**	**2010-15**	**2006-15**
Primary sector and utilities	-1 606	-1 529	-1 251	-1 038	-2 289
Manufacturing	-505	-2 426	385	-842	-457
Construction	785	627	457	-15	442
Distribution and transport	4 210	1 676	1 836	1 662	3 498
Business and other services	7 606	4 011	3 988	4 933	8 921
Non-marketed services	2 642	2 452	1 329	1 837	3 165
All industries	13 131	4 811	6 743	6 537	13 280

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 26. **Employment trends by industry, EU-25+**

Levels (000s)	1996	2001	2006	2010	2015
Agriculture, etc.	12 230	11 096	9 753	8 690	7 764
Mining and quarrying	1 005	724	651	572	500
Food, drink and tobacco	5 012	4 987	4 781	4 743	4 632
Engineering	7 943	8 096	7 502	7 660	7 542
Rest of manufacturing	24 847	24 214	22 588	22 852	22 241
Electricity, gas and water	1 817	1 626	1 514	1 404	1 364
Construction	13 729	14 514	15 141	15 598	15 583
Distribution	28 945	31 127	32 153	33 042	34 031
Hotels and catering	7 891	9 158	9 932	10 801	11 547
Transport & telecommunications	11 520	12 280	12 157	12 235	12 162
Banking and insurance	5 743	6 028	6 014	6 040	6 032
Other business services	17 424	23 308	26 140	29 196	33 079
Public admin. and defence	13 837	14 157	14 258	14 336	14 432
Education	12 896	13 693	14 507	14 927	15 574
Health and social work	17 020	18 545	20 081	20 911	22 005
Miscellaneous services	10 855	12 292	13 485	14 390	15 448
All industries	192 714	205 844	210 656	217 399	223 936
Shares (%)	**1996**	**2001**	**2006**	**2010**	**2015**
Agriculture, etc.	6.3	5.4	4.6	4.0	3.5
Mining and quarrying	0.5	0.4	0.3	0.3	0.2
Food, drink and tobacco	2.6	2.4	2.3	2.2	2.1
Engineering	4.1	3.9	3.6	3.5	3.4
Rest of manufacturing	12.9	11.8	10.7	10.5	9.9
Electricity, gas and water	0.9	0.8	0.7	0.6	0.6
Construction	7.1	7.1	7.2	7.2	7.0
Distribution	15.0	15.1	15.3	15.2	15.2
Hotels and catering	4.1	4.4	4.7	5.0	5.2
Transport & telecommunications	6.0	6.0	5.8	5.6	5.4
Banking and insurance	3.0	2.9	2.9	2.8	2.7
Other business services	9.0	11.3	12.4	13.4	14.8
Public admin. and defence	7.2	6.9	6.8	6.6	6.4
Education	6.7	6.7	6.9	6.9	7.0
Health and social work	8.8	9.0	9.5	9.6	9.8
Miscellaneous services	5.6	6.0	6.4	6.6	6.9
All industries	100.0	100.0	100.0	100.0	100.0

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 27. **Employment trends by industry, change, EU-25+**

Growth (% p.a.)	1996-01	2001-06	2006-10	2010-15	2006-15
Agriculture, etc.	-1.9	-2.5	-2.8	-2.2	-2.5
Mining and quarrying	-6.3	-2.1	-3.2	-2.7	-2.9
Food, drink and tobacco	-0.1	-0.8	-0.2	-0.5	-0.4
Engineering	0.4	-1.5	0.5	-0.3	0.1
Rest of manufacturing	-0.5	-1.4	0.3	-0.5	-0.2
Electricity, gas and water	-2.2	-1.4	-1.9	-0.6	-1.2
Construction	1.1	0.8	0.7	0.0	0.3
Distribution	1.5	0.7	0.7	0.6	0.6
Hotels and catering	3.0	1.6	2.1	1.3	1.7
Transport & telecommunications	1.3	-0.2	0.2	-0.1	0.0
Banking and insurance	1.0	0.0	0.1	0.0	0.0
Other business services	6.0	2.3	2.8	2.5	2.7
Public admin. and defence	0.5	0.1	0.1	0.1	0.1
Education	1.2	1.2	0.7	0.9	0.8
Health and social work	1.7	1.6	1.0	1.0	1.0
Miscellaneous services	2.5	1.9	1.6	1.4	1.5
All industries	1.3	0.5	0.8	0.6	0.7
Change (000s)	**1996-01**	**2001-06**	**2006-10**	**2010-15**	**2006-15**
Agriculture, etc.	-1 134	-1 344	-1 062	-926	-1 989
Mining and quarrying	-281	-73	-78	-72	-150
Food, drink and tobacco	-25	-206	-38	-112	-149
Engineering	153	-595	159	-119	40
Rest of manufacturing	-633	-1 625	264	-611	-348
Electricity, gas and water	-192	-112	-110	-40	-150
Construction	785	627	457	-15	442
Distribution	2 182	1 025	889	989	1 878
Hotels and catering	1 268	773	869	746	1 615
Transport & telecommunications	760	-123	78	-73	4
Banking and insurance	286	-15	26	-8	18
Other business services	5 884	2 832	3 056	3 883	6 939
Public admin. and defence	320	101	78	96	174
Education	797	814	420	647	1 067
Health and social work	1 524	1 536	831	1 094	1 924
Miscellaneous services	1 437	1 193	905	1 058	1 963
All industries	13 131	4 811	6 743	6 537	13 280

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 28. **Employment trends (levels) by occupation, EU-25+**

