Forecasting skill supply and demand in Europe: Imbalances and Mismatches - Reconciling the Demand for and Supply of Skills.

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Preface and Acknowledgements

This report summarises some results from the Cedefop *Skillsnet* project on *Forecasting skill supply and demand in Europe* undertaken as part of a *Framework Agreement* which extends over the 4 years 2008/09-2012/13. The researchers are grateful to Cedefop for this financial support.

The results from the project as a whole represent the result of a team effort, and reflect the contributions of all those working on the project, including: Ilias Livanos from IER; Terry Ward and Robert Stehrer from Alphametrics; Ben Gardiner, Hector Pollitt, Unnada Chewpreecha and Jennifer Barton from CE; and Ben Kriechel and Jan Sauerman from ROA. These all form part of the Core team responsible for producing the projections. In addition important contributions were made by the Country Group Experts (Pekka Tiainen, Catalin Ghinaru, Tim Grebe, Matthias Kirbach, Simonas Gausas, Haroldas Brozaitis). Jan Koucký and Martin Lepič also contributed to the review of sectoral studies and development of the methodology for qualification profiles. The authors are grateful to all of them for their contributions.

Thanks are also due to the various experts from individual countries who have taken time to review and comment upon the emerging findings as well as from the Cedefop team managing the project.

Finally, thanks are due to Peter Millar who undertook much of the technical analysis required to process the European LFS data, and the linking of this with the results from the macroeconomic model.

Rob Wilson (Project team leader)

Abstract

This report provides an overview of the results of part of the Cedefop *Skillsnet* research on developing a medium-term forecast of occupational skill needs and skills supplies in Europe. It focuses on skills imbalances and mismatches and the reconciliation of the demand and supply estimates.

Despite the worldwide recession, Europe is likely to see a significant increase in both the demand for and supply of formal qualifications, especially at the highest (graduate) level. The analysis highlights the possible tensions that may arise between demand and supply trends, with many well qualified individuals needing to take up jobs that have typically not required such high qualifications in the past and the need for policy interventions to ensure a continued growth in demand for high skill jobs and to maximise the utilization of the skills that individual are acquiring.

Contents

Glossary

CE Cambridge Econometrics
IER Institute for Employment Research
ROA Research Centre for Education and the Labour Market, Maastricht
ICEs Individual Country Experts

E3ME Multi-sectoral macroeconomic model
EDMOD Model to produce occupational projections
RDMOD Model to produce projections of replacement demands
QUALMOD Model to produce qualification projections
STOCKMOD Model to produce supply stock estimates
BALMOD Model to produce reconciled supply-demand projections

LF Labour force
LGR
LMAR Labour market account residual
NA National accounts
HQ High educated (ISCED 5+6)
MQ Medium educated (ISCED 3+4)
LQ Low educated (ISCED 1+2)

Summary/Abstract

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

Comparing current demand and supply projections is however problematic for both practical and theoretical reasons. Unless the two sets of results are based on common data and are carried out simultaneously, they cannot be directly compared. There are also various other conceptual and methodological issues regarding imbalances that need to be considered with some care if misleading inferences are not to be drawn. These matters are discussed in more detail in this document.

1. Introduction

The search to define and measure skill shortages is not new:

- Bosworth (1993) describes measuring skill shortageas "a 'notoriously difficult' task" and says that "there is no one 'best way' to do it".

- *"… no single empirical measure of occupational shortages exists, nor does it appear that one can easily be developed"* (Veneri, US Bureau of Labor Statistics (1999, page 17).

- *"Unfortunately there is no generally agreed upon method for measuring skill shortages"* Zaidi and Cohen (2002, page 2)

The UK Migration Advisory Committee MAC (2008) has recently carried out an extensive review of these issues. In it s first report it concludes that "As with skill, there is no universal definition or measure of 'shortage'. However, two key lessons emerge from the UK and overseas literature. First, although these attempts at identifying shortages of skilled labour are based on different methods, it is apparent that most approaches do not rely on a single indicator of shortage. And ….

Second, the differences between the approaches suggest that there is no single, infallible way of measuring shortage, …. "

York Consulting (2008), in a report for the MAC reviewing concepts of labour shortages, skills shortages and skills gaps, conclude that that shortage is not a straightforward concept: "Perhaps the most important message is that no single measure of skill shortages is sufficient, and that it is necessary to use a range of indicators to ensure an accurate estimation…This is one area where there is almost complete consensus in the literature." A subsequent more detailed and in depth analysis by West Midland Enterprise (MAC (2010)) reached similar conclusions.

Quotes such as these highlight the conceptual and practical problems in analysing and measuring the differences between skills demand and skills supply. Yet this is a topic at the top of many policy makers' agendas. They would like simple answers to the question of how to ensure a balance of the supply of and demand for skills and to avoid mismatches.

This report presents some results from the Cedefop *Skillsnet* project on *Forecasting skill supply and demand in Europe.*[1] The main report provides an overview of the projections of demand and supply (see Wilson, (2010) for details). The present document focuses on skills imbalances and mismatches and the reconciliation for demand and supply estimates. The main results suggest that, despite the worldwide

[1] This is being undertaken as part of the new *Framework Agreement* which extends over the 4 years 2008/09-2012/13. The results from the project as a whole represent the result of a considerable team effort, and reflect the contributions of all those working on the project, including: Ilias Livanos from IER; Terry Ward and Robert Stehrer from Alphametrics; Ben Gardiner, Hector Pollitt, Unnada Chewpreecha and Jennifer Barton from CE; and Ben Kriechel and Jan Suerman from ROA. These all form part of the Core team responsible for producing the projections.

recession, Europe is likely to see a significant increase in both the demand for and supply of formal qualifications, especially at the highest (graduate) level. The present analysis highlights the possible tensions that may arise between demand and supply trends, with many well qualified individuals needing to take up jobs that have typically not required such high qualifications in the past and the need for policy interventions to ensure a continued growth in demand for high skill jobs and to maximise the utilization of the skills that individual are acquiring. However, the analysis also highlight the conceptual and practical difficulties in tackling what turn out to be very slippery issues despite their common appearance in popular discourse.

The discussion begins with an outline of conventional theoretical approaches to the topic. Section 3 then goes on to discuss various general issues in comparing demand and supply, highlighting problems of mismatches, imbalances, shortages and over and under-qualification. It emphasises that these outcomes are the result of market and other adjustments, reflecting, incorporating, and (to some degree) reacting to shortages and surpluses as they emerge.

Section 4 focuses on one particular problem. This results from discrepancies between estimates of labour demand and supply from different data sources, notably the National Accounts, official estimates of population and the Labour Force Survey. This poses problems for the macroeconomic model and other modules used to analyse skills demand and supplies.

Section 5 moves onto the specific problems of comparing the demand for and supply of skills as measured by highest formal qualifications held. This highlights the way in which markets operate to allocate the supply of people with formal qualifications in to the jobs on offer.

Section 6 describes how this process has been modelled in the current exercise. It sets out the treatment of imbalances and mismatches in the broad conceptual framework develop to produce the Cedefop projections. This is focused in the "Imbalances module", which forms an integral part of a broader modular conceptual framework that has been developed for this work. This module brings together the separate forecasts of supply and demand and reconciles the two.

The specific examples of Greece, the UK and the Netherlands presented in Section 7 highlight some key issues. Finally, Section 8 provides an overview for the whole of Europe based on the latest Cedefop projections.

2. Theoretical background: Shortages and imbalances

Imbalances on the labour market can occur for many reasons. The project focuses on skill shortages where skills are measured primarily by the highest qualification held or by the occupation in which people work.

Economic theory relies on the market mechanism, mainly wage adjustments, to solve such imbalances. Figure 2.1 depicts such a situation in which supply and demand are given by the S and D lines. Consider a situation where Demand is represented by the schedule D_0 , with the supply schedule S . The former suggests that demand is negatively related to the cost of labour (the wage rate), while supply is positively related.[2] Assume firms and workers were faced with a wage W^0. This wage level is below the equilibrium wage level, which leads to a Demand-Supply gap indicated by the arrows. The distance $L^{d0} – L^{S0}$ is the size of the gap between the willingness to supply labour at the given market wage and the demand. This is one measure of a "shortage". But note that because the demand and supply schedules are theoretical concepts this cannot be measured directly.

In general, as the wage moves closer to the equilibrium wage, this should diminish the imbalance. The D-S gap becomes smaller. However, allowing for some dynamics, the demand curve may shifts outwards (as it does in Figure 2.1 to D^1 and then to D^2). Shifts in the demand curve can arise as a result of the changes in the medium to long term, i.e. an increase in demand for the product or service being produced or an adjustment in the production technology requiring the utilization of more labour. If the supply curve remains fixed, such outward shifts will generally increase the equilibrium wage level (e_0, e_1, and e_2) and the actual wage level paid. However, there may be lags as the labour market adjusts wages to the new equilibrium level. With every combination of D-S schedules and current versus equilibrium wages, there is an associated D-S gap.

[2] The latter ignores complication of so called "backward bending supply curves in which wages may rise to certain level which encourage workers to increas their leisure rather than their income.

Figure 2.1: Demand – Supply (dynamic)

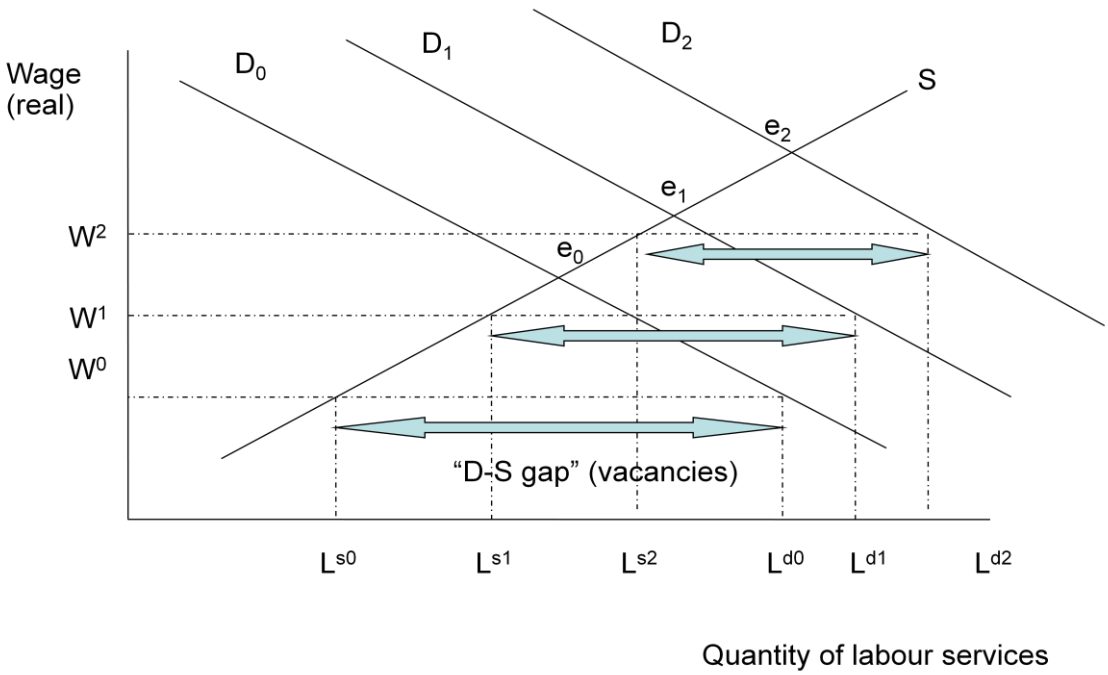


Figure 2.2: Demand/Supply – Observed Employment level

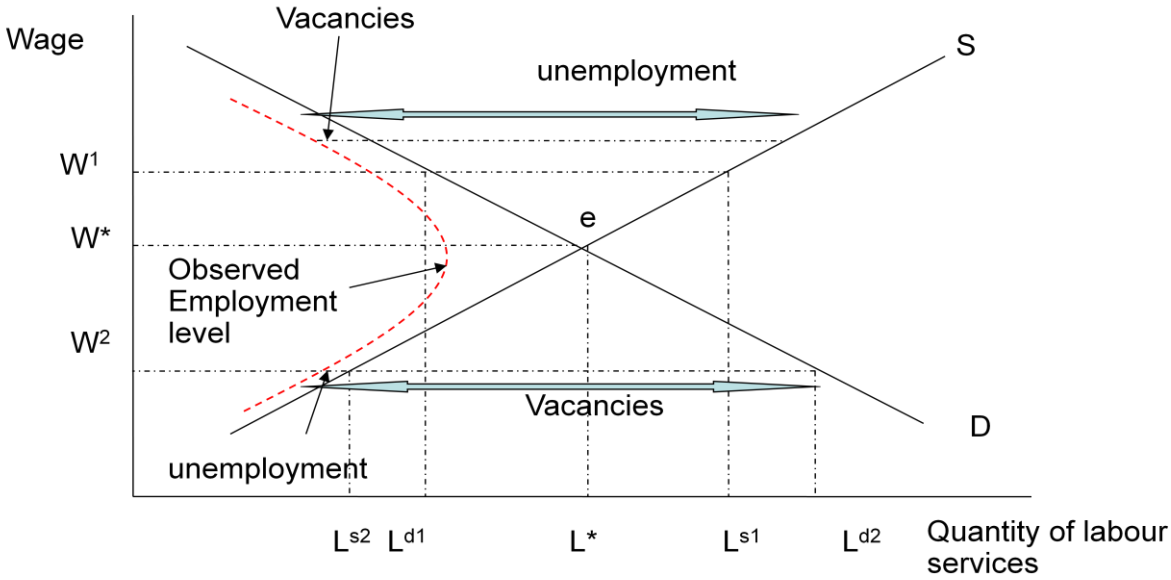


Figure 2.1 focus on the positive gap between demand and supply (which can be regarded as unfilled vacancies where there is an excess demand for labour relative to that on offer. The opposite can be true as well. If the equilibrium wage is above the market clearing wage, the resulting imbalance will show itself as a surplus of labour (i.e. unemployment).

Figure 2.2 highlights both cases. Wage levels above W^*, such as W^1, will lead to unemployment; whereas wage levels of W^2 will result in unfulfilled vacancies. However, as noted above the demand and supply schedule are notional or theoretical concepts. The actual employment levels which are observed will only show the result of the combination of both effects. For a given wage level the shorter end of the supply and demand schedules will determine the market outcome, even if wages adjust to “clear” the market. Even at the equilibrium wage level there will be both unemployment and vacancies as the natural process of labour turnover takes place and workers retire or leave for other reasons and have to be replaced. The observe schedule of employment and wages in this situation would be As shown in the dotted (red) curve, part of which is backward bending. This implies a particular relationship between vacancies and unemployment (all else held equal).

The Beveridge curve, as depicted in Figure 2.3, is the graphical representation of this relationship between unemployment and the vacancy rate, which can be derived from this analysis. In its textbook representation higher levels of vacancies are associated with lower unemployment and vice versa. The existence of both vacancies and unemployment can be explained by several aspects which allow the deviations from the classical economic supply and demand, with equalizing wages. Matching processes; labour force participation rates, frictional unemployment, and deterioration of human capital among long-term unemployed can all lead to changes in the location of the curve.

The Beveridge curve depicts the macroeconomic outcome in terms of vacancies and unemployment. One of the reasons for imbalances lies in mismatches of skills to occupations. If there are shortages in certain occupations, and surpluses of persons with skills suitable for different occupations, this will be reflected in the simultaneous existence of unemployment and vacancies. Minimizing unnecessary mismatches by providing early signals for the development of skill surpluses or shortages within a field, is one of the possible benefits of skill forecasting exercises.

Figure 2.3: Beveridge Curve

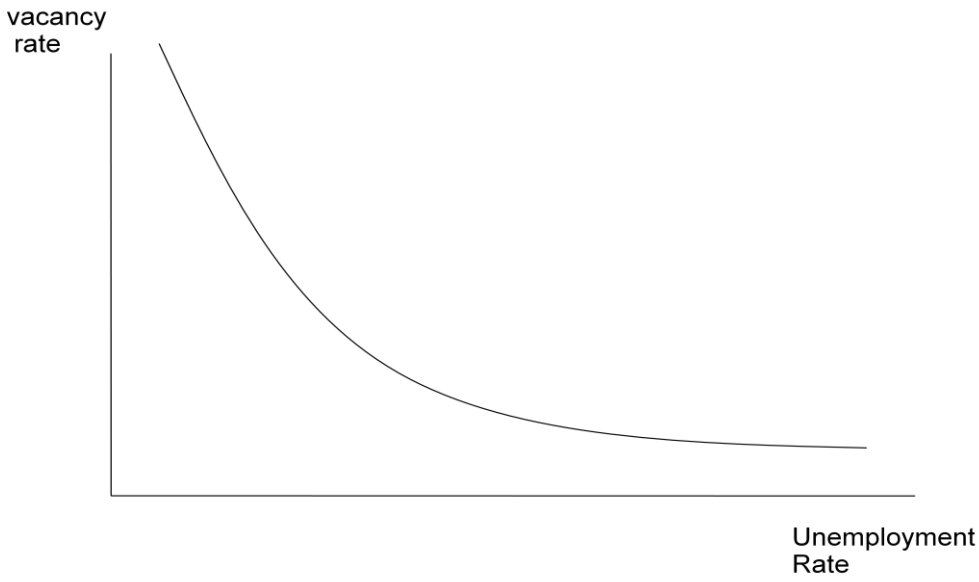


Figure 2.4: Demand/Supply – Two labour markets

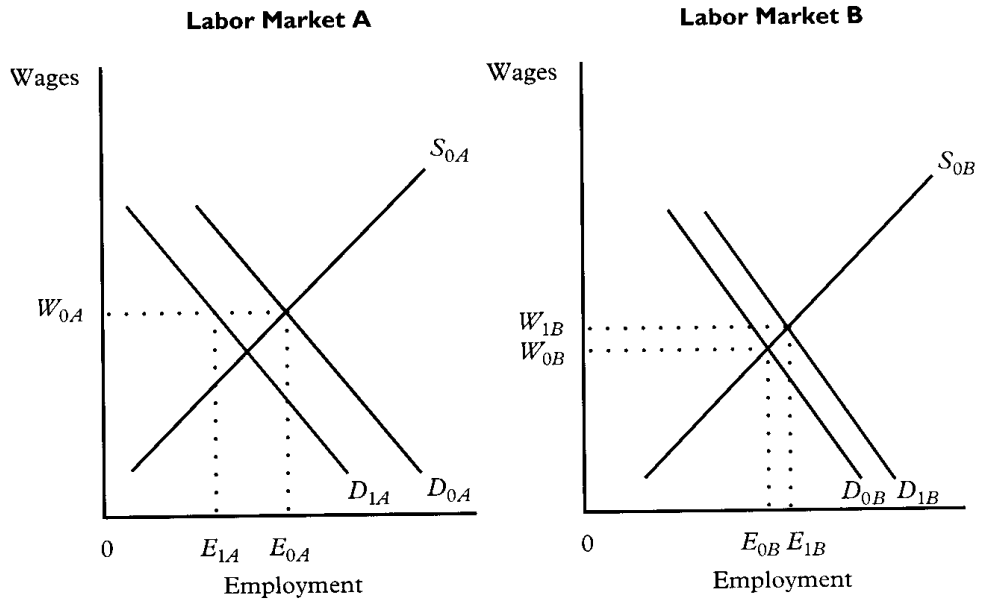


Figure 2.4 depicts the case in which there are multiple separate labour markets. Those markets can be interrelated. An example in the context of the present study is that of labour market for different occupations. Within the labour market for a specific occupation, there are a demand and supply schedules related to the wage rate. The supply comes from workers that, based on the skills they possess, fit into that labour market. This can sometimes be quite broad, i.e. that there are multiple education levels and fields which can fill vacancies in an occupation, or it can be rather narrow. For example, in occupations in the medical field, for which the access to certain occupations are regulated towards holders of certain certificates or degrees that certify the level of skills necessary, it will be quite narrow.

