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BEST PRACTICES IN FORECASTING LABOUR DEMAND IN EUROPE

REPORT II

Editors
Łukasz Arendt
Magdalena Ulrichs

This publication is a part of the project
Analysis of the labour market processes and social integration in Poland in the context of economic policy, co-financed by the European Social Fund

Task 2. The implementation of the integrated forecasting and information system providing employment forecasts

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EDITOR'S PREFACE

An important element of the institutional framework of the labour market in the modern economies is a system of anticipating skills needs. Usually, such a system is focused on projecting and forecasting demand for labour by occupation and with regard to some other dimensions (i.e. industries, qualifications, etc.). Information provided by this system is of a great importance for policy makers, and also for other labour market actors, as it helps to counteract future mismatches between qualification requirements and formal and informal qualifications acquired by individuals. In other words, the system of forecasting skills needs helps to balance the labour market in a short and medium term. The importance of such a system is confirmed by the fact that at the European Union level, CEDEFOP has been conducting for years many projects on forecasting labour demand and skills demand in the EU. At the same time, it is assumed that every EU Member State has set up its own system for forecasting labour demand.

Unfortunately, at present (2012) in Poland there is no integrated system of labour market forecasting (on the national or regional level). The main national initiative within this framework was the Labour Demand Forecasting System (*System Prognozowania Popytu na Pracę* – SPPP), which was launched in 2004. It was an IT system that generated quarterly labour demand forecasts according to various dimensions (vocational groups, gender, education, industries, provinces, etc.) with the use of various econometric modelling techniques (among others: exponential smoothing, trend modelling, VAR, autoregressive modelling). Regrettably, since 2006 SPPP system has not been neither updated nor available to users on-line.

Setting up a system for forecasting labour demand in Poland is a challenge but, at the same time, a necessity. The concept of introducing such a system was initiated in 2011 by launching a Task "*The implementation of the integrated forecasting and information system providing employment forecasts*" within an EU co-funded project "*Analysis of the labour market processes and social integration in Poland in the context of economic policy*". The project conducted by the Centrum Rozwoju Zasobów Ludzkich (Leader) and the Institute of Labour and Social Studies (Partner) aims to implement an integrated system of employment forecasting in Poland by 2014. Although it is not yet a system that forecasts demand for labour, it should be seen as a milestone in setting up this kind of measure in the coming years.

Forecasts, based on an econometric model, will be available through an on-line tool at the internet portal www.prognozowaniezatrudnienia.pl. This on-line tool will allow one to generate employment forecasts by occupation group, region and sector of the economy by 2020. This tool is supposed to be an important in-

strument in the labour market policy, especially for the public employment services, as well as for the young people who are about to decide what career path to choose. Of course, other groups of stakeholders should also benefit from it (i.e. labour market institutions, educational institutions, employers, employees, etc.).

It has been assumed that a new Polish system of employment forecasting should be based on foreign expertise and learn as much as possible from the experience of other EU Member States that have been developing their forecasting system for many years. Basically, we would like to take advantage of a leapfrog opportunity by implementing up-to-date developments in econometric modelling and management of the forecasting process, including methods of making the results available to the public.

The rationale of this book is to present systems of forecasting demand for labour used in selected EU countries that may be seen as examples of best practices in this area and formulate recommendations for establishing a new Polish system of employment forecasting. The recommendations stemming from the presented international experiences are of general as well as specific nature. While specific recommendations are connected with the exact features of the employed approach to the forecasting, and may be found in the successive chapters of the book, the general ones are following:

- Setting up a well-organised forecasting system is a process that takes time and requires substantial investment;
- The issues common to all forecasting systems are data availability and inconsistency of time series caused by changes in statistical classifications;
- Although it is impossible to predict future (all forecasts are imperfect), the quality of forecasts should be evaluated in terms of their usefulness to different stakeholders;
- The most successful forecast is the one that addresses and influences specific target groups (especially policy makers) to undertake specific measures in order to avoid projected negative changes. In this sense, we should wish that forecasts will 'destroy themselves';
- To forecast demand for labour it is necessary to include in the model different types of demand, such as expansion demand and replacement demand in order to make projection on the number of job openings;
- As some international experiences show, the major impact on the labour market up to 2020 is expected to be related to changes in replacement demand, while expansion demand is projected to be rather moderate;
- Well-established systems of forecasting demand for labour should be based on an integrated approach in which demand and supply-side of the labour market are modelled within one framework.