Levels (000s)	1996	2001	2006	2010	2015
01 Armed Forces	1 245	1 197	1 215	1 197	1 165
11 Legislators and senior officials	484	603	495	531	596
12 Corporate managers	8 349	9 294	9 920	11 032	12 346
13 Managers of small enterprises	6 561	6 436	7 990	8 071	8 135
21 Physical, mathematical and engineering science professionals	5 518	5 995	6 401	6 944	7 452
22 Life science and health professionals	3 698	3 345	3 551	3 602	3 658
23 Teaching professionals	7 862	8 057	8 464	8 595	8 736
24 Other professionals	7 143	8 086	8 933	9 927	11 265
31 Physical and engineering science associate professionals	6 911	7 666	7 715	7 927	8 129
32 Life science and health associate professionals	4 807	5 559	5 618	5 671	5 800
33 Teaching associate professionals	2 126	2 408	2 606	2 874	3315
34 Other associate professionals	13 799	16 100	18 013	19 626	21446
41 Office clerks	20 840	20 891	18 795	18 075	16944
42 Customer services clerks	3 792	4 198	4 522	4 758	5100
51 Personal & protective services workers	15 408	17 497	18 848	20 154	21361
52 Models, salespersons and demonstrators	9 977	11 221	10 642	10 611	10656
61 Skilled agricultural and fishery workers	9 829	8 960	7 789	6 817	6082
71 Extraction and building trades workers	11 205	11 657	12 597	12 851	12718
72 Metal, machin. & related trades workers	11 976	11 646	10 466	10 264	9555
73 Precision, handicraft, craft printing & related trades workers	1 865	1 614	1 444	1 298	1171
74 Other craft and related trades workers	5 595	4 975	4 338	4 237	3977
81 Stationary plant and related operators	2 034	2 081	2 103	2 060	2079
82 Machine operators and assemblers	6 622	6 961	6 498	6 588	6596
83 Drivers and mobile plant operators	8 414	8 262	8 713	8 991	9175
91 Sales & services elementary occupations	10 408	14 092	15 568	17 095	18630
92 Agricultural, fishery & related labourers	1 269	1 197	1 249	1 163	1116
93 Labourers in mining, construction, manufacturing and transport	4 978	5 848	6 163	6 440	6 735
All occupations	192 713	205 844	210 656	217 399	223 936

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 29. **Employment trends (shares) by occupation, EU-25+**

Shares (%)	1996	2001	2006	2010	2015
01 Armed Forces	0.6	0.6	0.6	0.6	0.5
11 Legislators and senior officials	0.3	0.3	0.2	0.2	0.3
12 Corporate managers	4.3	4.5	4.7	5.1	5.5
13 Managers of small enterprises	3.4	3.1	3.8	3.7	3.6
21 Physical, mathematical & engineering science professionals	2.9	2.9	3.0	3.2	3.3
22 Life science and health professionals	1.9	1.6	1.7	1.7	1.6
23 Teaching professionals	4.1	3.9	4.0	4.0	3.9
24 Other professionals	3.7	3.9	4.2	4.6	5.0
31 Physical and engineering science associate professionals	3.6	3.7	3.7	3.6	3.6
32 Life science and health associate professionals	2.5	2.7	2.7	2.6	2.6
33 Teaching associate professionals	1.1	1.2	1.2	1.3	1.5
34 Other associate professionals	7.2	7.8	8.6	9.0	9.6
41 Office clerks	10.8	10.1	8.9	8.3	7.6
42 Customer services clerks	2.0	2.0	2.1	2.2	2.3
51 Personal & protective services workers	8.0	8.5	8.9	9.3	9.5
52 Models, salespersons & demonstrators	5.2	5.5	5.1	4.9	4.8
61 Skilled agricultural and fishery workers	5.1	4.4	3.7	3.1	2.7
71 Extraction & building trades workers	5.8	5.7	6.0	5.9	5.7
72 Metal, machin. & related trades workers	6.2	5.7	5.0	4.7	4.3
73 Precision, handicraft, craft printing and related trades workers	1.0	0.8	0.7	0.6	0.5
74 Other craft and related trades workers	2.9	2.4	2.1	1.9	1.8
81 Stationary plant and related operators	1.1	1.0	1.0	0.9	0.9
82 Machine operators and assemblers	3.4	3.4	3.1	3.0	2.9
83 Drivers and mobile plant operators	4.4	4.0	4.1	4.1	4.1
91 Sales and services elementary occupations	5.4	6.8	7.4	7.9	8.3
92 Agricultural, fishery & related labourers	0.7	0.6	0.6	0.5	0.5
93 Labourers in mining, construction, manufacturing and transport	2.6	2.8	2.9	3.0	3.0
All occupations	100.0	100.0	100.0	100.0	100.0

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 30. **Employment trends (growth) by occupation, EU-25+**

Growth (% p,a.)	1996-01	2001-06	2006-10	2010-15	2006-15
01 Armed Forces	-0.8	0.3	-0.4	-0.5	-0.5
11 Legislators and senior officials	4.5	-3.9	1.7	2.3	2.1
12 Corporate managers	2.2	1.3	2.7	2.3	2.5
13 Managers of small enterprises	-0.4	4.4	0.3	0.2	0.2
21 Physical, mathematical and engineering science professionals	1.7	1.3	2.1	1.4	1.7
22 Life science and health professionals	-2.0	1.2	0.4	0.3	0.3
23 Teaching professionals	0.5	1.0	0.4	0.3	0.4
24 Other professionals	2.5	2.0	2.7	2.6	2.6
31 Physical and engineering science associate professionals	2.1	0.1	0.7	0.5	0.6
32 Life science and health associate professionals	2.9	0.2	0.2	0.4	0.4
33 Teaching associate professionals	2.5	1.6	2.5	2.9	2.7
34 Other associate professionals	3.1	2.3	2.2	1.8	2.0
41 Office clerks	0.0	-2.1	-1.0	-1.3	-1.1
42 Customer services clerks	2.1	1.5	1.3	1.4	1.3
51 Personal & protective services workers	2.6	1.5	1.7	1.2	1.4
52 Models, salespersons & demonstrators	2.4	-1.1	-0.1	0.1	0.0
61 Skilled agricultural & fishery workers	-1.8	-2.8	-3.3	-2.3	-2.7
71 Extraction and building trades workers	0.8	1.6	0.5	-0.2	0.1
72 Metal, machin. & related trades workers	-0.6	-2.1	-0.5	-1.4	-1.0
73 Precision, handicraft, craft printing and related trades workers	-2.8	-2.2	-2.6	-2.0	-2.3
74 Other craft and related trades workers	-2.3	-2.7	-0.6	-1.3	-1.0
81 Stationary plant and related operators	0.5	0.2	-0.5	0.2	-0.1
82 Machine operators and assemblers	1.0	-1.4	0.3	0.0	0.2
83 Drivers and mobile plant operators	-0.4	1.1	0.8	0.4	0.6
91 Sales and services elementary occupations	6.2	2.0	2.4	1.7	2.0
92 Agricultural, fishery & related labourers	-1.2	0.9	-1.8	-0.8	-1.3
93 Labourers in mining, construction, manufacturing and transport	3.3	1.1	1.1	0.9	1.0
All occupations	1.3	0.5	0.8	0.6	0.7