The broader a labour market is, i.e. the ease with which different types of worker's (as defined by the skills or qualifications they posses) are substitutable, the easier such imbalances can potentially be solved. However, if the labour market requirements are quite narrow, i.e. particular degrees or certificates are required, then it may take much longer to solve imbalances if this requires schooling and or training workers to fulfil the required skills. This time to re-train workers to be able to supply themselves into specific labour markets is one of the reasons why there can be persistent imbalances on the labour markets, unemployed workers and vacancies existing simultaneously.

Forecasting skill imbalances can help to resolve and smooth out those imbalances as it can provide an early warning of future imbalances *before* they occur. Therefore, the supply through retraining can start before the imbalance manifests itself.[3]

[3] Although it also has the potential to exacerbate disequilibrium if so called cob-web cycles emerge with supply and demand responses acting so as to move away rather than toward equilibrium. However this kind of problem tends to be limited to very specific and narrowly defined labour markets.

3. Measurement Issues

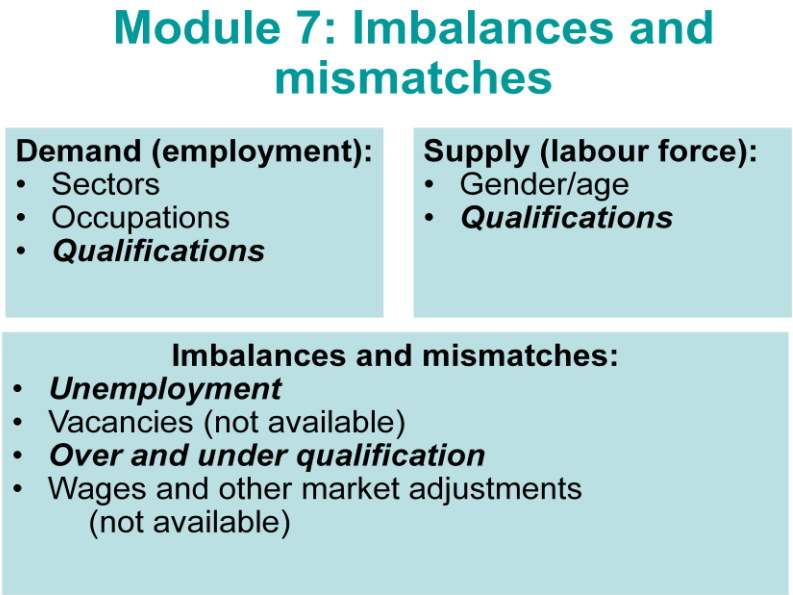
It was shown in the previous section that simultaneous existence of unemployment and vacancies can be a normal feature of the labour market. It is not sensible to expect to reduce the number of unfilled vacancies to zero in a situation of less than full employment.

This is especially the case when the mismatch is due to imbalances in supply in labour markets for occupations that could be solved by retraining and/or reallocation of workers across the occupational labour markets.

One of the aim of the process of anticipating changing skill needs and supplies is to uncover potential imbalances in such a way that adequate measures to pre-empt the imbalances from taking place.

Module 7 (see Figure 3.1) brings together the demand and supply estimates in the Cededfop conceptual framework developed for this purpose. Demand is projected by sector, occupation, and qualification level (highest qualification held), whereas the supply focuses on qualification, by gender and age.

Figure 3.1: Imbalance Module



Analyses by Cohen and Zaidi (2002) and the UK Migration Advisory Committee (MAC (2008) and (2010) propose a range of indicators. For example, Cohen and Zaidi (2002) use the following indicators:

- Average annual growth of employment;
- Unemployment (previous occupation);
- Wage growth;
- Occupational training time (level of education).

The MAC work focuses on:

- measures of pay (absolute and relative change over time);
- indicators of vacancies (including measures of intensity, scale and duration);
- measures of unemployment (similar to vacancies);
- growth in employment.

Within the current Cedefop framework the focus is on:

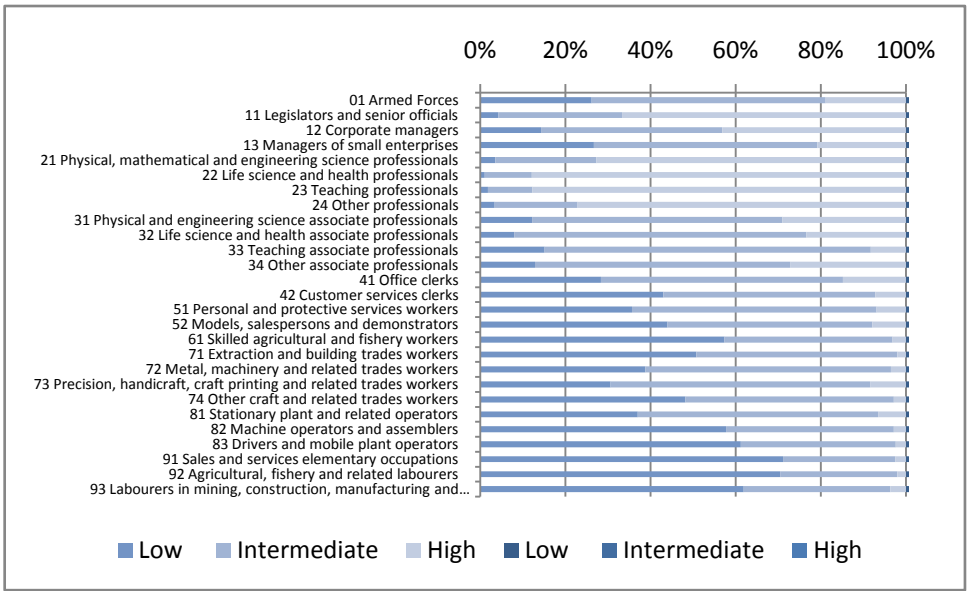
- Employment in occupations and by qualifications;
- Labour supply by qualification, age and gender;
- Unemployment distinguished by broad qualification category only.

Vacancies are not used as there are no detailed and comprehensive measures available at a pan-European level.[4]

The model framework does not distinguish supply to an occupation as such, but it does focus on the composition of employment by skill level (highest qualification held) within each occupation as shown in Figure 3.2.

The key assumptions that have been taken in developing the forecasts of supply, demand and imbalances are set out in the following sections. This includes indicative results for particular countries and an overview for the whole of Europe

Figure 3.2: Composition of skill levels to occupations



Source: ROA

[4] Although Cedefop are exploring the possibilities for collecting such data via a new Employer survey.

4. The Labour Market Accounts Residual (LMAR)

In comparing estimates of demand and supply of labour (and skills) it is important to recognise that there are some significant problems that arise due to different measurements in different sources. This section focuses on differences in the historical estimates of the labour force, employment and unemployment used in the Cedefop framework that occur because they are drawn from different data sources.

Employment (demand) as used in the macroeconomic model (E3ME) is based on the Eurostat National Accounts (NA) data set, which provides a link to economic activity. However, labour supply is not available from the NA data and therefore is taken from the European LFS, in combination with official Eurostat demographic data. The estimates of the economically active labour force are made by calculating LFS labour market participation rates and applying them to Eurostat population figures. Unemployment data in E3ME are based on information from DG Ecfin's AMECO database, which uses a definition similar, but not identical, to the LFS.

Many of the differences between the series are related to the differences between LFS and NA definitions for employment, for example counting people rather than jobs[5], the treatment cross-border commuting (residence versus workplace) and sample (and other) measurement errors. Different factors apply in different countries; these problems have been described in detail in Cedefop (2008).[6]

The E3ME model's internal structure deals with these discrepancies by automatically calculating a labour market accounts "residual" (LMAR) that corrects for the discrepancy between the different data sets. This is defined as:

$$residual_{t}$$

The LMAR is defined for each country in each year of the model solution. In forecasting it is held constant as a share of employment (so any discrepancies are maintained throughout the forecast). This allows the model to endogenously determine labour supply, employment and unemployment using the data available. In the scenarios, the residual value will be the same, independent of the model inputs, so the differences in results reflect only the scenario inputs. The notes below spell this out in more detail.

Some country examples

Luxembourg stands out as an obvious example where there is a large discrepancy in the historical data; this is mostly due to cross-border commuting, a difference between LFS and NA data. The next largest difference is in Greece, where the two sets of figures differ in their units between jobs and persons.

Ideally, a more detailed understanding of how the national accounts employment data sets are compiled in each of the EU's member states is needed. If this could be quantified then there is scope for improving the treatment of these discrepancies in the modelling, both for forecasting and scenario analysis. For example, factors that affect total employment may also affect cross-border commuting, and the 16-25 population level will influence the number of students.

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[5] An obvious problem here is that of double jobbing.

[6] This is the main report on the pilot demand project carried out by the same authors.

[7] These various terms are defined more precisely below.

Measuring the LMAR in E3ME

For the work on imbalances the aggregate unemployment numbers, as well as employment and labour force, need to be precisely measured and consistent for each country.

The population data used in E3ME are constrained to match the official Eurostat numbers and projections. The labour supply numbers in E3ME (LF/ LGR) are therefore *not* LFS benchmarked as such, although they use LFS activity rates. They rely on Eurostat demographic data to produce the overall numbers and LFS activity rates by age and gender.[8]

Labour demand is measured as employment. Obviously this is not strictly correct. Observed employment is the consequence of both demand and supply factors, nevertheless it is common practice in work of this kind to refer to employment as *de facto* "demand". Overall employment levels form E3ME by sector are translated into implications for occupations by the EDMOD module (which focuses on so called "expansion demand". This is based on a detailed analysis of occupational employment patterns within sectors. EDMOD also produces initial (unconstrained) estimates of employment by qualification (again based on an analysis of changes in employment patterns within occupation and sectors.

In order to focus on imbalances by skill (as measured by qualification) these initial estimates of employment by qualifications are constrained to match "Supply in employment". This is a measure of the number of people by highest qualification held who are economically active and in employment. This is on an LFS/Eurostat demographic accounts basis. It is then scaled to match the E3ME National Accounts based estimate of employment to deal with the LMAR issue. This final set of employment estimates by qualification matches the total employment in E3ME on a NA basis (ESA95).

As note above, the labour market accounts residual (LMAR) in E3ME is the difference between Employment (workplace jobs, national accounts), and Employment (heads, LFS based , residents).

$$LMAR = E(j) - E(r) \qquad (1)$$

The person/jobs distinction is not entirely clear cut. The LMAR arises for a range of reasons, of which double jobbing is just one. Other factors include: commuting (flows across national borders); and statistical discrepancies between NA and LFS based estimates. NA employment appears to generally refer to persons rather than jobs (as in the LFS), meaning that most of the discrepancies arise from the other reasons than double jobbing. However, in the UK for certain the standard NA accounts definition of employment is jobs not heads, and (as already noted) in Greece the measure is the Eurostat estimates is "jobs". In most other countries both NA and LFS official estimates are measured in "heads".

[8] Note that in the comparing the previous set of demand and supply estimates a set of employment numbers was generated on the demand side that was constrained to match the LFS employment figures. It is not proposed to do that this time. Instead NA numbers straight from E3ME are used for measuring total employment (demand).

The LFS base estimate of employment (E(r)) is a count of people employed in particular country. It is equal to the Labour Force (LF) less the number of people unemployed (U), both measured by head count.[9]

$$E(r) = LF - U \quad (2)$$

Information on unemployment by qualification level is available from the LFS. This can be used in combination with the projected totals of unemployment from E3ME to generate projected levels of unemployment by qualification level by making assumptions about maintenance of historical differentials in unemployment rates.

Equations 1 and 2 can be variously rearranged in order to derive indicators of interest from the model outputs:

$$E(r) = E(j) - LMAR \quad (3)$$

$$LMAR = E(j) - (LF-U) \quad (4)$$

$$LF = E(r) + U \quad (5)$$

$$E(j) = LMAR + (LF - U) \quad (6)$$

$$E(j) = LMAR + E(r) \quad (7)$$

In E3ME the following slightly different terminology is used:

$$E(j) = EMP \quad (8)$$

$$LF = LGR \quad (9)$$

In E3ME LGR –EMP, is in fact NOT unemployment as defined above but includes the LMAR. Therefore, from (6), (7) (8) and (9), what is called "Unemployed" in E3ME:[10]

"Unemployed"= LGR –EMP

$$= LF - E(j) = E(r) + U - (LMAR + E(r)) = U - LMAR \quad (10)$$

E3ME then generates a variable called "U level" as:

"U level" = "Unemployed" + LMAR (11)

This is equivalent to the normal ILO measure of unemployment.

[9] E (r) is called "Supply in employment" in the imbalances workbooks.
[10] In the Imbalances workbooks this is what is included in Table 4 in the sheet "Summary Table".

Unemployment in all countries is calculated this way, except for Luxembourg, where the discrepancies were so large that it was not possible to model unemployment in a stable manner. The LMAR is calculated to match against the last year of historical data, taken from DG Ecfin's AMECO database, which uses ILO-consistent definitions. In the modelling, the LMAR is calculated using a “fixed share of employment”, although in the workbooks it can appear to vary; this is because the unemployment rate in the workbooks is only calculated to one decimal place.

"U Level" can easily be calculated from “U rate” by multiplying by the total labour force (LF).

However, as shown in equation (10) above, this will include the LMAR. The value of the LMAR will vary for those with H, M & L qualifications. It is possible to assess this by going back to the raw LFS data and using the historical estimate of the unemployment rate for H, M & L qualified people to generate a number for those unemployed in each category in the base year. This can then be compared with the difference between the “demand” and “supply” numbers in the base year. The difference is the LMAR for that qualification category. In principle, this can then be projected assuming (in the first instance) that it remains a constant proportion of the total LMAR (from E3ME) for all future years. In practice this has not been done. Instead an assumption is made about how unemployment is “shared out” amongst the H.M and L categories.

The E3ME data on total unemployment are used to provide overall constraints on the implied unemployment numbers by qualification (three broad levels: High (H), Medium or intermediate (M), and Low (or no) qualifications (L)) in the imbalances work. The latter are constrained to match the overall E3ME estimates of “U level”, making assumptions about how overall unemployment will be “shared “ between those with different levels of qualification, using LFS historical data and assumptions about how these patterns might change in the future. These assumptions are that pervious differentials will be maintained but that the better qualified will take an increasing share of total unemployment in line with their increasing share of the workforce.

One measure of initial imbalance and mismatch by H, M & L qualification levels can be obtained by subtracting the unconstrained “demand” estimates (employment estimates by qualification from the demand model, summed across all sectors and occupations) from the corresponding “supply” estimates (the total labour force across all ages and genders).

Table 4.1: Example E3ME data for Employment, the labour force and unemployment for the UK

UK	Emp_base																				
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total	29419.8	29779.8	29967	30241.6	30538.4	30887.6	31163.3	31389.2	31580.77	30579.09	30942.66	31172.33	31342.81	31480.11	31625.97	31727.52	31909.96	32246.85	32454.39	32618.03	32654.71
UK	LGR_base																				
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total	28869.5	28893.3	29183.5	29422.9	29623.6	30100.2	30573	30740.3	31119.4	31167.87	31294.15	31352.58	31579.5	31618.65	31726.89	31792.68	31924.43	32065.35	32195.58	32304.89	32371.99
UK	POP_base																				
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total	58892.52	59108.69	59327.66	59568.78	59879.86	60242.85	60621.25	60996.15	61343.82	61692.2	62042.91	62396.13	62754.78	63119.17	63487.18	63859.64	64236.62	64617.25	65001.14	65386.95	65772.52
	Unemployed (LGR-EMP)																				
	-550.299	-886.504	-783.501	-818.7	-914.8	-787.402	-590.302	-648.9	-461.373	588.775	351.492	180.249	236.685	138.541	100.918	65.159	14.476	-181.497	-258.81	-313.137	-282.715
U rate	5.4%	5.0%	5.1%	5.0%	4.7%	4.8%	5.4%	5.3%	5.6%	8.7%	8.0%	7.5%	7.7%	7.4%	7.3%	7.2%	7.0%	6.5%	6.2%	6.1%	6.2%
U level	1558.953	1444.665	1488.359	1471.145	1392.309	1444.81	1650.942	1629.236	1742.686	2711.604	2503.532	2351.444	2431.621	2339.78	2316.063	2289.073	2234.71	2084.248	1996.126	1970.598	2007.063
Residual	2109.252	2331.169	2271.86	2289.845	2307.109	2232.212	2241.244	2278.136	2204.059	2122.829	2152.04	2171.194	2194.936	2201.239	2215.145	2223.914	2220.234	2265.745	2254.936	2283.735	2289.778

Source E3ME

Initial comparisons suggest that the independent projections of qualifications patterns for supply and demand exhibit significantly different trends, with the supply of those with high and intermediate level qualifications generally rising more rapidly than the demand.

The implied demand side employment rates (e/r) by qualification category using such estimates when compared with the supply side activity rates (a/r) indicate some odd patterns, both:

a) Across categories; and
b) Over time.

In principle, of course $e/r < a/r$.