The book contains six chapters.

In the first one, Rob Wilson describes not only the system of forecasting skills in the UK but also elaborates on forecasting as such, presenting in an interesting manner the world of econometric models, techniques and forecasts. The first

chapter mainly focuses on the methodology and outcomes of *Working Futures* projections that follow international best practices in quantitative anticipation of changing skill requirements. The approach adopted by the Institute for Employment Research (IER) and Cambridge Econometrics (CE) is based on a regional multi-sectoral macroeconomic model (RMDM) and modules that translate the results into implications for skills demand and supply. The model provides forecasts of replacement demand and expansion demand in various dimensions, showing changes in demand for skills to 2020. In the concluding section of the chapter Rob Wilson comments on the strengths and weaknesses of the UK's system.

The second chapter presents the framework of forecasting demand for labour force employed in Finland. The core of the Finnish system is based on the Long Term Labour Force Model (LTM) developed at the Ministry of Labour by Pekka Tiainen (the Author of the chapter), and has been used since 1990. LTM is linked to the Mitenna model, whose role is to model the skills of labour force. LTM comprises of the supply side of the labour market (projection of the population and labour force participation rates) as well as the demand side (projection by industry). In this integrated approach the interaction between labour demand and supply constitutes the forecasted demand for labour. The system provides forecasts on the national level, but disaggregation on regional level is also feasible.

In the third chapter Martin Lepič and Jan Koucký describe the latest developments in the system of forecasting labour demand in the Czech Republic. Czech's experiences are especially valuable in the context of setting up the Polish system of employment forecasting – in the 1990's the Czech Republic, like Poland, started the transition process from a centrally-planned economy to a market economy and has witnessed enormous socio-economic changes in the last two decades. The challenges connected to the introduction of a modern forecasting system are confirmed by the fact that in the Czech Republic such a system has been implemented only recently, after many years of working on this issue. The system in the Czech Republic follows a top-down approach similar to the framework developed by CEDEFOP. A macroeconomic forecast is taken from the international *Forecasting skill supply and demand in Europe* project for 2009–2012. This macroeconomic forecast is based on the output from the E3ME model introduced by Cambridge Econometrics, and then is translated into changes in the number of employees by sectors in the Czech Republic. The econometric specification of the model makes it suitable for short and medium-term forecasting and policy analysis – projections to 2020 are elaborated in the chapter. Because of the characteristics of the model (the data base includes EU-wide statistics), it allows to forecast demand for labour also in other EU Member States – the Authors presented some preliminary employment forecast for Poland as well.

The next two chapters describe the German forecasting system and its latest developments – BIBB-IAB Qualification and Occupational Field Projections done within the framework of the QUBE project.

In the fourth chapter, Gerd Zika gives an overview of the historical developments of labour forecasts in the Institute for Employment Research (IAB) and de-

scribes the methodology of the IAB/INFORGE model. After this "methodological introduction", the projected changes in the demand for labour by sectors, occupations and qualifications until 2025 are presented. Gerd Zika also points out how the model could be used to forecast the development of occupations on a regional level. In the concluding remarks he formulates six recommendations with regards to the methodology, planning process and communication of forecast results that are to be taken into consideration in the process of establishing and then launching the Polish system of employment forecasting.