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 31. **Employment trends (change) by occupation, EU-25+**

Change (000s)	1996-01	2001-06	2006-10	2010-15	2006-15
01 Armed Forces	-48	18	-18	-32	-51
11 Legislators and senior officials	119	-108	35	65	101
12 Corporate managers	945	626	1 112	1 314	2426
13 Managers of small enterprises	-125	1 554	81	64	145
21 Physical, mathematical & engineering science professionals	478	406	543	509	1052
22 Life science and health professionals	-354	206	51	56	107
23 Teaching professionals	195	408	130	141	271
24 Other professionals	943	847	994	1 338	2 332
31 Physical and engineering science associate professionals	755	48	212	202	414
32 Life science and health associate professionals	751	60	53	129	182
33 Teaching associate professionals	282	198	268	441	709
34 Other associate professionals	2 301	1 913	1 613	1 820	3 434
41 Office clerks	51	-2 096	-719	-1 131	-1 851
42 Customer services clerks	405	324	235	342	578
51 Personal & protective services workers	2 089	1 351	1 307	1 207	2 514
52 Models, salespersons & demonstrators	1 244	-579	-31	45	14
61 Skilled agricultural & fishery workers	-869	-1 171	-972	-735	-1 707
71 Extraction & building trades workers	452	940	254	-133	121
72 Metal, machin. & related trades workers	-330	-1 181	-202	-710	-911
73 Precision, handicraft, craft printing and related trades workers	-251	-171	-146	-127	-273
74 Other craft and related trades workers	-620	-637	-101	-260	-361
81 Stationary plant and related operators	47	22	-43	19	-24
82 Machine operators and assemblers	339	-462	89	8	98
83 Drivers and mobile plant operators	-152	451	278	184	461
91 Sales & services element. occupations	3 684	1 476	1 527	1 535	3 062
92 Agricultural, fishery & related labourers	-72	53	-86	-48	-134
93 Labourers in mining, construction, manufacturing and transport	870	314	278	295	572
All occupations	13 131	4 811	6 743	6 537	13 280

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 32. **Replacement demand by occupation, broad group, EU-25+**

Levels (000s)	1996	2001	2006	2010	2015	2006-15 (000s) Expans. demand	Replacem. demand	Total requirem.
Armed forces	1 245	1 197	1 215	1 197	1 165	-51	294	244
Legislators, senior officials and managers	15 394	16 333	18 405	19 633	21 076	2 671	4 362	7 034
Professionals	24 220	25 482	27 349	29 067	31 111	3 762	5 747	9 509
Technicians & associate professionals	27 643	31 733	33 952	36 099	38 691	4 739	6 857	11 596
Clerks	24 632	25 088	23 317	22 833	22 044	-1 273	5 772	4 498
Service workers & shop & market sales workers	25 385	28 717	29 490	30 765	32 017	2 528	8 039	10 567
Skilled agricultural and fishery workers	9 829	8 960	7 789	6 817	6 082	-1 707	2 201	494
Craft and related trades workers	30 641	29 893	28 845	28 650	27 420	-1 425	7 493	6 067
Plant and machine operators & assemblers	17 069	17 304	17 314	17 639	17 850	536	4 048	4 584
Elementary occupations	16 655	21 137	22 980	24 699	26 480	3 501	6 188	9 689
All occupations	192 713	205 844	210 656	217 399	22 3936	13 280	51 001	64 281

Shares (%)	1996	2001	2006	2010	2015	2006-15 (%) Expans. demand	Replacem. demand	Total requirem.
Armed forces	0.6	0.6	0.6	0.6	0.5	-4.2	24.2	20.1
Legislators, senior officials and managers	8.0	7.9	8.7	9.0	9.4	14.5	23.7	38.2
Professionals	12.6	12.4	13.0	13.4	13.9	13.8	21.0	34.8
Technicians & associate professionals	14.3	15.4	16.1	16.6	17.3	14.0	20.2	34.2
Clerks	12.8	12.2	11.1	10.5	9.8	-5.5	24.8	19.3
Service workers & shop & market sales workers	13.2	14.0	14.0	14.2	14.3	8.6	27.3	35.8
Skilled agricultural & fishery workers	5.1	4.4	3.7	3.1	2.7	-21.9	28.3	6.3
Craft & related trades workers	15.9	14.5	13.7	13.2	12.2	-4.9	26.0	21.0
Plant and machine operators & assemblers	8.9	8.4	8.2	8.1	8.0	3.1	23.4	26.5
Elementary occupations	8.6	10.3	10.9	11.4	11.8	15.2	26.9	42.2
All occupations	100.0	100.0	100.0	100.0	100.0	6.3	24.2	30.5