This implies the need to adjust either the initial demand or supply estimates to ensure consistency. The approach adopted here follows that used In the UK *Working Futures* work, where supply was used as a benchmark and demand is constrained to match. In this case it is not quite so obvious that the supply side estimates are sufficiently robust to justify this. In some respects it may be better to use the demand side numbers as benchmarks and adjust supply to match, as the demand numbers may be more reliable in some countries. However, in the present set of results the constraint is applied from demand to supply, rather than conversely.

A final adjustment has been made to the employment by qualification estimates to take into account the LMAR. As noted above, this residual measures the difference between employment as measured in the NA estimates (workplace based, jobs) and the corresponding Labour Force Survey (LFS) estimates (heads, residence based). Both these measures are used in the project.[11] The difference between the two can be quite significant and needs to be taken in to account, especially when comparing demand and supply estimates. The former are primarily NA based and focus on workplace jobs. The latter is mainly LFS based and focuses on residents.

The differences between the two include:

- Double jobbing (some have more than one job);
- Distinction between residence and workplace (many people do not live in the same country as they work, this is especially significant for some small countries such as Luxembourg);
- Government training and related schemes (which may count as in the labour force but not as in employment);
- Different definitions of unemployment (ILO versus measures of claimants to benefits);
- Statistical errors (in measures of employment, unemployment and related indicators, including sampling and measurements errors)
- Other differences due to use of different data sources; treatment of the armed forces and nationals working abroad.

Most of the employment estimates use the NA based measure. For qualifications two measures are presented:

1. ***Unconstrained employment estimates*** (E3ME, NA based numbers) showing “notional demand” (what employers would like to find given past trends);

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

2. Constrained (employment on a LFS basis, reconciled with supply). These are referred to as ***supply in employment*** or ***constrained employment estimates***.
3. Constrained (as in 2.) and scaled to NA levels. These are referred to as ***scaled employment estimates***.

The skill supply estimates should be compared with the LFS based *supply in employment* based figures (2). The employment estimates in 3. are consistent with all the other NA based estimates by sector and occupation.

5. Issue in Comparing Supply and Demand by Qualification

Distinguishing Demand and Supply

The historical patterns of employment by qualification observed are the result of a combination of both supply and demand factors. Separating them is not straightforward. Recent trends have seen a sharp rise in the formal qualifications held by those in employment in most countries. There is some evidence that this reflects **demand** changes, with many jobs requiring more formal higher level qualifications than used to be the case. There are also indications that the returns to obtaining such qualifications have remained high (for a review see Wilson *et al.* (2007)). On the other hand it is clear that there have been major changes on the **supply** side, in part at least in response to government policies to increase participation in higher education. The latter has resulted in a big increase in the numbers emerging on to the labour market with formal qualifications. The proportion of young people with formal qualifications is much higher than for older people. There is therefore a strong **cohort** effect. This has been reinforced to some extent by increasing qualification rates for older people as well (an "**upskilling**" effect).

The observed patterns of employment (**stocks** of people in employment with formal qualifications) clearly reflect both the demand and supply side influences. Certain indicators are more informative about one than the other. In particular, there are various measures of the **flows** of people through the education system which can be regarded as primarily supply side indicators (although even these reflect decisions that people are making about education based on their perceptions of the overall balance of supply and demand for different qualifications).

Issues in Developing Stock- Flow Models

In principle, it is possible to develop quite sophisticated analyses of the numbers of qualified people at higher level, using information on the **flows** of people through the education system. The **overall** supply of people holding formal qualifications at higher level (ISCED 5 and 6) is relatively straightforward to conceptualise and model. However, there are considerable conceptual and practical difficulties in extending this:

a) to include lower level qualifications (ISCED 1-2);
b) to conceptualise the idea of supply to cover specific dimensions such as occupation, sector and geographical area.

This is because the educational systems in most countries are not completely hierarchical. These issues are discussed in turn.

Limitations by ISCED level: The first problem to be addressed in extending this type of model to cover the full range of qualifications is the much more limited information available on lower level qualifications (ISCED1-2). Ideally, stock-flow modelling requires a comprehensive set of *demographic accounts* showing how individuals progress through the educational system and the labour market over time. In practise such accounts do not exist, although there is a considerable amount of information on certain flows as exploited in Module 6.

Statistical agencies collect and publish a considerable amount of information on the higher educational system in particular. In principle, this can be used to develop estimates of the main flows involved and thereby develop stock-flow models of this process. In practice, this information is often disparate and far from comprehensive.

In the case of lower level qualifications, while there is an enormous amount of detailed information available on the acquisition of qualifications, there is much less information on what prior qualifications these individuals may have possessed. This makes it difficult, if not impossible, to develop stock-flow models analogous to those constructed for higher levels (as for example in Wilson and Bosworth (2006) for the UK).

Highest versus all qualifications held: The discussion so far has focussed on highest qualifications held. As individuals acquire ISCED level 4, 5 and 6 qualifications, it is almost inevitable that the proportions with ISCED levels 1-3 as their highest qualification will fall. This can mean that, despite increases in those acquiring ISCED level 1-3 qualifications, the numbers and proportions of people with these as their highest qualification may actually decline.

Problems in conceptualising supply into occupations or sectors: Most occupations are undertaken by people with a range of formal qualifications. This is partly a function of age, with older workers generally relying more upon experience than formal qualifications. However, even allowing for the age factor, there are enormous differences. This makes defining the **supply of people into an occupation** almost impossible. It is possible to identify some key elements, focussing on the flows of people through the education and training system, but boundaries are too blurred and transitory to enable robust quantitative modelling.

Much the same is true for the concept of **supply of labour to a sector**. This will depend upon the occupational mix of the sector and its geographical location. For some occupations the labour market may be worldwide. This is increasingly true of many high level managerial and professional groups. Ever increasing ease of transport now means that it is also a feature of the labour markets for many lower-level occupations (for example, construction and agricultural workers, as well as nurses). While individual sectors may be able to address these issues it is very difficult to develop a general approach that can cover all these aspects consistently for the whole economy.

ROA's experience of confronting labour supply by education with labour demand by occupation (sector) in the Netherlands suggest that this can be done using a detailed allocation matrix of education/qualification by occupation (sector). This matrix indicates in each year the number of workers with various qualifications working in the various occupations (sectors). Using this matrix, a supply forecast by education can be translated into a supply forecast by occupation (sector) which in turn can be confronted against the demand forecast by occupation. The distance between supply and demand at the occupational level can give an indication of the adjustment required to achieve equilibrium. Although this type of matrix is available in the Netherlands for a long period, and has been used by ROA in its forecasting activity, the currently available data at a pan European level are inadequate to provide this for all countries. This limits the scope for confronting demand and supply.

The **Sort** algorithm (BALMOD) described below provides a simpler approach to reconciling the demand and supply results in aggregate, given the data available for all countries. Its outcome is that for individual occupations or sectors the patterns of qualifications as revealed by the original unconstrained demand projections and the constrained ones will show how any surpluses or shortages affect the qualification mix. If supply is growing faster than demand for particular levels of qualifications then the constrained qualification mix will be "richer" than the unconstrained one (and conversely). Comparison of the constrained and unconstrained results provides a

useful indicator of supply demand pressures for different occupational and sectoral groups. Where supply is growing faster than demand for a particular qualification category, the proportions qualified in the constrained results will exceed those in the unconstrained results, and conversely.

The concept of supply of qualifications at a spatial level is somewhat more manageable than those for occupations or sectors. It is relatively straightforward to develop quantitative estimates and projections of population and the labour force for each country. In principle, this can be extended to cover formal qualifications held. However, the data available at pan-European level are generally less robust than at a national level. Moreover the issues of commuting and migration flows become significant. While it is possible, in principle, to envisage the development of customised qualification supply models for each individual country this would require considerable resources and a time frame going well beyond that available in the present project. A common approach is therefore adopted here.

The present modelling therefore limits the modelling to a much more simplified level that the more detailed and sophisticated stock-flow analysis that have been applied in some individual member states (e.g. to the UK national level, Wilson and Bosworth (2006)), reflecting the data constraints faced at a pan European level.

6. Allocation of supply to demand

In order to match or reconcile the estimates of supply and demand for skills some form of allocation matrix, assigning qualification mixes of the employed population to occupations (jobs) has to be used. One approach is to use a fixed allocation matrix, matching the allocation of jobs to the available supply:

$$\mathbf{S}\ \mathbf{A} = \mathbf{D} \qquad (12)$$

The supply estimate provides us with a forecast of supply. Supply can be distinguished between the three major levels of qualification, low, medium, and high. This supply has to be matched to the demand by occupation, (allocated to the jobs available). This allocation of qualifications to supply follows the observed patterns of qualifications within occupations.

The supply by education levels (in matrix ***S***) is allocated through an allocation matrix ***A*** with shares to demand. Note that in order for the equation to hold, given that it is the predicted supply $\hat{S}$ and predicted demand $\hat{D}$ that is used, the allocation matrix also has to rescale the overall level of "supply in employment" to match the overall level of demand (number of jobs available on a National Accounts basis. Furthermore, it is important that the shares assigned in ***A*** to reconcile supply and demand are reasonable, in that they reflect economically feasible matches of occupations and qualifications.

The **SORT** algorithm developed for the project is a method to determine a matrix **A**, that allocates qualifications to occupations appropriately. It transforms an existing matrix ***B***, containing the starting values, in such a way that it fulfils the condition in equation (12).

$$f(\mathbf{B}) \rightarrow \mathbf{A} \qquad (13)$$

The process follows an RAS procedure[12] that iteratively scales rows and columns of **B** to match values which are determined in equation (12).

The sort algorithm insures that the matrix ***A*** matches supply and demand, however the economic feasibility is only insured insofar as the starting values to determine ***A*** are "sensible". To insure economic feasibility the starting values of matrix ***B***, i.e. the initial distribution of qualification shares of occupations before entering the RAS procedure, should reflect likely or rather economically meaningful values.

Two candidates stand out here: one is the allocation as it is determined through the demand side of the forecast, which we will denote by $\boldsymbol{D_a}$. In the demand forecast not only the number of workers in an occupation is determined, but also the distribution share of education. However, supply will usually not be able to fulfil all of the demand. If we use the $\boldsymbol{D_a}$ as starting values to determine the matrix of allocation ***A*** in the RAS procedure the outcomes will reflect adjustment necessary to the forecasted demand to match supply. While the system / procedure is in itself ignorant of economic processes, it tries to adjust the initial matrix only to the extent that they fulfil equation (1).

[12] RAS is a well established iterative procedure, developed originally to handle input output matrices, that is designed to produce a solution to such problems.

The second alternative is to start the procedure from the initial distribution in the base year of the forecast. In that way the allocation matrix to be adjusted reflects the current allocation of qualifications into occupations. Adjustments necessary to match the forecasted supply S and demand ***D*** can then be interpreted as the adjustment process necessary over the forecasting period. Beyond the forecast of total worker in occupations demand and total qualifications provided, no extra information is necessary. This is thus also a good choice if the forecast of occupation by education are not possible (or give highly implausible results).

The current set of results adopts the first of these alternatives. Future work will consider the other possibility and how sensitive the results are to this assumption.

Demand side

In these initial results the occupational employment projections are taken here as given (exogenous).

The initial Qualification shares within occupations then give the overall ***unconstrained demand*** picture for qualifications (numbers in employment for Highly qualified (HQ), Medium qualified (MQ) and Low qualified (LQ) categories).

These can then be compared with the supply side projections. This ignores any complications caused by differences in definition or coverage, which as discussed in Section 1, includes problems due to differences between LFS and National Accounts (NA) based employment estimates, use of estimates based on heads versus jobs, residence versus workplace, etc.

Supply side

Labour force numbers by qualification are taken from the stock based model.

Total Unemployment is taken from E3ME and is regarded as given (exogenous) for the purpose of these comparisons. It shows a slow downward trend but remains at historically quite high levels following the recession of 2009.

Unemployment is shared out between HQ, MQ and LQ categories, based on an analysis of LFS historical data (using trends in shares of unemployment in the three categories), subject to unemployment rates remaining plausible for each of the HQ, MQ and LQ categories, maintaining the well established hierarchy in rates, with the better qualified have lower rates than the les well qualified.

The unemployed by qualification level are then subtracted from the labour force to obtain ***supply in employment***.

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The iterative **SORT** mechanism (algorithm) is then used to sort the available people (as given by the supply projections) into jobs (occupations), thereby reconciling the projected supply numbers (net of unemployment) with projected demand. This is called BALMOD. The adjustments are done in proportion to where the existing numbers are deployed. This analysis focuses attention on shifting patterns of qualification mix within occupations. This general approach builds upon previous similar research as set out in Wilson and Bosworth (2006) for the UK.

This algorithm increases or decreases qualifications shares (for each of HQ, MQ, LQ) within occupations and sectors until the overall numbers in the HQ, MQ and LQ categories for each country match the economically active, supply side figures, net of unemployment. (This ignores any possible migration or other factors that may result in a discrepancy between the labour force and sum of employment and unemployment). Employment shares of the HQ, MQ and LQ categories are constrained:

- To lie between 0 and 1 (1 and 100%);
- To sum to 1 (or 100%).

A final step scales the estimates employment numbers to match the E3ME NA based employment estimates. This ensures complete consistency with the estimates of employment by sector and occupation and effectively deals with the LMAR discrepancy. These are referred to as ***scaled and constrained estimates***.

The final results imply that there may be some over or under-qualification compared with the initial demand side projections, and that this pressure varies between occupations and sectors.

The following elements are important here:

I. the ***Demand for qualifications model*** (Module 3, EDMOD), which delivers overall numbers of people in employment, qualified at three broad ISCED levels);
II. the ***Stock model*** of supply (Module 5, STOCKMOD, in the overall *Framework*);
III. the ***Sorting model (SORT algorithm),*** (Module 7, BALMOD)which sorts people classified by qualifications held into occupations such that the results from I and II can be made consistent.

The **SORT** algorithm reconciles the two sets of estimates of demand for and supply of qualifications. This final element compares the supply numbers with the demand ones and re-computes the employment patterns to bring the two into agreement (making certain assumptions about unemployment). Effectively it acts as a sorting mechanism that raises or lowers qualification shares within occupations until demand and supply numbers match. This does not imply that demand and supply are equal however, since some people may be over or under-qualified for the jobs they are employed to do.

Box 6.1 provides a summary of how this sorting algorithm works. The 3 main elements are now discussed in more detail, in turn.

Demand for qualifications model (Occupational/qualifications share model, Module 3, EDMOD)

The discussion above has focussed upon the numbers of people entering and leaving the stock of those with formal qualifications (the supply side). The other side of the coin is the way qualification profiles are changing within occupations (demand). Previous analysis (Wilson, 2001) has indicated that ideally these patterns should be examined at a quite detailed level, since they vary significantly within occupational groups. In practice, the current set of Cedefop demand side projections is restricted to the 2 digit level of ISCO. In these results LFS data were used to develop qualification profiles and projections for those in employment.

Stock model of supply (qualification shares in supply) (Module 5, STOCKMOD)

In order to assess changing skills supply patterns within each country a simple model for developing projections of the supply of people by qualification has been developed. This focuses upon patterns in the qualifications currently held as reported in the Labour Force Survey (LFS).[13] These patterns are then applied to independent projections of labour supply by age and gender taken from E3ME (based in turn on official Eurostat population projections).

The LFS is a sample survey which collects information on current educational attainment and individuals list qualifications currently held (by level and type). This information is used to ascertain the current *stock* of qualifications. The model focuses on the highest qualification held by age group, gender and country. The models used effectively identify separate time trends for each qualification level. These fitted time trends are then used to generate projections of qualification attainment over the forecast period. The data on qualifications shares are then mapped onto labour force projections from the E3ME model to project numbers holding qualifications by age category and gender.

The propensity to hold a given level of qualification is measured using aggregate data drawn from the LFS, with the trends estimated using a logistic model. Variables are introduced into the model to specifically capture 'spatial effects' (including country specific intercept and time trend for each qualification level, age and gender category. This modelling strategy makes maximum use of the limited data. The analysis focuses upon individual qualification achievement levels (dependent variable) against a set of explanatory variables. Demographics are controlled for by including age band categories across which qualifications achievement may be expected to vary.

Note that the focus is not primarily on *explaining* attainment *per se*, instead it is upon using the estimated trends by qualification level to project future attainment, whilst controlling for other influences. The time trend variables drive the projections, and the inclusion of the age-gender categories allows independent projections by age and gender.

The regression analysis uses a logistic specification. The propensity to obtain a given level of qualification at the individual level is given by:

$$Q_{ijk} = \alpha_{jk} + \beta_{jk} t + \gamma A_{ijk} + \varphi G_{ijk} \qquad (14)$$

where, *i* denotes the *i*-th individual, j refers to the *j*-th country and *k* is the *k*-th age group. **Q** takes values of 0 or 1 depending on whether the individual holds a particular qualification or not. There are 3 qualification categories, high medium and low, (one category is left out as the base group). **A** denotes a set of age band dummies, taking values of 1 if the individual falls into a particular age category. **G** is a gender dummy, taking values of 1 for females and 0 for males. Finally, a set of time trend variables **t** are included, capturing changes in achievement levels over time. These differ by country and gender and for each age band.[14]

[13] It is based on a model originally developed by IER for Future Skills Scotland. See Dickerson *et al.* (2004).

[14] i.e. time trends multiplied by dummy variables which take a value of 1 for those living in a particular region or in a particular age category.

Although (as note above) the focus here is not on explaining attainment, it is interesting to note that an upward trend in attainment at all levels is observed in almost all cases (other than the low qualifications category).

Sorting model (SORT algorithm, Module 7, BALMOD)
These two sets of results are compared and reconciled using the *qualifications sorting algorithm.* The results obtained from the models of supply and demand are developed quite independently. This reflects in some respects the way the labour market operates. Supply driven changes in educational participation and the acquisition of credentials operate quite independently of changing demand side patterns that affect the typical qualification requirements in jobs offered by employers. Typically, market forces will tend to operate in such a way as to bring supply and demand into balance. Generally, those who are better qualified will tend to find and retain employment more readily than those less well qualified. As shown in Table 6.1, for many countries there is a clear monotonic relationship between unemployment rates and the level of qualification held. The table shows the results for the Eur27+2. Although the differentials between qualification levels have narrowed over the past decade, the probability of unemployment for somebody with low formal qualifications is still more than twice as high as for someone with a high level of qualification across Europe as a whole.