Growth (% p.a.)	1996-01	2001-06	2001-06	2006-10	2006-15	2006-15 (% p.a.)		
						Expans. demand	Replacem. demand	Total requirem.
Armed forces	-0.8	0.3	-0.4	-0.5	-0.5	-0.5	2.4	2.1
Legislators, senior officials and managers	1.2	2.4	1.6	1.4	1.5	1.5	2.4	3.7
Professionals	1.0	1.4	1.5	1.4	1.4	1.4	2.1	3.4
Technicians & associate professionals	2.8	1.4	1.5	1.4	1.5	1.5	2.1	3.3
Clerks	0.4	-1.5	-0.5	-0.7	-0.6	-0.6	2.5	2.0
Service workers & shop & market sales workers	2.5	0.5	1.1	0.8	0.9	0.9	2.7	3.5
Skilled agricultural & fishery workers	-1.8	-2.8	-3.3	-2.3	-2.7	-2.7	2.8	0.7
Craft and related trades workers	-0.5	-0.7	-0.2	-0.9	-0.6	-0.6	2.6	2.1
Plant and machine operators & assemblers	0.3	0.0	0.5	0.2	0.3	0.3	2.4	2.6
Elementary occupations	4.9	1.7	1.8	1.4	1.6	1.6	2.7	4.0
All occupations	1.3	0.5	0.8	0.6	0.7	0.7	2.4	3.0

Note: expansion demand = net change
Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 33. **Implications for qualifications, broad groups, EU-25+**

Levels (000s)	1996	2001	2006	2010	2015
Low qualification	63 339	55 671	55 104	51 209	46 516
Medium qualification	89 127	102 799	102 291	107 508	111 752
High qualification	40 248	47 374	53 261	58 682	65 668
All qualifications	192 714	205 844	210 656	217 399	223 936
Shares (%)	**1996**	**2001**	**2006**	**2010**	**2015**
Low qualification	32.9	27.0	26.2	23.6	20.8
Medium qualification	46.2	49.9	48.6	49.5	49.9
High qualification	20.9	23.0	25.3	27.0	29.3
All qualifications	100.0	100.0	100.0	100.0	100.0
Growth (% p.a.)	**1996-01**	**2001-06**	**2006-10**	**2010-15**	**2006-15**
Low qualification	-2.5	-0.2	-1.8	-1.9	-1.9
Medium qualification	2.9	-0.1	1.3	0.8	1.0
High qualification	3.3	2.4	2.5	2.3	2.4
All qualifications	1.3	0.5	0.8	0.6	0.7
Change (000s)	**1996-01**	**2001-06**	**2006-10**	**2010-15**	**2006-15**
Low qualification	-7 667	-567	-3 895	-4 693	-8 588
Medium qualification	13 672	-508	5 217	4 244	9 461
High qualification	7 126	5 887	5 421	6 986	12 408
All qualifications	13 131	4 811	6 743	6 537	13 280

Source: IER estimates based on Cambridge Econometrics E3ME model.

Table 34a. **Employment by sector, occupation and qualification, 1996-2015,**

	All qualifications			
All industries	**1996**	**2006**	**2015**	**1996**
Armed forces	1 245	1 215	1 165	315
Legislators, senior officials and managers	15 394	18 405	21 076	3 960
Professionals	24 220	27 349	31 111	874
Technicians and associate professionals	27 643	33 952	38 691	3 792
Clerks	24 632	23 317	22 044	6 580
Service workers and shop and market sales workers	25 385	29 490	32 017	10 701
Skilled agricultural and fishery workers	9 829	7 789	6 082	5 691
Craft and related trades workers	30 641	28 845	27 420	11 912
Plant and machine operators and assemblers	17 069	17 314	17 850	8 656
Elementary occupations	16 655	22 980	26 480	10 859
All occupations	192 714	210 656	223 936	63 339
Primary sector and utilities	**1996**	**2006**	**2015**	**1996**
Armed forces	0	1	0	0
Legislators, senior officials and managers	621	628	606	183
Professionals	334	358	380	13
Technicians and associate professionals	633	647	716	60
Clerks	515	402	336	109
Service workers and shop and market sales workers	130	116	122	51
Skilled agricultural and fishery workers	9 205	7 012	5 259	5 417
Craft and related trades workers	1 257	793	599	267
Plant and machine operators and assemblers	879	667	529	351
Elementary occupations	1 479	1 295	1 083	1 047
All occupations	15 052	11 917	9 629	7 499
Manufacturing	**1996**	**2006**	**2015**	**1996**
Armed forces	2	3	2	0
Legislators, senior officials and managers	2 555	2 569	2 892	485
Professionals	2 109	2 466	2 897	88
Technicians and associate professionals	4 220	4 692	5 089	559
Clerks	3 550	2 850	2 579	943
Service workers and shop and market sales workers	885	826	879	347
Skilled agricultural and fishery workers	52	55	29	27
Craft and related trades workers	13 347	10 797	9 413	5 295
Plant and machine operators and assemblers	8 378	8 040	8 198	4 533
Elementary occupations	2 705	2 573	2 436	1 591
All occupations	37 802	34 871	34 414	13 869
Construction	**1996**	**2006**	**2015**	**1996**
Armed forces	0	0	0	0
Legislators, senior officials and managers	837	1 011	1 200	201
Professionals	548	560	684	27
Technicians and associate professionals	823	906	1 083	84
Clerks	789	735	740	203
Service workers and shop and market sales workers	73	62	66	27
Skilled agricultural and fishery workers	25	25	21	11
Craft and related trades workers	8 601	9 444	9 285	3 593
Plant and machine operators and assemblers	970	1 032	1 073	476
Elementary occupations	1 063	1 366	1 431	710
All occupations	13 729	15 141	15 583	5 332

EU-25+ (000s)