Table 6.1: Unemployment Rates by Qualification Level (UK)

	2000	2001	2002	2003	2004	2005	2006	2007
Low	8.8	7.6	8.1	7.5	7.7	7.6	9.1	9.4
Medium	5.1	4.1	4.4	4.4	4.3	4.3	5.2	5.1
High	2.6	2.4	2.8	2.8	2.4	2.5	2.7	2.3
All qualifications	5.6	4.7	5.1	4.8	4.6	4.6	5.3	5.2

Source: EU LFS micro-data

The way in which people find jobs, once they acquire their qualification, is very complex. However the typical outcomes can be proxied by a very simple sorting algorithm which effectively “shuffles” qualified people into jobs (occupations). The algorithm can be adjusted to allow for the differential unemployment probabilities as set out in Table 2.1. In this case unemployment rates and levels have been projected based on an assumption that the past relativities between qualification categories are maintained. The implications for unemployment rates are shown in the following section.

Based on the overall projected level of unemployment, and the implications for how this is shared between those qualified at different levels, the iterative procedure is then used to adjust the total numbers qualified from the occupational/qualification shares (demand) results to match the results from the supply model (net of unemployment). This process of scaling changes the occupational employment totals. The occupational totals are then readjusted to match the original levels. The qualification levels are then readjusted and the process repeated until a solution is reached in which both the qualification profile matches the supply model results and the original occupational results are restored.

A final scaling process adjust the estimates back on to an E3ME NA employment basis to ensure consistency with the other employment estimates from E3ME.

Box 6.1: Reconciling Demand and Supply - BALMOD

The sorting algorithm at the heart of BALMOD is designed to reconcile the projections from the **Stock model** of supply (numbers available by the three qualification levels) with those from the **demand for qualifications model** (number of jobs requiring particular qualification levels). The former provides a view of supply side developments (the overall numbers of people who have acquired qualifications at the three different levels that are actively searching for work), while the latter is more concerned with changing demand for qualifications within occupations (the number of jobs available requiring particular levels of qualifications).

The module also has to deal with differences between the various estimates of employment used in E3ME (based on National Accounts and LFS data) and the so called Labour Market Accounts Residual (LMAR) which arises in part because of such discrepancies but which is also affected by other issues, including measurement error. The main employment measure used in E3ME is a National Accounts based one. This is referred to as ***unconstrained estimates of employment***. All the estimates by sector and occupation are on this basis. A second measure, based on LFS information and Eurostat demographic data is implicit in the modelling of labour supply. This is referred to as ***supply in employment***. The two differ for a variety of reasons, encompassed under the heading of the LMAR. These include:

- Double jobbing (some have more than one job);
- Distinction between residence and workplace (many people do not live in the same country as they work, this is especially significant for some small countries such as Luxembourg);
- Government training and related schemes (which may count as in the labour force but not as in employment);
- Different definitions of unemployment (ILO versus measures of claimants to benefits);
- Statistical errors (in measures of employment, unemployment and related indicators, including sampling and measurements errors);
- Other differences due to use of different data sources; treatment of the armed forces and nationals working abroad.

The **Sorting** model uses an iterative RAS procedure to reconcile two sets of estimates of employment, ***changing*** the overall qualification shares from the **demand for qualifications model (QUALMOD)** to match those from the **Stock model** of supply (STOCKMOD), while at the same time maintaining the patterns of occupational deployment, and ensuring a plausible pattern of unemployment rates for the different qualification categories. It is therefore focused upon which occupations the people with different qualifications end up in.

Overall Unemployment levels are taken from E3ME. This is taken as exogenous for these purposes. The overall level of unemployment is shared out between qualification categories, based on an extrapolation of patterns from historical LFS data. In the current versions it is assumed that the relative rates of unemployment for the three broad qualification categories are maintained. Checks are made to see that this results in plausible unemployment levels for the three qualification categories. The implied unemployment levels by qualification are then deducted from the overall supply numbers to get the numbers of people in employment by qualification level (**Supply in employment**). The sorting model then reconciles these estimates with the number of jobs available (unconstrained estimates) by altering the shares of people with the three different qualification levels employed within each occupation until the overall numbers match the numbers of people available.

The final results may show indications of over or under-qualification of people in different occupations, depending on the overall demand supply balance.

The ***constraint*** (matching of numbers by the three qualifications levels) is imposed at the 2 digit occupational level. The key dimensions in the SORT routine are:

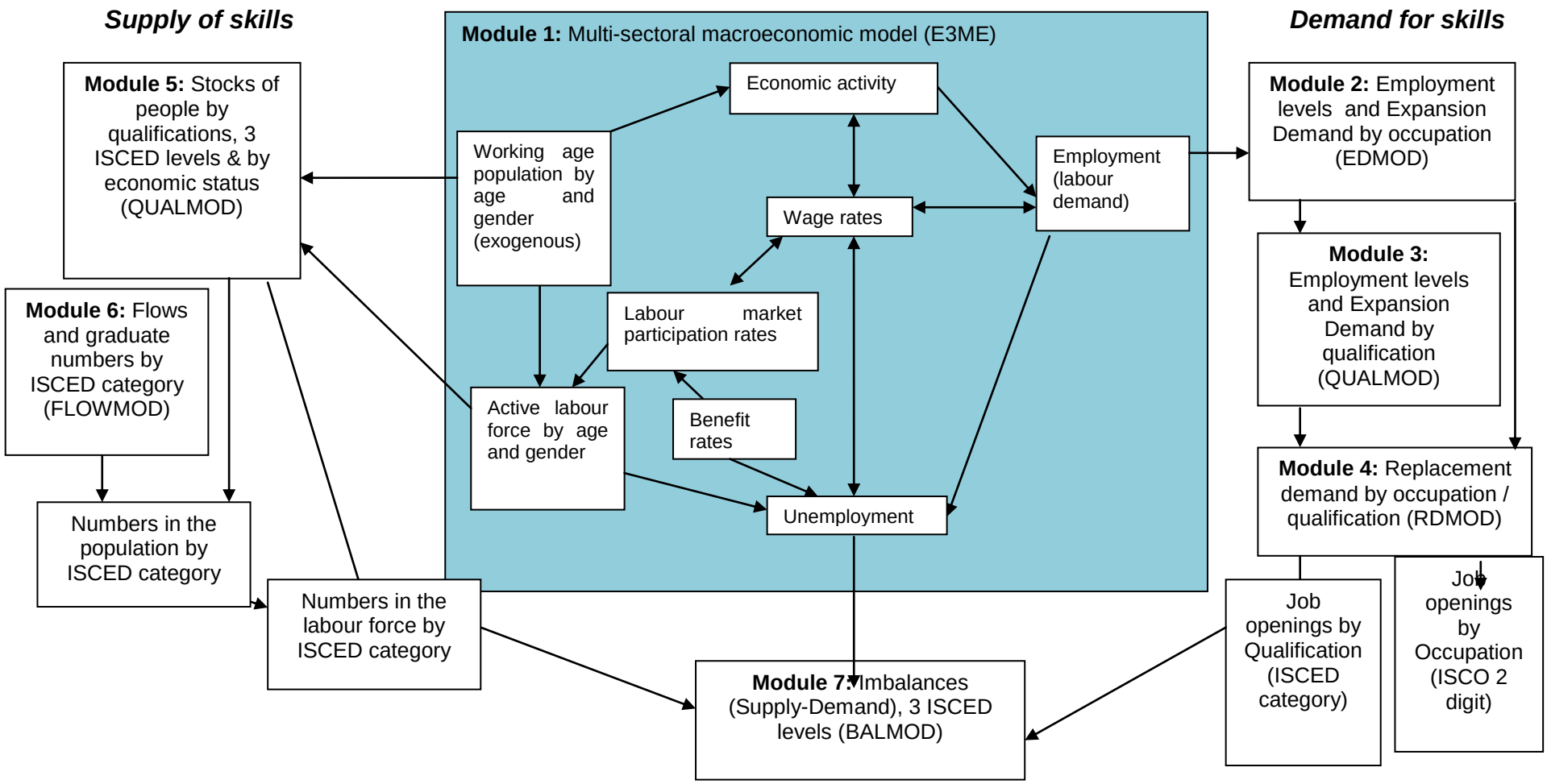
- Occupation (27);
- Qualification level (3);
- Sector (41);

(although the results in a number of the summary tables in the ***Imbalances*** workbook where this is undertaken show outcomes for aggregate 1 digit occupational groups and 6 broad sectors only)

The Sorting model operates for each country separately. There are assumed to be no adjustments via cross border flows (migration or commuting).

There is then one final step, where the final outcomes from the sort routine are scaled to match the original E3ME employment totals, to deal with the LMAR discrepancy.

Figure 6.1: Modelling the Demand for and Supply of Skills – E3ME Extended



7. Comparing imbalances for Greece, the UK and the Netherlands

Table 7.1 presents an initial comparison of supply and demand for Greece. The top part of the table shows employment estimates. The middle section of the table shows the difference between employment and the labour force. For various reasons this cannot be interpreted as unemployment (if "supply" (the labour force) exceeds "demand" (employment)) or a shortage (if demand exceeds supply). This is because the two sets of estimates are not directly comparable, as discussed above.

The bottom part of the table draws out some implications for unemployment. As discussed above this takes the overall E3ME estimates of unemployment and divides these up for the historical and forecast periods based on maintaining well the established hierarchy in terms of unemployment rates by qualification category taken from LFS data.

The implications of this for unemployment **rates** for the different qualification categories are shown in Table 7.2. The overall unemployment rate remains steady in this scenario at between 7 and 8%. The rates for those with low qualifications are projected to fall as the recovery from recession takes place but to remain above those for the high qualification category. In Greece the unemployment rates for the intermediate group have unusually been higher than for the low qualified category and this is projected (by assumption) to continue). These should be regarded as working assumptions rather than projections.

Taking these estimates of unemployment as given, the implications for the supply projections of the numbers in employment can then be compared with the demand figures. This is done in the top panel of Table 7.3.

The **Sort** algorithm described above is then used to reconcile the two sets of estimates for particular occupations and sectors. This is done for all years, but the table focuses on the results for 2020. The results in Table 7.3 show how particular occupations or sectors might be expected to absorb the projected pattern of supply compared to the original demand based projection for 2020.

The final columns show the final ratios of demand to supply. A value greater than 1 indicates demand exceeds supply and conversely. These ratios vary, although averaging out to the same values across all industries or across all occupations.

Tables 7.4 – 7.9 show corresponding results for the UK and the Netherlands respectively.

Table 7.1: Estimates of imbalances by broad qualification, (GREECE)

Table 3a Employment by level of qualification {from E3ME scaled to match overall total of supply in employment (as Table 3b)(="demand")}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	1,852	1,482	1,287	1,099	-370	-20.0	-2.2	-196	-13.2	-2.8	-384	-25.9	-2.9
Medium	1,418	1,841	1,974	2,044	422	29.8	2.6	133	7.2	1.4	203	11.0	1.1
High	830	1,207	1,367	1,489	377	45.5	3.8	160	13.3	2.5	282	23.3	2.1
All qualifications	4,100	4,530	4,628	4,632	430	10.5	1.0	97	2.2	0.4	102	2.2	0.2

Note: This is the demand estimate (employment) before its use in the sort model.

Table 3b Supply in employment by level of qualification {economically active less E3ME unemployment from supply projection run (as Table 5)}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	1,768	1,460	1,231	1,003	-308	-17.4	-1.9	-229	-15.7	-3.3	-456	-31.3	-3.7
Medium	1,526	1,820	1,975	2,053	294	19.2	1.8	155	8.5	1.7	233	12.8	1.2
High	806	1,250	1,421	1,576	444	55.1	4.5	171	13.6	2.6	326	26.0	2.3
All qualifications	4,100	4,530	4,628	4,632	430	10.5	1.0	97	2.2	0.4	102	2.2	0.2

Source: Economically active less unemployment.

Table 4a Overall imbalances[a] by level of qualification (economically active (supply estimate) less employment (demand estimate))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	94	92	28	-27	-1	-1.3	-0.1	-65	-69.9	-21.3	-120	-129.5	*
Medium	377	169	178	192	-209	-55.3	-7.7	9	5.3	1.0	24	14.0	1.3
High	46	133	141	185	87	186.9	11.1	8	6.3	1.2	52	38.9	3.3
All qualifications	517	394	347	350	-123	-23.8	-2.7	-47	-12.0	-2.5	-44	-11.2	-1.2

Source: IER estimates, based on CE's E3ME model.

Notes: a) This table refers to the difference between estimates of the economically active (from Table 2) and those in employment from Table 3a above

b) Positive numbers indicate unemployment (supply exceeds demand)

*) not computable

Table 4b Mismatch in employment (supply in employment less demand (E3ME employment))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	-84	-22	-55	-95	61	0.0	0.0	-33	0.0	0.0	-73	0.0	15.6
Medium	108	-21	2	9	-128	-119.0	#NUM!	22	0.0	0.0	29	0.0	0.0
High	-24	43	53	87	67	0.0	0.0	11	24.5	4.5	44	102.0	0.0
All qualifications	0	0	0	0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

Table 5 E3ME unemployment by level of qualification

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	177	115	83	68	-63	-35.3	-4.3	-32	-27.6	-6.3	-47	-40.7	-5.1
Medium	269	189	176	184	-80	-29.8	-3.5	-13	-7.1	-1.5	-6	-2.9	-0.3
High	70	90	88	98	20	27.8	2.5	-2	-2.3	-0.5	8	8.9	0.9
All qualifications	517	394	347	350	-123	-23.8	-2.7	-47	-12.0	-2.5	-44	-11.2	-1.2

Note: LFS qualification patterns of unemployment by qualification category are applied to E3ME unemployment totals.

Notes: The supply data and unemployment data are both taken from the E3ME "supply" projection.. The discussion in Section 4 highlights how E3ME deals with overall imbalances (i.e. labour supply not being consistent with employment + unemployment, which is due to use of different data sources, population forecasts, etc).

Table 7.2: Implications for unemployment by broad qualification (GREECE)

Table 7 Unemployment rate (%) by qualification								(from LFS)	(E3ME based)											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Low	9.2	8.9	8.4	7.8	9.3	8.8	8.1	7.6	7.0	7.9	7.3	7.2	6.9	6.7	6.3	6.3	6.3	6.3	6.3	6.3
Medium	15.1	13.6	13.0	12.2	12.4	11.8	10.7	9.8	9.1	10.2	9.4	9.3	9.0	8.6	8.2	8.2	8.1	8.1	8.1	8.2
High	8.1	7.7	7.1	6.8	7.8	7.9	7.2	7.0	6.5	7.3	6.7	6.7	6.4	6.2	5.8	5.8	5.8	5.8	5.8	5.8
All qualifications	11.3	10.5	10.0	9.4	10.3	9.9	8.9	8.3	7.7	8.6	8.0	8.0	7.6	7.4	7.0	7.0	6.9	7.0	7.0	7.0
Source: EU LFS micro-data																				
						fixed share values (% rates)			7.3	8.4	8.0	8.3	8.3	8.3	8.2	8.5	8.8	9.2	9.6	10.0
						(implausible			9.0	10.0	9.2	9.0	8.5	8.1	7.6	7.5	7.4	7.4	7.3	7.3
									6.2	6.9	6.2	6.0	5.7	5.4	5.0	4.9	4.7	4.7	4.6	4.5
Table 8 E3ME Unemployment Levels[d]																				
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	517	490	479	459	506	480	435	408	379	428	394	391	377	364	347	347	345	347	347	348
Note: d) based on CE calibrated unemployment rates and E3ME labour force						Using LFS 2007 qualificatio			122	137	127	126	121	117	111	111	111	111	111	112
						fixed share of unemploymer			177	200	184	183	176	170	162	162	161	162	162	162
									80	91	83	83	80	77	73	73	73	73	73	74
									379	428	394	391	377	364	347	347	345	347	347	348
Table 9 E3ME Unemployment by qualification[e]									Final projected unemployment based on scaled version of constant differential rates from above											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Low	177	172	161	147	160	146	141	131	117	129	115	110	102	94	86	83	79	77	73	71
Medium	269	249	249	243	256	245	207	191	179	203	189	190	185	181	174	176	176	178	180	181
High	70	70	70	69	90	88	87	86	84	96	90	91	90	89	86	88	89	92	94	96
All qualifications	517	490	479	459	506	480	435	408	379	428	394	391	377	364	347	347	345	347	347	348
Note: e) LFS unemployment proportions (from Table 6) are applied to E3ME unemployment levels																				

(projected unemployment rates by qualification level assume a fixed share of unemployment between the three categories from 2007)