Low qualification		Medium qualification			High qualification		
2006	**2015**	**1996**	**2006**	**2015**	**1996**	**2006**	**2015**
275	208	691	677	687	239	263	270
3 635	3 231	6 359	7 658	8 271	5 075	7 112	9 574
547	630	3 749	4 298	5 772	19 597	22 504	24 709
3 217	3 156	16 086	18 793	19 957	7 765	11 943	15 578
4 694	3 957	15 161	14 421	12 993	2 891	4 202	5 094
9 132	7 590	13 108	17 388	19 953	1 576	2 969	4 475
3 543	2 037	3 784	3 772	3 465	354	474	580
10 454	8 528	16 971	16 403	16 485	1 758	1 989	2 408
7 049	5 637	7 885	9 511	11 191	528	754	1 022
12 559	11 542	5 332	9 369	12 980	464	1 051	1 958
55 104	46 516	89 127	102 291	111 752	40 248	53 261	65 668
2006	**2015**	**1996**	**2006**	**2015**	**1996**	**2006**	**2015**
0	0	0	1	0	0	0	0
209	140	258	236	192	180	182	274
9	7	65	71	76	255	278	297
56	57	431	423	444	141	168	215
66	42	351	273	232	55	63	62
39	25	69	67	78	9	10	19
3 222	1 761	3 477	3 377	3 011	310	414	488
174	122	919	572	433	71	47	43
237	165	499	406	343	29	24	21
793	514	391	450	490	41	52	79
4 805	2 832	6 462	5 875	5 300	1 091	1 238	1 497
2006	**2015**	**1996**	**2006**	**2015**	**1996**	**2006**	**2015**
2	1	2	1	1	0	0	0
380	338	1 019	1 025	1 123	1 050	1 164	1 431
69	81	420	514	648	1 600	1 883	2 169
513	490	2 602	2 791	2 853	1 059	1 388	1 745
617	465	2 280	1 868	1 728	327	365	385
254	233	487	499	548	51	72	98
28	10	22	25	18	3	2	1
3 666	2 732	7 353	6 425	5 929	700	707	751
3 336	2 630	3 602	4 337	5 097	242	367	471
1 298	993	1 046	1 167	1 302	68	108	141
10 163	7 974	18 832	18 652	19 247	5 101	6 057	7 193
2006	**2015**	**1996**	**2006**	**2015**	**1996**	**2006**	**2015**
0	0	0	0	0	0	0	0
259	290	385	448	489	251	305	420
17	31	86	118	168	434	425	485
95	111	548	560	593	191	252	379
170	140	499	446	436	87	118	165
20	22	42	36	36	3	6	8
10	7	12	14	12	2	2	1
3 920	3 224	4 564	4 944	5 221	444	580	841
493	375	478	511	651	17	28	47
838	675	331	483	678	22	46	78
5 821	4 875	6 945	7 559	8 285	1 451	1 761	2 423

Table 34b. **Employment by sector, occupation and qualification, 1996-2015,**

	All qualifications			
Distribution and transport	**1996**	**2006**	**2015**	**1996**
Armed forces	3	8	10	1
Legislators, senior officials and managers	6 950	8 018	8 179	2 385
Professionals	1 255	1 712	2 277	75
Technicians and associate professionals	4 949	6 385	7 603	915
Clerks	7 463	7 403	7 592	2 375
Service workers and shop and market sales workers	14 047	15 407	16 214	6 100
Skilled agricultural and fishery workers	135	159	153	45
Craft and related trades workers	4 906	4 653	4 545	1 853
Plant and machine operators and assemblers	5 336	5 768	5 999	2 554
Elementary occupations	3 311	4 730	5 167	2 088
All occupations	48 356	54 242	57 740	18 391
Business and other services	**1996**	**2006**	**2015**	**1996**
Armed forces	14	13	12	5
Legislators, senior officials and managers	3 027	4 374	5 935	553
Professionals	6 576	7 660	9 140	322
Technicians and associate professionals	6 746	9 045	10 391	935
Clerks	7 119	7 002	6 462	1 611
Service workers and shop and market sales workers	3 279	4 366	5 495	1 462
Skilled agricultural and fishery workers	213	337	400	101
Craft and related trades workers	1 515	2 359	2 899	513
Plant and machine operators and assemblers	931	1 264	1 522	466
Elementary occupations	4 601	9 219	12 303	3 202
All occupations	34 022	45 638	54 559	9 171
Non-marketed services	**1996**	**2006**	**2015**	**1996**
Armed forces	1 225	1 191	1 140	309
Legislators, senior officials and managers	1 404	1 806	2 265	152
Professionals	13 400	14 592	15 731	348
Technicians and associate professionals	10 272	12 278	13 810	1 239
Clerks	5 196	4 926	4 336	1 339
Service workers and shop and market sales workers	6 972	8 713	9 241	2 713
Skilled agricultural and fishery workers	199	201	220	89
Craft and related trades workers	1 015	800	678	390
Plant and machine operators and assemblers	575	543	530	276
Elementary occupations	3 495	3 798	4 060	2 221
All occupations	43 753	48 846	52 011	9 077

Source: IER estimates based on Cambridge Econometrics E3ME model.

EU-25+ (000s)

Low qualification		Medium qualification			High qualification		
2006	**2015**	**1996**	**2006**	**2015**	**1996**	**2006**	**2015**
3	1	2	4	4	0	1	5
2 195	1 533	3 183	3 912	3 857	1 381	1 911	2 789
66	98	309	435	626	871	1 211	1 553
912	874	3 085	3 883	4 325	949	1 590	2 404
1 782	1 769	4 452	4 635	4 476	635	985	1 347
5 092	4 246	7 232	9 008	9 829	714	1 307	2 138
46	30	78	99	103	13	14	20
1 531	1 328	2 731	2 758	2 795	322	364	423
2 227	1 682	2 607	3 288	3 953	175	253	364
2 339	2 106	1 105	2 144	2 637	119	246	423
16 194	13 666	24 786	30 166	32 606	5 179	7 881	11 467
2006	**2015**	**1996**	**2006**	**2015**	**1996**	**2006**	**2015**
4	1	8	5	7	2	4	4
511	845	1 121	1 564	2 035	1 353	2 298	3 055
223	243	1 066	1 570	2 120	5 188	5 867	6 777
858	929	3 948	4 824	4 968	1 864	3 363	4 494
1 148	937	4 435	4 221	3 594	1 073	1 632	1 931
1 414	1 392	1 586	2 467	3 359	231	484	744
152	151	98	154	194	14	31	55
873	879	854	1 266	1 750	148	220	269
523	596	421	683	836	44	58	90
5 311	5 584	1 265	3 437	5 692	134	471	1 028
11 018	11 557	14 800	20 191	24 555	10 050	14 429	18 447
2006	**2015**	**1996**	**2006**	**2015**	**1996**	**2006**	**2015**
267	205	679	667	675	237	257	260
81	85	394	473	575	859	1 252	1 605
163	170	1 802	1 590	2 133	11 249	12 839	13 428
782	695	5 473	6 313	6 774	3 560	5 183	6 341
910	604	3 143	2 977	2 527	714	1 039	1 205
2 311	1 672	3 692	5 312	6 101	567	1 090	1 468
85	79	97	104	127	13	12	14
291	242	551	438	356	74	71	80
234	190	277	286	311	21	23	29
1 980	1 670	1 195	1 688	2 181	79	129	209
7 104	5 611	17 302	19 847	21 759	17 374	21 894	24 641

ANNEX II

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]

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]
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 and Defence [75]	Public administration and defence; compulsory social security [75]
39	Education [80]	Education [80]
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 16-industry

16-industry [NACE]		41-industry [NACE]	
1	Agriculture, etc.[01-05]	1	Agriculture, etc.[01-05]
2	Mining and quarrying [10-14]	2	Coal [10]
		3	Oil and gas, etc.[11, 12]
		4	Other mining [13, 14]
3	Food, drink and tobacco [15-16]	5	Food, drink and tobacco [15, 16]
4	Engineering [29-33]	16	Mechanical engineering [29]
		17	Electronics [30, 32]
		18	Electrical engineering and instruments [31, 33]
5	Rest of manufacturing [17-28, 34-37]	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)]
		12	Rubber and plastics [25]
		13	Non-metallic mineral products [26]
		14	Basic metals [27]
		15	Metal goods [28]

16-industry [NACE]		41-industry [NACE]	
		19	Motor vehicles [34]
		20	Other transport equipment [35]
		21	Manufacturing nes [36, 37]
6	Electricity, gas and water [40-41]	22	Electricity [40.1, 40.3]
		23	Gas supply [40.2]
		24	Water supply [41]
7	Construction [45]	25	Construction [45]
8	Distribution [50-52]	26	Distribution [50, 51]
		27	Retailing [52]
9	Hotels and catering [55]	28	Hotels and catering [55]
10	Transport and telecommunications [60-64]	29	Land transport, etc.[60, 63]
		30	Water transport [61]
		31	Air transport [62]
		32	Communications [64]
11	Banking and insurance [65-67]	33	Banking and finance [65, 67]
		34	Insurance [66]
12	Other business services [70-74]	35	Computing services [72]
		36	Professional services [70, 71, 73, 74.1-74.4]
		37	Other business services [74.5-74.8]
13	Public admin and defence [75]	38	Public administration and defence [75]
14	Education [80]	39	Education [80]
15	Health and social work [85]	40	Health and social work [85]
16	Miscellaneous services [90-99]	41	Miscellaneous Services [90-93, 95, 99]

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)]
		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]

6-industry [NACE]		41-industry [NACE]	
		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]

Qualifications

Level of qualification

Low qualification	At most lower secondary (ISCED 0-2)
Medium qualification	Upper secondary (ISCED 3-4)
High qualification	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 who conduct 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, i.e. 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 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)

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 3: clerks	
41	Office clerks
42	Customer services clerks
Major group 4: 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	

ANNEX III

List of contributing country experts

	Name	Organisation
Austria	LASSNIGG, Lorenz	Institute for Advanced Studies
	STEINER, Peter	Institute for Advanced Studies
	VOGTENHUBER, Stefan	Institute for Advanced Studies
	HUEMER, Ulrike	WIFO
	MAHRINGER, Helmut	WIFO
Belgium	SCHATTEMAN, Paul	Ministry of Education and Training
	HENDRICKX, Koen	Federal Planning Bureau
Bulgaria	KUNEV, Ruslan	NCVT within the BCCI
	BRATOEVA, Liliya	NCVT
Croatia	NESTIC, Danijel	Institute of Economics
	CRNKOVIĆ-POZAIĆ, Sanja	CEPOR
Cyprus	MOUROUZIDES, Yiannis	Human Resource Development Authority
	OXINOS, George	Human Resource Development Authority
Czech Republic	HAVLICKOVA, Vera	National Training Fund, National Observatory of Employment and Training
	MICHALICKA, Ludvik	Research Institute for Labour and Social Affairs
	LAPÁČEK, Michal	National Training Fund, National Observatory of Employment and Training
	LEPIC, Martin Education	Policy Centre, Charles University in Prague
	KOUCKY, Jan Education	Policy Centre, Charles University in Prague
Estonia	LAMBING, Mario	Ministry of Economic Affairs and Communication
	MERIKULL, Jaanika	University of Tartu
Finland	TIAINEN, Pekka	Ministry of Labour

	Name	Organisation
France	SAUVAGEOT, Claude	DEPP – Ministry of Education
	ESTRADE, Marc-Antoine	Centre d'analyse stratégique
	OMALEK, Laure	Ministère de l'Emploi – DARES
Germany	SCHNEIDER, Marc	Institute for the Study of Labour (IZA)
	VOGLER-LUDWIG, Kurt	Economix
Greece	CHLETSOS, Michalis	University of Ioannina, Dept of economics
	KAMINIOTI, Olimpia	Employment Observatory
Hungary	HÁRS, Agnes	Kopint-Tarki
Ireland	FOX, Roger	FAS
	LUNN, Pete	Economical and Social Research Institute
Italy	DELL'ARINGA, Carlo	Universita Cattolica
	TORCHIO, Nicoletta	IRS – Istituto per la Ricerca Sociale
Latvia	JAKOBSONS, Andrejs	Riga Business School
Lithuania	SVENTICKAITE, Kristina	Institute of Labour and Social Research
	DUMČIUS, Rimantas	Public Policy and Management Institute
	KVEDARAS, Virmantas	Vilnius University, Dept of Econometric Analysis Luxembourg
	CLEMENT, Franz	CEPS/INSTEAD
	BLOND-HANTEN, Carole	CEPS/INSTEAD Malta
	CAMILLERI, Edwin	Employment and Training Corporation, Labour Market Information Section
Netherlands	CÖRVERS, Frank	ROA – Maastricht University
	KRIECHEL, Ben	ROA – Maastricht University
	HEIJKE, Hans	ROA – Maastricht University
Norway	STØLEN, Nils Martin	Statistics Norway
Poland	GAJDOS, Artur	University of Lodz
	SUCHECKI, Bogdan	University of Lodz
Portugal	RODRIGUES, Maria João	University of Lisbon
	VALENTE, Ana	Higher Institute of Social Sciences and Business studies