Table 7.3: Reconciling demand and supply by broad qualification GREECE, 2020

	Unconstrained Demand (employment) *Table 3a*	Supply (labour force) *Table2*	Unemployment *Table 5*	Supply in Employment *Table 3b*	Constrained Demand	Ratio Demand/ Constrained Demand	Ratio Unconstrained Demand/ Supply in	Ratio Supply in employment/ Constrained Demand	Check
Totals	4,631,786	4,981,486	349,700	4,631,786	4,631,786	1.000	1.000	1.000	1.000
ISCED 1-2	1,098,643	1,071,413	68,074	1,003,339	1,003,339	1.095	1.095	1.000	1.095
ISCED 3-4	2,043,924	2,236,204	183,557	2,052,647	2,052,647	0.996	0.996	1.000	0.996
ISECD 5-6	1,489,218	1,673,869	98,069	1,575,800	1,575,800	0.945	0.945	1.000	0.945
By occupation				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.			
All qualifications									
All occupations	4,631,786			4,631,786	4,631,786	1.000	1.000	1.000	1.000
Armed forces	54,090			55,550	54,090	1.000	0.974	1.027	1.000
Legislators, senior officials and managers	442,236			443,276	442,236	1.000	0.998	1.002	1.000
Professionals	637,137			671,787	637,137	1.000	0.948	1.054	1.000
Technicians and associate professionals	587,758			608,231	587,758	1.000	0.966	1.035	1.000
Clerks	516,087			517,858	516,087	1.000	0.997	1.003	1.000
Service workers and shop and market sales workers	724,018			723,425	724,018	1.000	1.001	0.999	1.000
Skilled agricultural and fishery workers	390,055			369,146	390,055	1.000	1.057	0.946	1.000
Craft and related trades workers	605,198			588,405	605,198	1.000	1.029	0.972	1.000
Plant and machine operators and assemblers	334,535			324,319	334,535	1.000	1.032	0.969	1.000
Elementary occupations	340,671			329,790	340,671	1.000	1.033	0.968	1.000
ISCED 1-2									
All occupations	1,098,643			1,003,339	1,003,339	1.095	1.095	1.000	1.095
Armed forces	3,257			2,975	2,640	1.234	1.095	1.127	1.234
Legislators, senior officials and managers	89,833			82,040	79,061	1.136	1.095	1.038	1.136
Professionals	1,843			1,683	1,466	1.257	1.095	1.148	1.257
Technicians and associate professionals	18,979			17,333	15,368	1.235	1.095	1.128	1.235
Clerks	59,848			54,657	52,249	1.145	1.095	1.046	1.145
Service workers and shop and market sales workers	129,862			118,597	113,492	1.144	1.095	1.045	1.144
Skilled agricultural and fishery workers	258,174			235,778	244,303	1.057	1.095	0.965	1.057
Craft and related trades workers	235,536			215,104	216,192	1.089	1.095	0.995	1.089
Plant and machine operators and assemblers	137,862			125,903	128,237	1.075	1.095	0.982	1.075
Elementary occupations	163,449			149,270	150,330	1.087	1.095	0.993	1.087
ISCED 3-4									
All occupations	2,043,924			2,052,647	2,052,647	0.996	0.996	1.000	0.996
Armed forces	22,516			22,612	20,941	1.075	0.996	1.080	1.075
Legislators, senior officials and managers	216,374			217,297	216,213	1.001	0.996	1.005	1.001
Professionals	39,470			39,639	35,706	1.105	0.996	1.110	1.105
Technicians and associate professionals	203,248			204,115	191,002	1.064	0.996	1.069	1.064
Clerks	363,132			364,682	359,162	1.011	0.996	1.015	1.011
Service workers and shop and market sales workers	443,116			445,007	441,105	1.005	0.996	1.009	1.005
Skilled agricultural and fishery workers	114,741			115,231	124,394	0.922	0.996	0.926	0.922
Craft and related trades workers	331,391			332,805	343,396	0.965	0.996	0.969	0.965
Plant and machine operators and assemblers	179,903			180,671	186,020	0.967	0.996	0.971	0.967
Elementary occupations	130,034			130,589	134,708	0.965	0.996	0.969	0.965
ISCED 5-6									
All occupations	1,489,218			1,575,800	1,575,800	0.945	0.945	1.000	0.945
Armed forces	28,317			29,963	30,508	0.928	0.945	0.982	0.928
Legislators, senior officials and managers	136,030			143,939	146,962	0.926	0.945	0.979	0.926
Professionals	595,824			630,465	599,965	0.993	0.945	1.051	0.993
Technicians and associate professionals	365,531			386,783	381,388	0.958	0.945	1.014	0.958
Clerks	93,106			98,520	104,676	0.889	0.945	0.941	0.889
Service workers and shop and market sales workers	151,040			159,821	169,421	0.892	0.945	0.943	0.892
Skilled agricultural and fishery workers	17,140			18,137	21,359	0.803	0.945	0.849	0.803
Craft and related trades workers	38,271			40,496	45,610	0.839	0.945	0.888	0.839
Plant and machine operators and assemblers	16,770			17,745	20,279	0.827	0.945	0.875	0.827
Elementary occupations	47,187			49,931	55,633	0.848	0.945	0.898	0.848
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.									
By Sector				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.			
All qualifications (total)									
All industries	4,631,786			4,631,786	4,631,786	1.000	1.000	1.000	1.000
Primary sector & utilities	450,748			429,239	450,748	1.000	1.050	0.952	1.000
Manufacturing	442,334			434,233	442,334	1.000	1.019	0.982	1.000
Construction	348,436			340,988	348,436	1.000	1.022	0.979	1.000
Distribution & transport	1,645,699			1,639,238	1,645,699	1.000	1.004	0.996	1.000
Business & other services	750,705			759,320	750,705	1.000	0.989	1.011	1.000
Non-marketed services	993,864			1,028,768	993,864	1.000	0.966	1.035	1.000
ISCED 1-2									
All industries	1,098,643			1,003,339	1,003,339	1.095	1.095	1.000	1.095
Primary sector & utilities	275,658			251,746	261,074	1.056	1.095	0.964	1.056
Manufacturing	162,820			148,696	151,919	1.072	1.095	0.979	1.072
Construction	117,370			107,188	106,295	1.104	1.095	1.008	1.104
Distribution & transport	349,870			319,520	311,985	1.121	1.095	1.024	1.121
Business & other services	127,594			116,525	113,614	1.123	1.095	1.026	1.123
Non-marketed services	65,331			59,664	58,451	1.118	1.095	1.021	1.118
ISCED 3-4									
All industries	2,043,924			2,052,647	2,052,647	0.996	0.996	1.000	0.996
Primary sector & utilities	144,338			144,954	154,062	0.937	0.996	0.941	0.937
Manufacturing	189,841			190,652	193,571	0.981	0.996	0.985	0.981
Construction	198,632			199,480	205,265	0.968	0.996	0.972	0.968
Distribution & transport	955,042			959,118	957,036	0.998	0.996	1.002	0.998
Business & other services	307,099			308,410	303,711	1.011	0.996	1.015	1.011
Non-marketed services	248,972			250,034	239,002	1.042	0.996	1.046	1.042
ISCED 5-6									
All industries	1,489,218			1,575,800	1,575,800	0.945	0.945	1.000	0.945
Primary sector & utilities	30,752			32,540	35,612	0.864	0.945	0.914	0.864
Manufacturing	89,673			94,886	96,843	0.926	0.945	0.980	0.926
Construction	32,434			34,319	36,876	0.880	0.945	0.931	0.880
Distribution & transport	340,787			360,600	376,678	0.905	0.945	0.957	0.905
Business & other services	316,012			334,385	333,380	0.948	0.945	1.003	0.948
Non-marketed services	679,561			719,070	696,411	0.976	0.945	1.033	0.976
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.									

Table 7.4: Estimates of imbalances by broad qualification (UK)

Table 3a Employment by level of qualification {from E3ME scaled to match overall total of supply in employment (as Table 3b)(="demand")}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	9,260	5,392	4,134	3,362	-3,868	-41.8	-5.3	-1,259	-23.3	-5.2	-2,030	-37.6	-4.6
Medium	10,441	13,317	14,504	15,587	2,875	27.5	2.5	1,187	8.9	1.7	2,270	17.0	1.6
High	7,609	9,587	10,486	11,241	1,978	26.0	2.3	899	9.4	1.8	1,654	17.3	1.6
All qualifications	27,311	28,296	29,123	30,190	986	3.6	0.4	827	2.9	0.6	1,894	6.7	0.7

Note: This is the demand estimate (employment) before its use in the sort model.

Table 3b Supply in employment by level of qualification {economically active less E3ME unemployment from supply projection run (as Table 5)}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	8,391	4,849	3,396	2,399	-3,542	-42.2	-5.3	-1,453	-30.0	-6.9	-2,450	-50.5	-6.8
Medium	11,154	13,443	14,592	15,644	2,289	20.5	1.9	1,149	8.5	1.7	2,201	16.4	1.5
High	7,765	10,004	11,135	12,147	2,238	28.8	2.6	1,132	11.3	2.2	2,144	21.4	2.0
All qualifications	27,311	28,296	29,123	30,190	986	3.6	0.4	827	2.9	0.6	1,894	6.7	0.7

Source: Economically active less unemployment.

Table 4a Overall imbalances[a] by level of qualification (economically active (supply estimate) less employment (demand estimate))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	-94	513	-27	-504	607	-646.2	*	-540	-105.3	*	-1,017	-198.2	*
Medium	1,292	1,582	1,611	1,562	290	22.5	2.0	28	1.8	0.4	-21	-1.3	-0.1
High	361	885	1,153	1,415	524	145.3	9.4	268	30.2	5.4	530	59.8	4.8
All qualifications	1,559	2,981	2,737	2,473	1,422	91.2	6.7	-244	-8.2	-1.7	-508	-17.0	-1.9

Source: IER estimates, based on CE's E3ME model.

Notes: a) This table refers to the difference between estimates of the economically active (from Table 2) and those in employment from Table 3a above

b) Positive numbers indicate unemployment (supply exceeds demand)

*) not computable

Table 4b Mismatch in employment (supply in employment less demand (E3ME employment))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	-869	-543	-737	-963	326	0.0	0.0	-194	0.0	0.0	-420	0.0	5.9
Medium	712	126	88	57	-586	-82.3	-15.9	-38	-30.5	-7.0	-70	-55.1	0.0
High	157	417	649	906	260	166.0	10.3	233	55.9	9.3	490	117.5	0.0
All qualifications	0	0	0	0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

Table 5 E3ME unemployment by level of qualification

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	775	1,056	710	459	281	36.3	3.1	-346	-32.7	-7.6	-597	-56.5	-8.0
Medium	580	1,456	1,523	1,505	876	151.2	9.6	67	4.6	0.9	49	3.4	0.3
High	204	469	504	509	264	129.4	8.7	35	7.5	1.5	40	8.5	0.8
All qualifications	1,559	2,981	2,737	2,473	1,422	91.2	6.7	-244	-8.2	-1.7	-508	-17.0	-1.9

Note: LFS qualification patterns of unemployment by qualification category are applied to E3ME unemployment totals.

Table 7.5: Implications for unemployment by broad qualification (UK)

(projected unemployment rates by qualification level assume a fixed share of unemployment between the three categories from 2007)

Table 7 Unemployment rate (%) by qualification								(from LFS)	(E3ME based)												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Low	8.8	7.6	8.1	7.5	7.7	7.6	9.1	9.4	10.3	18.1	17.9	17.8	18.6	17.8	17.3	17.3	17.2	16.7	16.4	16.1	16.1
Medium	5.1	4.1	4.4	4.4	4.3	4.3	5.2	5.1	5.6	9.9	9.8	9.7	10.2	9.7	9.4	9.5	9.4	9.1	8.9	8.8	8.8
High	2.6	2.4	2.8	2.8	2.4	2.5	2.7	2.3	2.6	4.5	4.5	4.4	4.7	4.5	4.3	4.3	4.3	4.2	4.1	4.0	4.0
All qualifications	5.6	4.7	5.1	4.8	4.6	4.6	5.3	5.2	5.6	9.8	9.5	9.3	9.6	9.1	8.7	8.6	8.4	8.1	7.9	7.7	7.6
Source: EU LFS micro-data																					
						fixed share values (% rates)			11.1	20.3	21.0	22.1	24.7	25.1	26.0	27.7	29.4	30.6	32.0	33.7	36.0
						(implausible			5.3	9.2	8.8	8.5	8.7	8.1	7.7	7.5	7.3	7.0	6.7	6.5	6.4
									2.4	4.2	4.1	3.9	4.0	3.7	3.4	3.4	3.2	3.1	2.9	2.8	2.8
Table 8 E3ME Unemployment Levels[d]																					
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	1,559	1,445	1,488	1,471	1,392	1,445	1,651	1,629	1,743	3,029	2,981	2,915	3,040	2,868	2,764	2,737	2,703	2,612	2,544	2,492	2,473
Note: d) based on CE calibrated unemployment rates and E3ME labour force						Using LFS 2007 qualificatio			725	1,260	1,239	1,212	1,264	1,193	1,149	1,138	1,124	1,086	1,058	1,036	1,028
						fixed share of unemploymer			769	1,337	1,316	1,287	1,342	1,266	1,220	1,208	1,194	1,153	1,123	1,101	1,092
									249	432	425	416	433	409	394	390	385	373	363	355	353
									1,743	3,029	2,981	2,915	3,040	2,868	2,764	2,737	2,703	2,612	2,544	2,492	2,473
Table 9 E3ME Unemployment by qualification[e]									Final projected unemployment based on scaled version of constant differential rates from above												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Low	775	726	715	662	599	597	659	678	672	1,124	1,056	973	955	847	765	710	657	594	541	495	459
Medium	580	514	532	557	580	611	740	719	809	1,442	1,456	1,468	1,573	1,523	1,504	1,523	1,535	1,512	1,500	1,494	1,505
High	204	205	241	253	213	237	252	232	261	463	469	475	511	498	495	504	511	506	504	504	509
All qualifications	1,559	1,445	1,488	1,471	1,392	1,445	1,651	1,629	1,743	3,029	2,981	2,915	3,040	2,868	2,764	2,737	2,703	2,612	2,544	2,492	2,473
Note: e) LFS unemployment proportions (from Table 6) are applied to E3ME unemployment levels																					

Table 7.6: Reconciling demand and supply by broad qualification UK (2020)

	Unconstrained Demand (employment) *Table 3a*	Supply (labour force) *Table2*	Unemployment *Table 5*	Supply in Employment *Table 3b*	Constrained Demand	Ratio Demand/ Constrained Demand	Ratio Unconstrained Demand/ Supply in	Ratio Supply in employment/ Constrained Demand
Totals	30,190,438	32,663,029	2,472,591	30,190,438	30,190,438	1.000	1.000	1.000
ISCED 1-2	3,361,999	2,858,069	458,985	2,399,084	2,399,084	1.401	1.401	1.000
ISCED 3-4	15,587,372	17,148,926	1,504,919	15,644,006	15,644,006	0.996	0.996	1.000
ISECD 5-6	11,241,066	12,656,034	508,686	12,147,347	12,147,347	0.925	0.925	1.000
By occupation				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.		
All qualifications								
All occupations	30,190,438			30,190,438	30,190,438	1.000	1.000	1.000
Armed forces	28,440			28,755	28,440	1.000	0.989	1.011
Legislators, senior officials and managers	4,726,486			4,859,582	4,726,486	1.000	0.973	1.028
Professionals	4,328,072			4,530,817	4,328,072	1.000	0.955	1.047
Technicians and associate professionals	4,767,502			4,890,092	4,767,502	1.000	0.975	1.026
Clerks	3,265,995			3,226,900	3,265,995	1.000	1.012	0.988
Service workers and shop and market sales workers	5,397,435			5,331,996	5,397,435	1.000	1.012	0.988
Skilled agricultural and fishery workers	367,045			365,898	367,045	1.000	1.003	0.997
Craft and related trades workers	2,158,317			2,084,441	2,158,317	1.000	1.035	0.966
Plant and machine operators and assemblers	1,842,092			1,746,092	1,842,092	1.000	1.055	0.948
Elementary occupations	3,309,053			3,125,865	3,309,053	1.000	1.059	0.945
ISCED 1-2								
All occupations	3,361,999			2,399,084	2,399,084	1.401	1.401	1.000
Armed forces	3,808			2,718	2,675	1.424	1.401	1.016
Legislators, senior officials and managers	265,654			189,568	177,022	1.501	1.401	1.071
Professionals	127,572			91,034	82,189	1.552	1.401	1.108
Technicians and associate professionals	276,608			197,384	187,030	1.479	1.401	1.055
Clerks	463,165			330,509	322,639	1.436	1.401	1.024
Service workers and shop and market sales workers	626,145			446,810	439,996	1.423	1.401	1.015
Skilled agricultural and fishery workers	40,847			29,148	29,469	1.386	1.401	0.989
Craft and related trades workers	357,089			254,815	256,412	1.393	1.401	0.994
Plant and machine operators and assemblers	408,373			291,410	307,623	1.328	1.401	0.947
Elementary occupations	792,737			565,688	594,029	1.335	1.401	0.952
ISCED 3-4								
All occupations	15,587,372			15,644,006	15,644,006	0.996	0.996	1.000
Armed forces	7,532			7,560	7,276	1.035	0.996	1.039
Legislators, senior officials and managers	1,954,309			1,961,409	1,877,020	1.041	0.996	1.045
Professionals	1,290,723			1,295,413	1,221,252	1.057	0.996	1.061
Technicians and associate professionals	2,081,509			2,089,072	2,003,732	1.039	0.996	1.043
Clerks	1,719,854			1,726,103	1,724,480	0.997	0.996	1.001
Service workers and shop and market sales workers	3,517,076			3,529,855	3,548,887	0.991	0.996	0.995
Skilled agricultural and fishery workers	204,537			205,281	201,632	1.014	0.996	1.018
Craft and related trades workers	1,517,374			1,522,887	1,583,946	0.958	0.996	0.961
Plant and machine operators and assemblers	1,229,108			1,233,574	1,292,694	0.951	0.996	0.954
Elementary occupations	2,065,349			2,072,853	2,183,086	0.946	0.996	0.950
ISCED 5-6								
All occupations	11,241,066			12,147,347	12,147,347	0.925	0.925	1.000
Armed forces	17,099			18,478	18,489	0.925	0.925	0.999
Legislators, senior officials and managers	2,506,523			2,708,605	2,672,444	0.938	0.925	1.014
Professionals	2,909,777			3,144,370	3,024,631	0.962	0.925	1.040
Technicians and associate professionals	2,409,385			2,603,635	2,576,740	0.935	0.925	1.010
Clerks	1,082,977			1,170,289	1,218,875	0.889	0.925	0.960
Service workers and shop and market sales workers	1,254,214			1,355,331	1,408,552	0.890	0.925	0.962
Skilled agricultural and fishery workers	121,660			131,469	135,944	0.895	0.925	0.967
Craft and related trades workers	283,854			306,739	317,958	0.893	0.925	0.965
Plant and machine operators and assemblers	204,611			221,108	241,775	0.846	0.925	0.915
Elementary occupations	450,966			487,324	531,937	0.848	0.925	0.916
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.								
By Sector				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.		
All qualifications (total)								
All industries	30,190,438			30,190,438	30,190,438	1.000	1.000	1.000
Primary sector & utilities	624,144			624,255	624,144	1.000	1.000	1.000
Manufacturing	2,423,093			2,379,344	2,423,093	1.000	1.018	0.982
Construction	1,929,266			1,851,173	1,929,266	1.000	1.042	0.960
Distribution & transport	8,501,383			8,329,685	8,501,383	1.000	1.021	0.980
Business & other services	9,241,147			9,331,058	9,241,147	1.000	0.990	1.010
Non-marketed services	7,471,405			7,674,923	7,471,405	1.000	0.973	1.027
ISCED 1-2								
All industries	3,361,999			2,399,084	2,399,084	1.401	1.401	1.000
Primary sector & utilities	60,573			43,224	43,311	1.399	1.401	0.998
Manufacturing	379,742			270,979	282,723	1.343	1.401	0.958
Construction	365,657			260,929	266,399	1.373	1.401	0.979
Distribution & transport	1,197,029			854,186	855,101	1.400	1.401	0.999
Business & other services	891,240			635,979	627,746	1.420	1.401	1.013
Non-marketed services	467,758			333,787	323,803	1.445	1.401	1.031
ISCED 3-4								
All industries	15,587,372			15,644,006	15,644,006	0.996	0.996	1.000
Primary sector & utilities	363,387			364,707	360,475	1.008	0.996	1.012
Manufacturing	1,295,334			1,300,040	1,323,652	0.979	0.996	0.982
Construction	1,291,437			1,296,129	1,353,387	0.954	0.996	0.958
Distribution & transport	5,426,086			5,445,801	5,530,196	0.981	0.996	0.985
Business & other services	4,260,564			4,276,044	4,203,245	1.014	0.996	1.017
Non-marketed services	2,950,565			2,961,285	2,873,053	1.027	0.996	1.031
ISCED 5-6								
All industries	11,241,066			12,147,347	12,147,347	0.925	0.925	1.000
Primary sector & utilities	200,184			216,324	220,359	0.908	0.925	0.982
Manufacturing	748,018			808,325	816,718	0.916	0.925	0.990
Construction	272,172			294,115	309,480	0.879	0.925	0.950
Distribution & transport	1,878,268			2,029,698	2,116,085	0.888	0.925	0.959
Business & other services	4,089,343			4,419,035	4,410,156	0.927	0.925	1.002
Non-marketed services	4,053,082			4,379,851	4,274,549	0.948	0.925	1.025
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.								

Table 7.7: Estimates of imbalances by broad qualification (Netherlands)

Table 3a Employment by level of qualification {from E3ME scaled to match overall total of supply in employment (as Table 3b)(="demand")}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	2,231	2,087	2,038	2,009	-144	-6.5	-0.7	-49	-2.3	-0.5	-78	-3.7	-0.4
Medium	3,665	3,541	3,418	3,342	-124	-3.4	-0.3	-122	-3.5	-0.7	-199	-5.6	-0.6
High	1,958	2,780	3,070	3,330	822	42.0	3.6	291	10.5	2.0	551	19.8	1.8
All qualifications	7,854	8,407	8,527	8,681	553	7.0	0.7	120	1.4	0.3	274	3.3	0.3

Note: This is the demand estimate (employment) before its use in the sort model.

Table 3b Supply in employment by level of qualification {economically active less E3ME unemployment from supply projection run (as Table 5)}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	2,396	1,946	1,675	1,436	-450	-18.8	-2.1	-271	-13.9	-3.0	-510	-26.2	-3.0
Medium	3,545	3,662	3,644	3,605	117	3.3	0.3	-18	-0.5	-0.1	-57	-1.6	-0.2
High	1,912	2,799	3,208	3,641	887	46.4	3.9	408	14.6	2.8	841	30.1	2.7
All qualifications	7,854	8,407	8,527	8,681	553	7.0	0.7	120	1.4	0.3	274	3.3	0.3

Source: Economically active less unemployment.

Table 4a Overall imbalances[a] by level of qualification (economically active (supply estimate) less employment (demand estimate))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	283	-39	-289	-521	-322	-113.9	*	-249	634.5	49.0	-481	1224.8	29.5
Medium	-45	221	310	332	266	-590.1	*	89	40.2	7.0	111	50.1	4.1
High	-11	67	183	353	78	-681.0	*	116	174.9	22.4	287	431.0	18.2
All qualifications	226	248	204	165	22	9.8	0.9	-44	-17.8	-3.8	-84	-33.8	-4.0

Source: IER estimates, based on CE's E3ME model.

Notes: a) This table refers to the difference between estimates of the economically active (from Table 2) and those in employment from Table 3a above

b) Positive numbers indicate unemployment (supply exceeds demand)

*) not computable

Table 4b Mismatch in employment (supply in employment less demand (E3ME employment))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	166	-140	-362	-573	-306	-184.7	#NUM!	-222	0.0	0.0	-432	0.0	15.1
Medium	-120	121	225	263	241	0.0	0.0	104	86.4	13.3	142	117.1	0.0
High	-46	20	137	310	65	0.0	0.0	117	600.6	47.6	291	1485.5	0.0
All qualifications	0	0	0	0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

Table 5 E3ME unemployment by level of qualification

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	117	101	74	52	-16	-13.6	-1.4	-27	-27.1	-6.1	-49	-48.5	-6.4
Medium	75	100	85	69	25	33.8	3.0	-15	-15.5	-3.3	-31	-30.8	-3.6
High	34	47	46	43	13	37.1	3.2	-1	-2.5	-0.5	-4	-8.3	-0.9
All qualifications	226	248	204	165	22	9.8	0.9	-44	-17.8	-3.8	-84	-33.8	-4.0

Note: LFS qualification patterns of unemployment by qualification category are applied to E3ME unemployment totals.

Table 7.8: Implications for unemployment by broad qualification (Netherlands)

(projected unemployment rates by qualification level assume a fixed share of unemployment between the three categories from 2007)

Table 7 Unemployment rate (%) by qualification								(from LFS)	(E3ME based)												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Low	4.5	3.2	3.9	5.8	7.2	7.3	7.2	6.0	4.7	5.0	4.9	4.5	4.6	4.0	4.3	4.2	4.0	3.9	3.9	3.8	3.5
Medium	2.0	1.7	2.1	2.9	4.2	4.4	4.1	3.3	2.5	2.7	2.7	2.5	2.5	2.2	2.3	2.3	2.1	2.1	2.1	2.1	1.9
High	1.7	1.6	1.8	2.4	2.9	2.9	2.6	2.0	1.6	1.7	1.6	1.5	1.5	1.3	1.4	1.4	1.3	1.3	1.3	1.3	1.2
All qualifications	2.7	2.1	2.6	3.6	4.7	4.7	4.5	3.6	2.8	3.0	2.9	2.6	2.6	2.3	2.4	2.3	2.2	2.1	2.1	2.1	1.9
Source: EU LFS micro-data																					
						fixed share values (% rates)			4.8	5.2	5.3	5.0	5.1	4.6	5.1	5.1	4.9	5.0	5.1	5.2	4.8
						(implausible			2.5	2.7	2.6	2.4	2.4	2.1	2.2	2.2	2.0	2.0	2.0	1.9	1.8
									1.5	1.6	1.5	1.3	1.3	1.1	1.1	1.1	1.0	0.9	0.9	0.9	0.8
Table 8 E3ME Unemployment Levels[d]																					
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	226	181	235	312	391	400	335	280	246	257	248	228	227	198	209	204	191	188	187	182	165
Note: d) based on CE calibrated unemployment rates and E3ME labour force						Using LFS 2007 qualificatio			107	112	108	100	99	86	91	89	83	82	81	79	72
						fixed share of unemploymer			97	101	98	90	90	78	82	81	75	74	74	72	65
									42	44	42	39	38	33	35	35	32	32	32	31	28
									246	257	248	228	227	198	209	204	191	188	187	182	165
Table 9 E3ME Unemployment by qualification[e]									Final projected unemployment based on scaled version of constant differential rates from above												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Low	117	83	108	146	169	166	145	122	106	108	101	91	88	75	77	74	67	64	62	59	52
Medium	75	65	87	110	152	160	135	110	97	102	100	93	93	81	86	85	79	78	78	77	69
High	34	33	40	56	70	74	56	47	43	46	47	45	46	41	45	46	44	45	46	46	43
All qualifications	226	181	235	312	391	400	335	280	246	257	248	228	227	198	209	204	191	188	187	182	165
Note: e) LFS unemployment proportions (from Table 6) are applied to E3ME unemployment levels																					

Table 7.9: Reconciling demand and supply by broad qualification Netherlands, 2020

	Unconstrained Demand (employment) *Table 3a*	Supply (labour force) *Table2*	Unemployment *Table 5*	Supply in Employment *Table 3b*	Constrained Demand	Ratio Demand/ Constrained Demand	Ratio Unconstrained Demand/ Supply in	Ratio Supply in employment/ Constrained Demand
Totals	8,681,186	8,845,716	164,530	8,681,186	8,681,186	1.000	1.000	1.000
ISCED 1-2	2,008,748	1,488,172	52,098	1,436,074	1,436,074	1.399	1.399	1.000
ISCED 3-4	3,341,962	3,673,896	69,388	3,604,507	3,604,507	0.927	0.927	1.000
ISECD 5-6	3,330,476	3,683,648	43,044	3,640,604	3,640,604	0.915	0.915	1.000
By occupation				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.		
All qualifications								
All occupations	8,681,186			8,681,186	8,681,186	1.000	1.000	1.000
Armed forces	18,547			19,144	18,547	1.000	0.969	1.032
Legislators, senior officials and managers	972,929			1,002,354	972,929	1.000	0.971	1.030
Professionals	1,863,366			2,015,133	1,863,366	1.000	0.925	1.081
Technicians and associate professionals	1,558,686			1,633,148	1,558,686	1.000	0.954	1.048
Clerks	987,784			979,391	987,784	1.000	1.009	0.992
Service workers and shop and market sales workers	1,207,218			1,179,549	1,207,218	1.000	1.023	0.977
Skilled agricultural and fishery workers	89,865			86,619	89,865	1.000	1.037	0.964
Craft and related trades workers	643,811			610,542	643,811	1.000	1.054	0.948
Plant and machine operators and assemblers	394,511			368,812	394,511	1.000	1.070	0.935
Elementary occupations	944,471			786,494	944,471	1.000	1.201	0.833
ISCED 1-2								
All occupations	2,008,748			1,436,074	1,436,074	1.399	1.399	1.000
Armed forces	2,590			1,851	1,542	1.680	1.399	1.201
Legislators, senior officials and managers	151,592			108,374	91,758	1.652	1.399	1.181
Professionals	49,827			35,622	27,206	1.831	1.399	1.309
Technicians and associate professionals	156,606			111,959	89,791	1.744	1.399	1.247
Clerks	246,758			176,409	163,112	1.513	1.399	1.082
Service workers and shop and market sales workers	344,062			245,973	225,700	1.524	1.399	1.090
Skilled agricultural and fishery workers	28,503			20,377	19,134	1.490	1.399	1.065
Craft and related trades workers	231,923			165,804	165,356	1.403	1.399	1.003
Plant and machine operators and assemblers	156,737			112,053	114,818	1.365	1.399	0.976
Elementary occupations	640,152			457,651	537,659	1.191	1.399	0.851
ISCED 3-4								
All occupations	3,341,962			3,604,507	3,604,507	0.927	0.927	1.000
Armed forces	10,347			11,160	10,437	0.991	0.927	1.069
Legislators, senior officials and managers	263,701			284,418	266,199	0.991	0.927	1.068
Professionals	199,285			214,940	182,001	1.095	0.927	1.181
Technicians and associate professionals	786,551			848,343	781,542	1.006	0.927	1.085
Clerks	484,097			522,128	514,622	0.941	0.927	1.015
Service workers and shop and market sales workers	683,895			737,622	756,426	0.904	0.927	0.975
Skilled agricultural and fishery workers	57,299			61,801	65,350	0.877	0.927	0.946
Craft and related trades workers	378,044			407,743	434,078	0.871	0.927	0.939
Plant and machine operators and assemblers	216,777			233,807	250,811	0.864	0.927	0.932
Elementary occupations	261,964			282,544	343,041	0.764	0.927	0.824
ISCED 5-6								
All occupations	3,330,476			3,640,604	3,640,604	0.915	0.915	1.000
Armed forces	5,610			6,132	6,568	0.854	0.915	0.934
Legislators, senior officials and managers	557,636			609,562	614,972	0.907	0.915	0.991
Professionals	1,614,254			1,764,571	1,654,159	0.976	0.915	1.067
Technicians and associate professionals	615,529			672,846	687,353	0.896	0.915	0.979
Clerks	256,929			280,853	310,050	0.829	0.915	0.906
Service workers and shop and market sales workers	179,261			195,953	225,092	0.796	0.915	0.871
Skilled agricultural and fishery workers	4,063			4,441	5,381	0.755	0.915	0.825
Craft and related trades workers	33,843			36,995	44,377	0.763	0.915	0.834
Plant and machine operators and assemblers	20,997			22,952	28,882	0.727	0.915	0.795
Elementary occupations	42,355			46,298	63,770	0.664	0.915	0.726
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.								
By Sector				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.		
All qualifications (total)								
All industries	8,681,186			8,681,186	8,681,186	1.000	1.000	1.000
Primary sector & utilities	239,995			233,314	239,995	1.000	1.029	0.972
Manufacturing	831,495			816,487	831,495	1.000	1.018	0.982
Construction	484,283			471,426	484,283	1.000	1.027	0.973
Distribution & transport	2,257,221			2,114,586	2,257,221	1.000	1.067	0.937
Business & other services	2,686,969			2,750,949	2,686,969	1.000	0.977	1.024
Non-marketed services	2,181,223			2,294,424	2,181,223	1.000	0.951	1.052
ISCED 1-2								
All industries	2,008,748			1,436,074	1,436,074	1.399	1.399	1.000
Primary sector & utilities	71,675			51,241	52,210	1.373	1.399	0.981
Manufacturing	229,880			164,344	169,080	1.360	1.399	0.972
Construction	142,524			101,892	96,976	1.470	1.399	1.051
Distribution & transport	894,655			639,598	671,238	1.333	1.399	0.953
Business & other services	461,652			330,039	314,851	1.466	1.399	1.048
Non-marketed services	208,361			148,960	131,719	1.582	1.399	1.131
ISCED 3-4								
All industries	3,341,962			3,604,507	3,604,507	0.927	0.927	1.000
Primary sector & utilities	131,922			142,286	145,039	0.910	0.927	0.981
Manufacturing	377,324			406,967	408,163	0.924	0.927	0.997
Construction	278,074			299,920	310,374	0.896	0.927	0.966
Distribution & transport	993,180			1,071,204	1,131,187	0.878	0.927	0.947
Business & other services	798,556			861,291	830,354	0.962	0.927	1.037
Non-marketed services	762,906			822,840	779,390	0.979	0.927	1.056
ISCED 5-6								
All industries	3,330,476			3,640,604	3,640,604	0.915	0.915	1.000
Primary sector & utilities	36,397			39,787	42,745	0.851	0.915	0.931
Manufacturing	224,291			245,176	254,252	0.882	0.915	0.964
Construction	63,684			69,614	76,933	0.828	0.915	0.905
Distribution & transport	369,387			403,783	454,796	0.812	0.915	0.888
Business & other services	1,426,761			1,559,619	1,541,763	0.925	0.915	1.012
Non-marketed services	1,209,956			1,322,625	1,270,115	0.953	0.915	1.041
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.								

8. Comparing imbalances for the whole of Europe

8.1 Imbalances at the Eur29 level

The supply results can also be compared with the demand estimates for Europe as a whole. Table 8.1 presents an initial comparison. The top part of the table shows employment estimates. The middle section of the table shows the difference between employment and the labour force.

As explained for Greece, for various reasons this cannot be simply interpreted as unemployment (if "supply" (the labour force) exceeds "demand" (employment)) or a shortage (if demand exceeds supply). This is because the two sets of estimates are not directly comparable.

The bottom part of the table draws out some implications for unemployment. As discussed above for the case of Greece, this takes the overall E3ME estimates of unemployment and divides these up for the historical and forecast periods based on assumptions about maintaining past patterns of unemployment by qualification category, country by country based on data taken from LFS.

The implications of this for unemployment **rates** for the different qualification categories are shown in Table 8.2. The overall unemployment rate rises to 2010 and then gradually declines to just around 6.0% by 2020. The unemployment rate for those with low qualifications is projected to rise quite substantially, before declining to just under 17% in 2020. The rate for the intermediate and high qualification categories also rise , but more modestly and then decline to levels similar to those observed back in 2007 by 2020. As noted in the discussion for Greece, these should be regarded as working assumptions rather than projections.

Taking these estimates of unemployment as given, the implications for the supply projections of the numbers in employment can be assessed. This is done in the top panel of Table 8.3. The **Sort** algorithm described above is used to reconcile the two sets of estimates for particular occupations or sectors. This is done for all years but the table focuses on 2020. The results show how particular occupations or sectors might be expected to absorb the projected pattern of supply compared to the original demand based projection. The final columns show the ratios of demand to supply. A value greater than 1 indicates that demand exceeds supply and conversely. Again the data shown here should be regarded for the time being as preliminary.

Table 8.1: Preliminary estimates of imbalances by broad qualification (Eur27+2)

Table 3a Employment by level of qualification {from E3ME scaled to match overall total of supply in employment (as Table 3b)(="demand")}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	60,349	50,228	46,124	43,000	-10,120	-16.8	-1.8	-4,105	-8.2	-1.7	-7,228	-14.4	-1.5
Medium	100,103	108,620	111,417	112,816	8,517	8.5	0.8	2,797	2.6	0.5	4,196	3.9	0.4
High	48,919	60,780	65,898	70,489	11,862	24.2	2.2	5,117	8.4	1.6	9,708	16.0	1.5
All qualifications	209,370	219,629	223,438	226,305	10,258	4.9	0.5	3,809	1.7	0.3	6,676	3.0	0.3

Note: This is the demand estimate (employment) before its use in the sort model.

Table 3b Supply in employment by level of qualification {economically active less E3ME unemployment from supply projection run (as Table 5)}

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	64,388	44,559	38,282	32,865	-19,830	-30.8	-3.6	-6,277	-14.1	-3.0	-11,694	-26.2	-3.0
Medium	99,327	110,406	112,596	113,798	11,079	11.2	1.1	2,189	2.0	0.4	3,391	3.1	0.3
High	45,655	64,664	72,561	79,643	19,009	41.6	3.5	7,897	12.2	2.3	14,979	23.2	2.1
All qualifications	209,370	219,629	223,438	226,305	10,258	4.9	0.5	3,809	1.7	0.3	6,676	3.0	0.3

Source: Economically active less unemployment.

Table 4a Overall imbalances[a] by level of qualification (economically active (supply estimate) less employment (demand estimate))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	9,745	4,298	333	-3,499	-5,447	-55.9	-7.9	-3,965	-92.3	-40.0	-7,797	-181.4	*
Medium	10,383	12,494	11,651	11,045	2,111	20.3	1.9	-842	-6.7	-1.4	-1,449	-11.6	-1.2
High	-661	6,454	9,435	12,053	7,114	-1077.0	*	2,981	46.2	7.9	5,600	86.8	6.4
All qualifications	19,467	23,246	21,419	19,599	3,778	19.4	1.8	-1,826	-7.9	-1.6	-3,646	-15.7	-1.7

Source: IER estimates, based on CE's E3ME model.