	Name	Organisation
Romania	GHINARARU, Catalin	National Scientific Research Institute for Labour and Social Protection
Slovakia	VANTUCH, Juraj	SNO – Slovak National Observatory of Vocational Education and Training
	KVETAN, Vladimir	Slovak Academy of Sciences
	PALENIK, Michal	Employment Institute
Slovenia	PAVLIN, Samo	University of Ljubljana, Faculty of Social Sciences
	KRAMBERGER, Anton	University of Ljubljana, Faculty of Social Sciences,
Spain	HOMS, Oriol	Fundació CIREM
	VILLAGÓMEZ, Elizabeth	Fundació CIREM
Sweden	PÄRLEMO, Lind	National Labour Market Board
Switzerland	SCHWERI, Juerg	Swiss Federal Institute of Vocational Education and Training
	MULATERO, Fulvio	Swiss Federal Institute of Vocational Education and Training
United Kingdom	LINDLEY, Robert	Institute for Employment Research, University of Warwick
	WILSON, Rob	Institute for Employment Research, University of Warwick
	LIVANOS, Ilias	Institute for Employment Research, University of Warwick
	GARDINER, Ben	Cambridge Econometrics
	POLLITT, Hector	Cambridge Econometrics

Acronyms

Institutions and organisations

CE	Cambridge Econometrics
Cedefop	European Centre for the Development of Vocational Training
IER	Institute for Employment Research, University of Warwick
ROA	Research Centre for Education and the Labour Market, University of Maastricht
Skillsnet	Cedefop's network on early identification of skill needs

Others

CGE	Computable general equilibrium
E3ME	Energy-environment-economy (E3) model of Europe
ESA95	European system of accounts
ED	Expansion demand
EDMOD	Expansion demand module
EU	European Union
EU-25	European Union 25 Members States as of December 2006
EU-25+	EU-25 plus Norway and Switzerland
ICEs	Individual country experts
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)
PIAAC	Programme for the international assessment of adult competencies
p.a.	Per annum
QMOD	Qualification module
RD	Replacement demand
RDMOD	Replacement demand module

Bibliography

BLS – Bureau of Labor Statistics. *BLS handbook of methods*. Washington DC: Bureau of Labor Statistics, 1997. Available from Internet: http://www.bls.gov/opub/hom/ [cited 14.1.2008].

Briscoe, G; Wilson, R.A. Modelling UK occupational employment. *International Journal of Manpower*, 2003, Vol. 24, Issue 5, p. 568-589.

Cambridge Econometrics and Warwick Institute for Employment Research. *Sectoral economic analysis and forecast up to the year 2005*. DG Economic and Financial Affairs, 2001.

Cedefop. *Early identification of skill needs in Europe*. Luxembourg: Publications Office, 2003 (Cedefop Reference series, 40).

Cedefop. *Training and learning for competence: second report on vocational training research in Europe: synthesis report*. Luxembourg: Publications Office, 2001 (Cedefop Reference series).

Cörvers, F. et al. Beyond manpower planning: a labour market model for the Netherlands and its forecasts to 2006. In Neugart, M.; Schömann, K. (eds) *Forecasting labour markets in OECD countries: measuring and tackling mismatches*. Cheltenham: Edward Elgar, 2002, p. 185-223.

Cörvers, F. Labour market forecasting in the Netherlands: a top-down approach. In Cedefop. *Early identification of skill needs in Europe*. Luxembourg: Publications Office, 2003, p. 72-83 (Cedefop Reference series, 40).

Cörvers, F.; Meriküll, J. Classifications, data and models for European skill needs forecasting. In Cedefop. *Towards European skill needs forecasting.* Luxembourg: Publications Office, 2007, p. 27-40 (Cedefop Panorama series, 137).

Council Decision of 12 July 2005 on Guidelines for the employment policies of the Member States. *Official Journal of the European Union*, 6.8.2005, L 205, pp. 21-27. Available from Internet: http://eurlex.europa.eu/LexUriServ/site/en/oj/2005/l_205/l_20520050806en00210027.pdf [cited 17.12.2007].

Czech National Observatory of Vocational Training and Labour Market. *Forecasting education and training needs in transition economies: lessons from the western European experience*. Prague: National Training Fund, 1999.

EC – European Commission. *Employment, trade and labour costs in manufacturing*. Luxembourg: Publication Office, 1998 (Single market review series: subseries VI: aggregate and regional impact).

Engle, R.F.; Granger, C.W.J. Co-integration and error-correction: representation, estimation and testing. *Econometrica*, 1987, Vol. 55, p. 251-276.

Eurostat. Euro area and EU-25 employment up by 0.3%. *Euro-indicators, News release*, 14 June 2006, 77/2006.

Fox, R.; Comerford, B. *The cohort component method of deriving replacement demand: lessons from Ireland*. Paper presented to Cedefop workshop on anticipating emerging skill needs, 2-3 November 2006. Dublin: FAS – National training and employment authority, 2006.

Freeman, C.; Soete, L. *Macro-economic and sectoral analysis of future employment and training perspectives in the new information technologies in the European Community*. 1991.

Frey, L.; Lindley, R.M. The comparison, integration and use of European labour statistics: a research perspective. In *Proceedings of the first CEIES Seminar: labour statistics in the European Union: labour statistics, basic needs*. The Hague, 3 May 1996. Luxembourg: Publication Office, 1997, p. 12-26.

Gardiner, B. *Orientation in E3ME: a non-technical description.* Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: interim results. 3rd technical workshop organised by Cedefop in Maastricht, 7 and 8 May 2007.

Gardiner, B. et al. *Medium-term forecast of occupational skill needs in Europe: macroeceonomic and sectoral scenarios: a final report for Cedefop*. Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: final results. 4th technical workshop organised by Cedefop in Vienna, 8-9 November, 2007.

Gerstenberger, W. et al. *Impacts of information technology on future employment: central report*. Brussels: Commission of the European Communities, 1991.

Heijke, H. (ed.) *Forecasting the labour market by occupation and education.* London: Kluwer Academic, 1994.

Heijke, H.; Borghans, L. (eds) *Towards a transparent labour market for educational decisions.* Aldershot: Ashgate, 1998.

Hendry, D.F. Econometric modelling of house prices in the United Kingdom. In Hendry, D.F; Wallis, K.F. (eds) *Econometrics and quantitative economics*. Oxford: Basil Blackwell, 1984.

Hogarth, T.; Lindley R.M. Occupation, gender and qualification. In: Vogler-Ludwig, K. et al. *Medium-term employment forecasts by EU Regions and sectors of industry 1991-97*. Luxembourg: Publication Office, 1994, p. 591-766.

Kriechel, B. *Replacement demand and cohort change analysis*. Paper presented at the workshop on medium-term forecast of occupational skill needs in

Europe: interim results. 3rd technical workshop organised by Cedefop in Maastricht, 7 and 8 May 2007.

Kriechel, B.; Cörvers, F. *The Skillsnet project on medium-term forecasts of occupational skill needs in Europe: replacement demand module*. Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: final results. 4th technical workshop organised by Cedefop in Vienna, 8 and 9 November 2007.

Lindley, R.M. Prospects for European labour demand. *European Journal of Population*, 1987, Vol. 3, No 3, p. 383-440.

Lindley, R.M. Population ageing and the labour market in Europe. *Rivista Italiana di Economia, Demografia e Statistica*, 1999, LIII, No 1, p. 167-192.

Lindley, R.M. Projections and institutions: the state of play in Britain. In: Neugart, M. (ed.) *Forecasting labour markets in OECD countries*. Cheltenham: Edward Elgar, 2003, p. 108-150.

Livanos, I. Information input from Member States using Cedefop's template: Greece II. In Cedefop. *Towards European skill needs forecasting.* Luxembourg: Publications Office, 2007, p. 101-104 (Cedefop Panorama series, 137).

Livanos, I.; Wilson, R. *Comparing national accounts (NA) and European labour survey (ELFS)*. Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: interim results. 3rd technical workshop organised by Cedefop in Maastricht, 7 and 8 May 2007a.

Livanos, I.; Wilson, R. *Expansion demand and changes in occupational structure.* Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: interim results. 3rd technical workshop organised by Cedefop in Maastricht, 7 and 8 May 2007b.

Livanos, I.; Wilson, R. *The Skillsnet project on medium-term forecasts of occupational skill needs in Europe: expansion demand and changes in occupational structure*. Paper presented at the Workshop on medium-term forecast of occupational skill needs in Europe: final results. 4th technical workshop organised by Cedefop in Vienna, 8 and 9 November 2007c.

Marey, P. et al. *Forecasting the labour markets for research scientists and engineers in the European Union.* Maastricht: Research Centre for Education and the Labour Market, 2001 (ROA-W-2001/3E).

Neugart, M.; Schömann, K. (eds) *Forecasting labour markets in OECD countries*. Cheltenham: Edward Elgar, 2002.

Pollitt, H. *The E3ME employment forecasts: background information and scenario development*. Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: interim results. 3rd technical workshop organised by Cedefop in Maastricht, 7 and 8 May 2007.

Shah, C.; Burke, G. Occupational replacement demand in Australia. *International Journal of Manpower*, 2001, Vol. 22, p. 648-663.

Shyrock, H.S.; Siegel, J.S. *The methods and materials of demography*. Washington DC: US Bureau of the Census, US Printing Office, 1980.

Willems, E.J.T.A.; de Grip, A. Forecasting replacement demand by occupation and education. *International Journal of Forecasting*, 1993, Vol. 9, No 2, p. 173-185.

Wilson, R.A. *Pan-European employment projections: some preliminary results.* Paper presented at the workshop on anticipating Europe's skill needs organised by Cedefop in Warwick, 2 and 3 November 2006.

Wilson, R.A. *The Skillsnet project on medium-term forecasts of occupational skill needs in Europe: an overview.* Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: interim results. 3rd technical workshop organised by Cedefop in Maastricht, 7 and 8 May 2007a.

Wilson, R.A. *The Skillsnet project on medium-term forecasts of occupational skill needs in Europe: country workbooks.* Paper presented at the workshop on medium-term forecast of occupational skill needs in Europe: final results. 4th technical workshop organised by Cedefop in Vienna, 8 and 9 November 2007b.

Wilson, R.A.; Bosworth, D. *Working futures 2004-2014: qualifications report*. Wath on Dearne: Sector Skills Development Agency, 2006.

Wilson, R.A. et al. *Working futures*. Wath on Dearne: Sector Skills Development Agency, 2004.

Wilson, R.A. et al. *Developing a national skills forecasting tool for South Africa.* Pretoria: South African Department of Labour, 2004.

Wilson, R.A.; Lindley, R.M. Pan-European skills forecasts. In Cedefop. *Towards European skill needs forecasting.* Luxembourg: Publications Office, 2007, p. 7-26 (Cedefop Panorama series, 137).

Wilson, R.A.; Lindley, R.M. Identifying skill needs in the UK. In Cedefop. *Systems, institutional frameworks and processes for early identification of skill needs*. Luxembourg: Publications Office, 2007 (Cedefop Panorama series, 135).

Cedefop (European Centre for the Development of Vocational Training)

Future skill needs in Europe

Medium-term forecast

Synthesis report

Luxembourg:
Office for Official Publications of the European Communities

2008 – VI, 121 pp. – 17 x 24 cm

ISBN 978-92-896-0500-7

Cat. No: TI-70-07-138-EN-C

No of publication: 4078 EN