Notes: a) This table refers to the difference between estimates of the economically active (from Table 2) and those in employment from Table 3a above

b) Positive numbers indicate unemployment (supply exceeds demand)

*) not computable

Table 4b Mismatch in employment (supply in employment less demand (E3ME employment))

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	4,040	-5,670	-7,842	-10,135	-9,709	-240.4	#NUM!	-2,172	0.0	0.0	-4,465	0.0	6.0
Medium	-776	1,786	1,179	981	2,562	0.0	0.0	-608	-34.0	-8.0	-805	-45.1	0.0
High	-3,264	3,884	6,663	9,154	7,147	0.0	0.0	2,780	71.6	11.4	5,270	135.7	0.0
All qualifications	0	0	0	0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

Table 5 E3ME unemployment by level of qualification

				000s	Change 2000-2010			Change 2010-2015			Change 2010-2020		
	2000	2010	2015	2020	000s	%	% p.a.	000s	%	% p.a.	000s	%	% p.a.
Low	5,705	9,968	8,175	6,636	4,263	74.7	5.7	-1,793	-18.0	-3.9	-3,332	-33.4	-4.0
Medium	11,159	10,707	10,473	10,063	-452	-4.0	-0.4	-235	-2.2	-0.4	-644	-6.0	-0.6
High	2,603	2,570	2,772	2,900	-33	-1.3	-0.1	202	7.8	1.5	330	12.8	1.2
All qualifications	19,467	23,246	21,419	19,599	3,778	19.4	1.8	-1,826	-7.9	-1.6	-3,646	-15.7	-1.7

Note: LFS qualification patterns of unemployment by qualification category are applied to E3ME unemployment totals.

Table 8.2: Implications for unemployment by broad qualification (Eur27+2)

(projected unemployment rates by qualification level assume a fixed share of unemployment between the three categories from 2007)

Table 7 Unemployment rate (%) by qualification								(from LFS)	(E3ME based)												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Low	12.7	11.7	13.4	15.8	17.6	19.2	19.3	17.3	12.8	18.0	18.3	18.4	18.5	18.1	17.7	17.6	17.4	17.1	17.0	16.9	16.8
Medium	8.0	8.1	8.7	10.1	11.2	11.1	9.9	8.3	6.2	8.7	8.8	8.9	8.9	8.8	8.6	8.5	8.4	8.3	8.2	8.2	8.1
High	4.3	4.2	4.3	5.1	5.4	5.5	4.4	3.6	2.7	3.8	3.8	3.8	3.9	3.8	3.7	3.7	3.6	3.6	3.5	3.5	3.5
All qualifications	7.9	7.8	8.5	9.8	10.8	11.1	10.3	8.7	6.9	9.5	9.6	9.5	9.5	9.2	8.9	8.7	8.5	8.3	8.2	8.1	8.0
Source: EU LFS micro-data																					
						fixed share values (% rates)			9.4	13.5	14.0	14.4	14.8	14.8	14.8	15.1	15.2	15.4	15.6	15.9	16.2
						(implausible			7.9	11.0	11.0	10.9	10.8	10.5	10.1	9.9	9.7	9.5	9.3	9.2	9.0
									2.6	3.6	3.5	3.4	3.3	3.2	3.0	2.9	2.8	2.7	2.6	2.5	2.4
Table 8 E3ME Unemployment Levels[d]																					
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	19,467	19,142	20,157	20,541	20,819	20,768	19,260	16,971	16,767	23,298	23,246	23,165	23,137	22,477	21,781	21,419	20,935	20,485	20,115	19,855	19,599
Note: d) based on CE calibrated unemployment rates and E3ME labour force						Using LFS 2007 qualificatio			5,488	7,626	7,608	7,582	7,573	7,357	7,129	7,011	6,852	6,705	6,584	6,499	6,415
						fixed share of unemployme			9,573	13,301	13,271	13,225	13,209	12,832	12,435	12,228	11,952	11,695	11,484	11,335	11,190
									1,707	2,371	2,366	2,358	2,355	2,288	2,217	2,180	2,131	2,085	2,047	2,021	1,995
									16,767	23,298	23,246	23,165	23,137	22,477	21,781	21,419	20,935	20,485	20,115	19,855	19,599
Table 9 E3ME Unemployment by qualification[e]									Final projected unemployment based on scaled version of constant differential rates from above												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Low	5,705	4,998	5,378	5,558	5,527	6,313	6,290	5,555	7,509	10,209	9,968	9,699	9,466	8,988	8,511	8,175	7,806	7,458	7,151	6,890	6,636
Medium	11,159	11,657	12,447	12,393	12,625	11,942	11,003	9,689	7,518	10,597	10,707	10,818	10,939	10,751	10,535	10,473	10,341	10,220	10,133	10,098	10,063
High	2,603	2,487	2,332	2,590	2,667	2,512	1,966	1,727	1,740	2,493	2,570	2,648	2,732	2,738	2,736	2,772	2,789	2,807	2,831	2,867	2,900
All qualifications	19,467	19,142	20,157	20,541	20,819	20,768	19,260	16,971	16,767	23,298	23,246	23,165	23,137	22,477	21,781	21,419	20,935	20,485	20,115	19,855	19,599
Note: e) LFS unemployment proportions (from Table 6) are applied to E3ME unemployment levels																					

Table 8.3: Reconciling demand and supply by broad qualification (Eur27+2), 2020

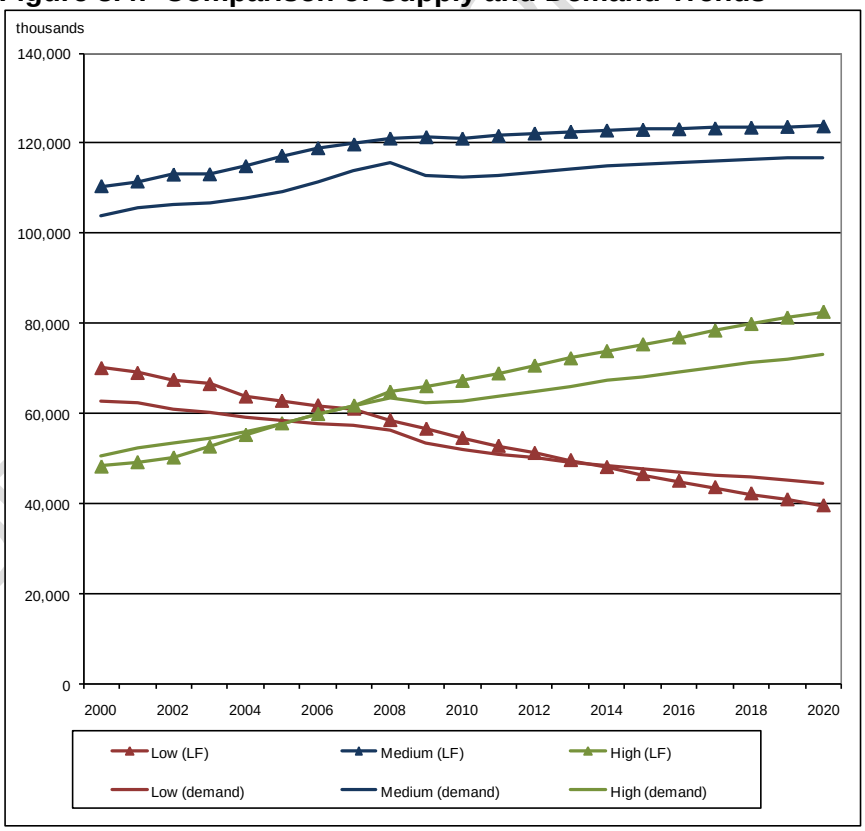
	Unconstrained Demand (employment) *Table 3a*	Supply (labour force) *Table2*	Unemployment *Table 5*	Supply in Employment *Table 3b*	Constrained Demand	Ratio Demand/ Constrained Demand	Ratio Unconstrained Demand/ Supply in	Ratio Supply in employment/ Constrained Demand
Totals	226,304,995	245,904,462	19,599,467	226,304,995	226,304,995	1.000	1.000	1.000
ISCED 1-2	42,999,993	39,501,389	6,636,441	32,864,947	32,864,947	1.308	1.308	1.000
ISCED 3-4	112,816,232	123,860,830	10,063,326	113,797,503	113,797,503	0.991	0.991	1.000
ISECD 5-6	70,488,771	82,542,244	2,899,699	79,642,545	79,642,545	0.885	0.885	1.000
By occupation				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.		
All qualifications								
All occupations	226,304,995			226,304,995	226,304,995	1.000	1.000	1.000
Armed forces	1,150,297			1,151,287	1,150,297	1.000	0.999	1.001
Legislators, senior officials and managers	19,856,515			20,521,229	19,856,515	1.000	0.968	1.033
Professionals	33,851,502			37,225,307	33,851,502	1.000	0.909	1.100
Technicians and associate professionals	41,310,571			42,854,708	41,310,571	1.000	0.964	1.037
Clerks	21,949,725			22,014,861	21,949,725	1.000	0.997	1.003
Service workers and shop and market sales workers	33,087,881			32,339,895	33,087,881	1.000	1.023	0.977
Skilled agricultural and fishery workers	7,406,206			6,755,189	7,406,206	1.000	1.096	0.912
Craft and related trades workers	25,604,751			24,344,011	25,604,751	1.000	1.052	0.951
Plant and machine operators and assemblers	17,857,058			16,875,394	17,857,058	1.000	1.058	0.945
Elementary occupations	24,230,489			22,223,116	24,230,489	1.000	1.090	0.917
ISCED 1-2								
All occupations	42,999,993			32,864,947	32,864,947	1.308	1.308	1.000
Armed forces	196,782			150,401	140,597	1.400	1.308	1.070
Legislators, senior officials and managers	2,649,909			2,025,329	1,889,902	1.402	1.308	1.072
Professionals	823,187			629,163	515,987	1.595	1.308	1.219
Technicians and associate professionals	3,448,724			2,635,864	2,374,076	1.453	1.308	1.110
Clerks	3,359,639			2,567,777	2,430,365	1.382	1.308	1.057
Service workers and shop and market sales workers	6,819,526			5,212,172	5,100,851	1.337	1.308	1.022
Skilled agricultural and fishery workers	3,241,122			2,477,193	2,621,284	1.236	1.308	0.945
Craft and related trades workers	7,230,576			5,526,338	5,606,304	1.290	1.308	0.986
Plant and machine operators and assemblers	5,222,261			3,991,381	4,085,645	1.278	1.308	0.977
Elementary occupations	10,008,266			7,649,330	8,099,936	1.236	1.308	0.944
ISCED 3-4								
All occupations	112,816,232			113,797,503	113,797,503	0.991	0.991	1.000
Armed forces	631,001			636,490	619,191	1.019	0.991	1.028
Legislators, senior officials and managers	7,800,872			7,868,724	7,420,139	1.051	0.991	1.060
Professionals	5,952,917			6,004,695	5,102,114	1.167	0.991	1.177
Technicians and associate professionals	21,126,806			21,310,566	19,792,340	1.067	0.991	1.077
Clerks	12,851,533			12,963,315	12,633,260	1.017	0.991	1.026
Service workers and shop and market sales workers	21,061,454			21,244,646	21,488,765	0.980	0.991	0.989
Skilled agricultural and fishery workers	3,532,194			3,562,917	3,922,334	0.901	0.991	0.908
Craft and related trades workers	16,032,877			16,172,330	16,971,543	0.945	0.991	0.953
Plant and machine operators and assemblers	11,484,944			11,584,840	12,258,646	0.937	0.991	0.945
Elementary occupations	12,341,634			12,448,981	13,589,172	0.908	0.991	0.916
ISCED 5-6								
All occupations	70,488,771			79,642,545	79,642,545	0.885	0.885	1.000
Armed forces	322,514			364,396	390,509	0.826	0.885	0.933
Legislators, senior officials and managers	9,405,734			10,627,176	10,546,475	0.892	0.885	1.008
Professionals	27,075,398			30,591,449	28,233,401	0.959	0.885	1.084
Technicians and associate professionals	16,735,041			18,908,278	19,144,155	0.874	0.885	0.988
Clerks	5,738,553			6,483,770	6,886,100	0.833	0.885	0.942
Service workers and shop and market sales workers	5,206,901			5,883,076	6,498,266	0.801	0.885	0.905
Skilled agricultural and fishery workers	632,891			715,079	862,588	0.734	0.885	0.829
Craft and related trades workers	2,341,298			2,645,342	3,026,904	0.773	0.885	0.874
Plant and machine operators and assemblers	1,149,852			1,299,174	1,512,767	0.760	0.885	0.859
Elementary occupations	1,880,589			2,124,805	2,541,380	0.740	0.885	0.836
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.								
By Sector				Supply allocated to industries and occupations in the same proportions found in the demand data.		A ratio greater than one indicates a shortfall.		
All qualifications (total)								
All industries	226,304,995			226,304,995	226,304,995	1.000	1.000	1.000
Primary sector & utilities	11,506,837			10,741,133	11,506,837	1.000	1.071	0.933
Manufacturing	33,140,572			32,409,815	33,140,572	1.000	1.023	0.978
Construction	15,152,995			14,561,800	15,152,995	1.000	1.041	0.961
Distribution & transport	60,010,223			58,704,268	60,010,223	1.000	1.022	0.978
Business & other services	54,079,124			55,091,057	54,079,124	1.000	0.982	1.019
Non-marketed services	52,415,243			54,796,922	52,415,243	1.000	0.957	1.045
ISCED 1-2								
All industries	42,999,993			32,864,947	32,864,947	1.308	1.308	1.000
Primary sector & utilities	4,301,079			3,287,320	3,484,214	1.234	1.308	0.943
Manufacturing	7,618,655			5,822,948	5,879,820	1.296	1.308	0.990
Construction	4,063,053			3,105,397	3,141,867	1.293	1.308	0.988
Distribution & transport	13,308,729			10,171,878	10,113,109	1.316	1.308	1.006
Business & other services	8,513,227			6,506,670	6,408,342	1.328	1.308	1.015
Non-marketed services	5,195,249			3,970,735	3,837,594	1.354	1.308	1.035
ISCED 3-4								
All industries	112,816,232			113,797,503	113,797,503	0.991	0.991	1.000
Primary sector & utilities	5,675,761			5,725,129	6,130,390	0.926	0.991	0.934
Manufacturing	18,564,687			18,726,162	19,170,738	0.968	0.991	0.977
Construction	8,861,531			8,938,608	9,308,260	0.952	0.991	0.960
Distribution & transport	34,943,103			35,247,037	35,728,138	0.978	0.991	0.987
Business & other services	23,924,403			24,132,496	23,456,328	1.020	0.991	1.029
Non-marketed services	20,846,747			21,028,071	20,003,650	1.042	0.991	1.051
ISCED 5-6								
All industries	70,488,771			79,642,545	79,642,545	0.885	0.885	1.000
Primary sector & utilities	1,529,997			1,728,685	1,892,233	0.809	0.885	0.914
Manufacturing	6,957,229			7,860,705	8,090,013	0.860	0.885	0.972
Construction	2,228,411			2,517,796	2,702,868	0.824	0.885	0.932
Distribution & transport	11,758,391			13,285,353	14,168,976	0.830	0.885	0.938
Business & other services	21,641,495			24,451,891	24,214,454	0.894	0.885	1.010
Non-marketed services	26,373,248			29,798,116	28,573,999	0.923	0.885	1.043
The Demand data (Industry by Occupation) has been scaled to the total of Supply in Employment.								

8.2 Synthesis and Interpretation

The results for sectors and occupations for the Eur29 as a whole suggest that the prospects for the demand for skills (as measured by formal qualifications) are likely to remain positive. Changes in industrial structure are combining with skill biased technological change to increase the demand for the highly qualified and intermediate level qualified categories, at the expense of the low qualified group. These trends are reflected in the results presented in Figure 8.4, which show the projected changes in *notional* demand for formal qualifications, unconstrained by likely supply developments. These are based on a continuation in past patterns of employment by broad qualification level within both occupations and sectors. On this basis demand for those in the high level category is projected to increase by just under 10 million between 2010 and 2020, with the medium qualification category growing slightly less rapidly (around 3½ million). In contrast the demand for number of those in employment with low (or no) qualifications is projected to fall by around 7½ million.

These estimates can be compared with the supply side projections which are also shown in Figure 8.4. This shows that the trends in both the demand for and supply of skills are very similar. It shows the numbers in the economically active labour force and the unconstrained estimates of the numbers in employment before adjustments to reconcile the demand and supply side estimates. Both sets of time series distinguish the highest levels of qualification held. As noted above, these differences between the labour force and the employment series shown cannot simply be interpreted as unemployment. As discussed above, differences arise because: some people have more than one job; the distinction between residence and workplace; as well as errors and differences in the measure of employment, unemployment and related indicators in different sources.

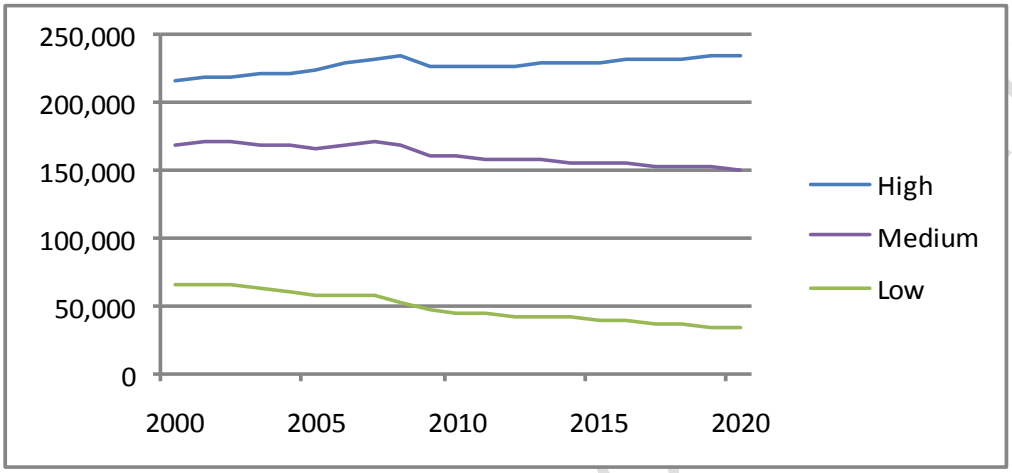
Figure 8.4: Comparison of Supply and Demand Trends



Notes: Unconstrained estimates of employment and numbers in the labour force aged 15+.
Source: IER estimates based on E3ME, EDMOD, STOCKMOD and BALMOD.

In practice, the future patterns of employment observed will reflect both demand and supply factors. As already noted above, substantial increases in the numbers and proportions of the workforce holding both intermediate and higher level qualifications are already in the pipeline. In general, better qualified people tend to have more success in obtaining and retaining jobs than those less well qualified, so they are likely to secure employment at the expense of less well qualified people. This is reflected in the projections of the ***constrained*** demand results shown in Figure 8.5.

Figure 8.5: Demand trends by level of qualification, 2000-2020 (EU-27 + Norway and Switzerland)



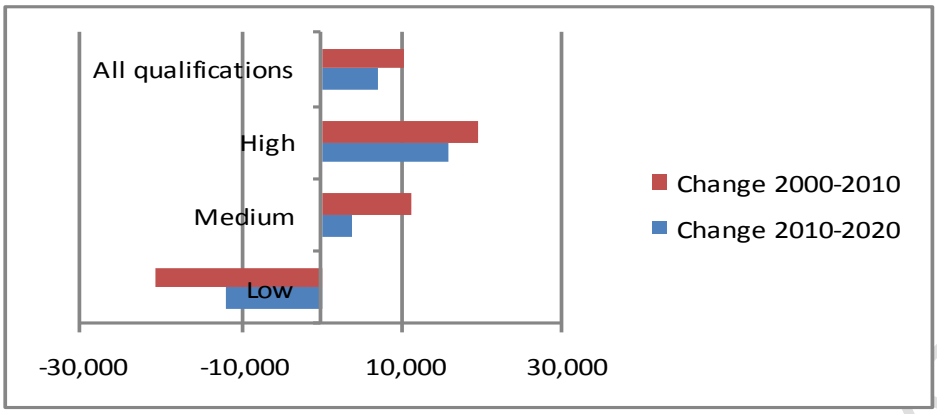
Source: IER estimates based on E3ME and BALMOD.
Notes: Constrained estimates. The estimates in this figure are constrained to match the supply available AND scaled to match E3ME employment figures (i.e. taking into account the so called Labour Market Accounts Residual (LMAR) as discussed in Section 2. They are therefore consistent with, and match, the employment estimates for sectors and occupations presented elsewhere in this report

The estimates in Figure 8.5 are based the procedures described in Section 8.1 above, applied at an al Eur29 level.. This involves allocating the projected numbers qualified to the jobs projected to be available, assuming that the main features of the historical patterns of unemployment amongst the qualified categories will continue. In particular, the better qualified are expected to continue to have lower probabilities of unemployment than those qualified at intermediate level, who in turn have lower probabilities than those with low (or no) qualifications. The implications of this are:

- More rapid increases in *effective* demand (numbers in employment) for those with high qualifications in some lower level occupations (i.e. more of such people are employed in less high skilled jobs than they might have hoped); and
- a faster projected decline of the number of jobs employing those with low (or no) qualifications, (implying better qualifications for those employed in many low skill jobs than the strict minimum requirements might demand).

The former means that the overall number of jobs employing highly qualified people is projected to rise by over 16 million, while the latter implies a more rapid decline of around 12 million in the number of jobs employing people with low (or no) formal qualifications). The results for the intermediate qualification category are an increase in the number of those in employment of almost 4 million between 2010 and 2020. The implications for imbalances and mismatches are discussed in more detail below.

Figure 8.6: Past and projected demand for qualifications, constrained (EU27+2)



Note: Changes in numbers in employment, constrained to match E3ME total and to reconcile demand with available supply.
Source: IER estimates based on E3ME and BALMOD.

8.3 Imbalances and mismatches – reconciling the demand and supply of skills

The effect of the recession has been to exacerbate the differences in trends for skill demand and supply highlighted in the previous discussion, making it more difficult for some of those qualified at intermediate and higher levels to find the kinds of jobs they would like.

There are some indications that the positive trends in demand are less strong than before the crisis and the subsequent recession. The results suggest that there is likely to be increased deployment of "graduates", and those qualified at intermediate level, in lower level jobs than might have been the case in the past. Despite these developments those in the high level qualification (and medium level qualification) categories will still have better chance of getting better jobs compared with those with low or no formal qualifications.

In presenting the implications for imbalances it is therefore important not to try to interpret the results too literally. It is important to emphasise that both the trends in supply (towards a more highly educated workforce) and the trends in demand (towards greater use of such people in employment) are both hard to predict precisely. They are also interrelated (supply can to some extent help to generate its own demand, and demand can also generate supply to some degree).

In some countries, such as Finland, policies to promote the supply of skills have helped to facilitate innovation and growth, but the Finnish model may be hard to reproduce in other (and larger) countries. Europe as a whole may need to consider measures to boost the demand for skills and to encourage endogenous innovation and creation of high level jobs. Policies may also be required to encourage the full utilization of existing skills and qualifications.

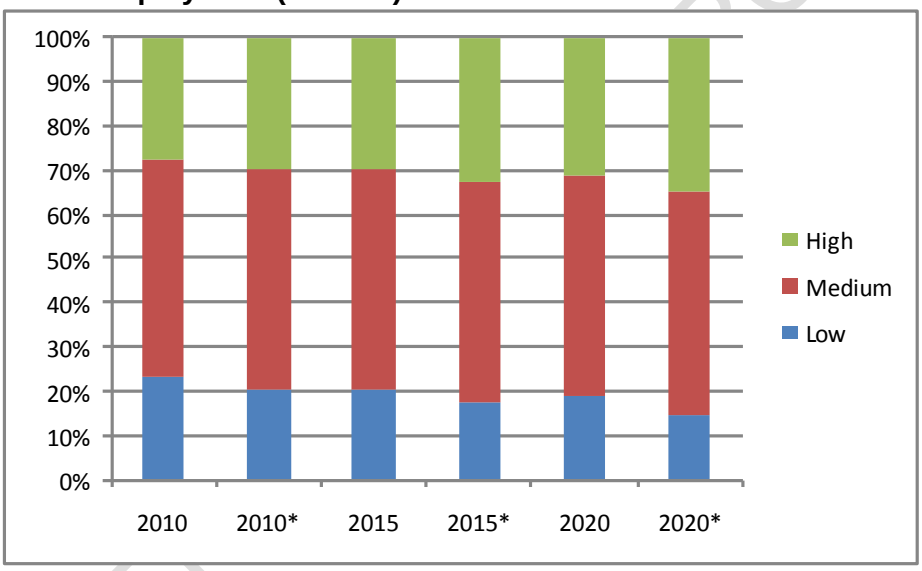
It is also important to recognise that the so called BRIC countries (Brazil, Russia, India China and other fast developing nations) are also aiming to increase their shares of high level jobs, so there is no room for complacency in Europe. Winning such jobs will remain a highly competitive game, dependent on achieving higher productivity in the EU. Optimal allocation (and use) of skilled workers may be a

necessary (but probably not sufficient) condition for this. However, better matching of the supply of skills to the right jobs will help.

The present results suggest that governments may need to stimulate demand from employers and find ways to increase the utilization of skills if such problems are to be avoided. Another important aspect of imbalances is the geographical dimension. The results suggest that there may be some structural problems across Europe (with Eastern Europe facing particular problems of potential oversupply).

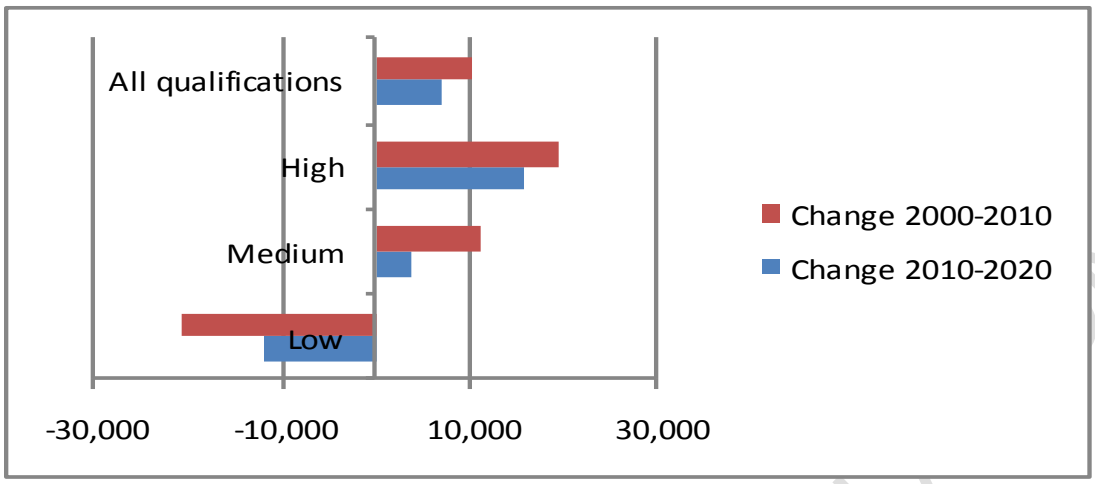
Other Cedefop research suggests that over-education is not such a serious problem. In a general cultural sense it is probably impossible for an individual to be too well educated. But over-qualification or over-skilling (lack of utilization of qualifications and particular skills) undoubtedly is a potential problem, as are concerns that individual's experience in the workplace may fail to match the expectations raised when undertaking education and training (in terms of the quality of jobs and terms and conditions of employment). These issues, which also emerge in other research from national studies, will require urgent attention from policy makers if the aims of the Lisbon Agenda are to be met.

Figure 8.7: Constrained and unconstrained qualification structure for those in Employment (EU27+2)



Notes: Constrained (to match supply available for employment and unconstrained "notional demand" estimates. The constrained estimates are indicated by a * .
Source: IER estimates based on E3ME, EDMOD and BALMOD.

Figure 8.8: Past and likely future qualification change for those in Employment (EU27+2)



Notes: Constrained and scaled estimates. The estimates in this figure are constrained to match the supply available AND scaled to match E3ME employment figures (i.e. taking into account the so called Labour Market Accounts Residual (LMAR) as discussed in Section 2). They are therefore consistent with, and match, the National Accounts based employment estimates for sectors and occupations presented elsewhere in this report

Source: IER estimates based on E3ME, EDMOD and BALMOD.

8.4 Imbalances, Mismatches and Reconciliation

The initial projections of the demand for and the supply of skills are developed independently. In reality there are large numbers of adjustment mechanisms that operate in the labour market to reconcile any imbalances and mismatches that may arise. In the short term, these include adjustments in wages and different kinds of mobility, as well as changes in the ways employers utilize the skills that are available. In the longer term both supply and demand will adjust to reflect the signals and incentives these cause to arise.

Generally, employers will not cease their operations if they cannot find the ideal mix of skills. They will operate with what is available.[15] Conversely if the educational system delivers too many people with particular levels of formal qualification this does not necessarily imply that such people will remain unemployed. Rather they tend to find jobs that make less direct use of their qualifications since the education and training still often puts them at an advantage in the labour market compared with those with lower level qualifications. The labour market operates as a kind of sorting mechanism that allocates people to jobs, based on the limited information available to both sides (employers as well as actual and potential employees).

In principle, these mechanisms can be modelled and incorporated into a forecasting tool.[16] In practice, this demands very detailed and rich data that are, at present, not available at a pan-European level. In the present results a more limited reconciliation is imposed that recognises the key features of this process. The projected numbers on the supply side are taken as given for this purpose. This reflects the fact that the total numbers available by qualification level are largely predetermined by demography and educational and training decisions already made. The much better qualified new entrants coming in to the labour market, replacing much less well qualified older people imply that substantial improvements in average qualification levels are inevitable in the short to medium term.[17]

The projections on the demand side are then adjusted to allocate the available supply by broad qualification level to the jobs on offer. This is done at a detailed level for each country, distinguishing both industry and occupation. In future work, other ways in which both demand and supply may respond to any initial imbalances and mismatches will be explored, but in the present results such feedback mechanisms are not included.

The results discussed above reflect the operation of this kind of mechanism to reconcile the projected patterns of demand for skills with the available supply. In the current sets of results the initial projections of supply of those available with higher (HQ) and intermediate level (MQ) qualifications show more rapid growth than implied on the demand side. This tendency has been reinforced by the impact of the recession. The implication is that some better qualified individuals will need to take up employment in jobs that have not typically required such levels of formal qualification. For some this may be a temporary phenomenon (e.g. graduates taking up jobs in restaurants, catering and bars). For others it may reflect a more permanent situation. This may prove a cause of frustration for those involved,

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

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

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

although as already highlighted it also opens up opportunities for individuals to expand the job in ways that the employer may not have thought about.

Historical evidence on patterns of unemployment by qualification level are used to develop estimates of how the overall levels of unemployment projected from the macroeconomic model are shared out between different qualification categories. The results reflect the strong observed hierarchical patterns in the historical data. Those with high level qualifications are much less likely to become and remain unemployed than those with intermediate level qualification. In turn, those with intermediate level qualifications are likely to be much less affected than those with low (or no) qualifications.

This does not mean that the better qualified escape unscathed from the impact of the recession. Indeed their share of total unemployment is projected to rise, since they are becoming a growing proportion of the labour force. However the better qualified are likely to suffer less from unemployment than the less well qualified in terms of rates (probabilities) of becoming or remaining unemployed. Figure 8.9 sets out the recent historical and projected future paths for unemployment rates for the three qualification categories. This illustrates clearly the hierarchy in unemployment rates as well as the impact of the recession and the subsequent recovery.

Nor does this process of reconciliation between the demand and supply numbers imply that there are no problems of mismatches between employers' skill demands and the available supply. Some individuals may be employed in jobs that do not strictly require the levels of qualifications they possess. This could imply wasted resources as the investment in prior education and training they have made is not being fully utilised. Other tensions may arise as individuals become frustrated that jobs do not meet their expectations, and that their skills are not being fully utilised. On the other hand, there may be various benefits in employing better qualified people in jobs that have not traditionally required such high level qualifications (better service or improved products). Supply may in a sense begin to create its own demand, as such individuals identify better ways of doing the job.

In the longer term, such phenomena raise some key policy questions about maximising the utilization of skills and helping to raise employers' sights with regard to the way they operate in an intensely competitive world economy. The present results suggest that Governments may need to stimulate demand from employers and find ways to increase the utilization of skills if such problems are to be avoided. Another important aspect of imbalances is the geographical dimension. The results suggest that there may be some structural problems across Europe (with Eastern Europe facing particular problems of potential oversupply).

For those with higher qualifications the "supply" trend (the labour force) has been rising more rapidly than the "demand" trend (employment), and this difference is project to continue. For those with low (or no) qualifications the opposite is true. At intermediate level the trends follow more or less parallel paths.

The effect of the recession has probably been to exacerbate these differences in trends for skill demand and supply highlighted. This could make it more difficult for some of those qualified at intermediate and higher levels to find the kinds of jobs they would like, especially in the short-term. There are some indications that the positive trends in demand are less strong than before the crisis and the subsequent recession. The recession is also probably reinforcing incentives to stay on in education for many young people facing very difficult labour market conditions. This will tend to accelerate positive trends in the supply of those with both intermediate and high level qualifications

The results suggest that there is likely to be increased deployment of "graduates" (HQ), and those qualified at intermediate level (MQ), in lower level jobs than might have been the case in the past. Despite these developments, those in the HQ (and MQ) categories will still have better chance of getting the better jobs compared with those with low or no formal qualifications (the LQ category).

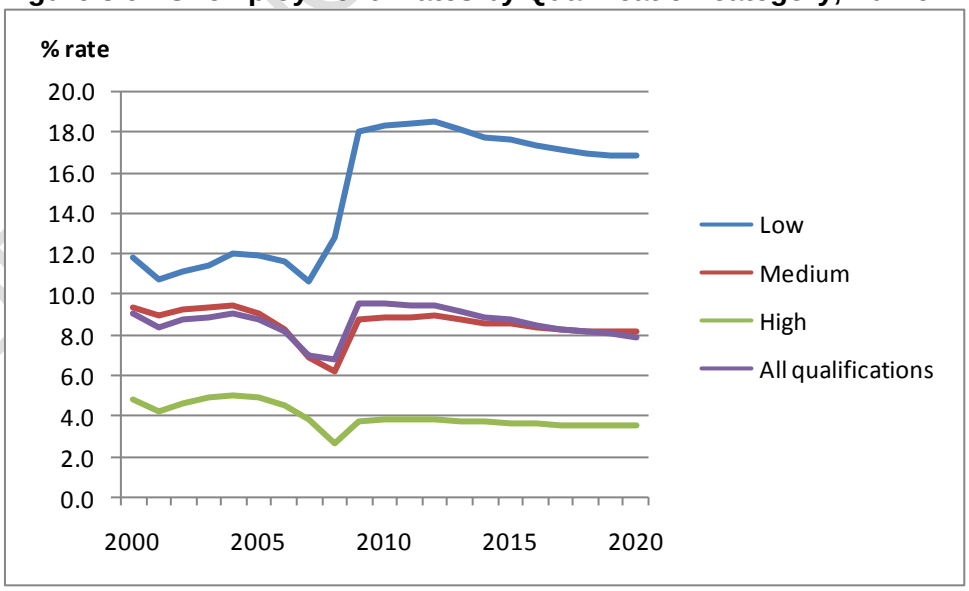
In presenting the implications for imbalances it is important not to try to interpret the results too literally. It is important to emphasise that both the trends in supply (towards a more highly educated workforce) and the trends in demand (towards greater use of such people in employment) are both hard to predict precisely. They are also interrelated (supply can to some extent help to generate its own demand, and demand can also generate supply to some degree).

In some countries, such as Finland, policies to promote the supply of skills have helped to facilitate innovation and growth, but the Finnish model may be hard to reproduce in larger countries. Europe as a whole may need to consider measures to boost the demand for skills and to encourage endogenous innovation and creation of high level jobs. Policies may also be required to encourage the full utilization of existing skills and qualifications.

It is also important to recognise that the so called BRIC countries (Brazil, Russia, India China and other fast developing nations) are also aiming to increase their shares of high level jobs, so there is no room for complacency in Europe. Winning such jobs will remain a highly competitive game, dependent on achieving higher productivity in the EU. Optimal allocation (and use) of skilled workers may be a necessary (but probably not sufficient) condition for this. However, better matching of the supply of skills to the right jobs will help.

Other Cedefop research suggests that over education is not a problem. In a general cultural sense it is probably impossible for an individual to be too well educated. But over qualification or over skilling (lack of utilization of qualifications and particular skills) undoubtedly is a potential problem, as are concerns that individual's experience in the workplace may fail to match the expectations raised when undertaking education and training (in terms of the quality of jobs and terms and conditions of employment). These issues also emerge in other research from national studies.

Figure 8.9: Unemployment Rates by Qualification category, Eur29



Notes: Constrained estimates.
Source: IER estimates based on E3ME, EDMOD and BALMOD.

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