Robert Helmrich and Tobias Maier start the fifth chapter with an overview of the data sources and taxonomy used for the coordinated projections of the demand and the supply of labour by occupation and qualification level. Then the methodology of two supply-side models (BIBB-DEMOS and BIBB-FIT) and the results of supply forecasts on the occupational level compared to the demand of occupations are described. The chapter presents the concept of occupational fields developed by BIBB and an occupational flexibility matrix – a tool designed to analyse the interaction between initial vocational qualifications and the occupation exercised. Those developments are of an innovative nature in the context of analysing future changes in demand for skills. The Authors also elaborate on the planned actions within the QUBE project aimed at combining the demand and supply-side models into one integrated model.

The last chapter presents the approach to forecasting labour demand in the Netherlands developed within the framework of "Education and the Labour Market" project. The primary rationale of the project that started in the 1980s was to generate information that can be useful to the youth in choosing a course of study or occupation. Because of this, forecasts are given in five-year periods. However, forecasts are made and results published every two years, including the input of actual data and re-estimation of the model. In his chapter, Arnaud Dupuy focuses on the problem of forecasting expansion demand. He gives an overview of the employed estimation procedure for forecasting demand by occupation and education. The methodology is described, including the theoretical background and the features of the econometric model and empirical approach. To illustrate the outcomes of the forecasting system selected results showing changes in skills demand and a discussion of evaluation of the forecasts are presented.

We believe that the presented papers will contribute to better understanding of forecasting labour demand and will play an important role in launching the Polish system of employment forecasting.

Rob A. Wilson

1. SKILLS FORECASTING IN THE UK

1.1. Introduction

All developed countries face problems in matching the supply of people emerging from their educational and training systems with the changing demands for skills from employers. Mismatches between qualification requirements and the level of vocational training and formal qualifications being acquired by individuals are becoming a global problem. Skills forecasting is seen as part of the solution to such problems. This chapter provides a summary of the experience of the UK in this area. The prime objective is to identify possible lessons for other countries.

The chapter presents a brief summary of the models, tools and other approaches used in order to help identify future skill needs in the UK, including an assessment of their strengths and weaknesses. It draws upon previous reviews by the Author and others. It also summarises the UK institutional framework and relevant statistical infrastructure. It focuses on the main quantitative approaches to such work at national (UK) level. Lessons are drawn about the role of research institutions, government ministries and other agencies, educational institutions and other significant stakeholders.

Anticipating the conclusions of this chapter, "best practice" worldwide, involves quantitative methods, based on the use of large scale, multi-sectoral models to produce a comprehensive overview of how structural economic and technological changes are affecting the demand for skills. However, it is also clear that this needs to be complemented by other quantitative and more qualitative methods, especially where data for building quantitative models are inadequate.

It is also important to emphasise that nobody has a crystal ball that can predict the demand for or supply of skills with precision. Nor is the future predetermined. However, many trends are very robust and these can be used to inform all those involved about the world they are likely to face.

The development and use of quantitative models is a very resource-intensive process, requiring substantial prior investments in data and analysis, taking many years. There are a number of other tried and tested methods that complement the quantitative approaches which are less dependent upon the existence of such data. These can be implemented in a much shorter space of time. However, at the end of the day, there is no substitute for robust quantitative information on the current position and trends.

Section 1.2 provides a brief history of skills forecasting in the UK, considering the various different approaches adopted, their strengths and weaknesses. Section 1.3 continues with a more detailed description of the main methods used to produce the *Working Futures* projections of changing skill needs. This is an example of quantitative forecasting, based on a regional multi-sectoral, macro-model. The reasons for favouring this approach are summarised in Section 1.2, along with some of the problems and pitfalls associated with this method. Section 1.4 sets out the key data requirements of such work. It requires substantial technical support from the state, including the need for major investment in statistical and analytical infrastructure. Section 1.5 summarises the current situation in the UK, based on the latest set of *Working Futures* national projections. Section 1.6 concludes by summarising the strengths and weakness of the UK approach. It draws some practical lessons that can be learned from the UK experience.

1.2. A brief history of UK skills forecasting

Background

There is a very long history of anticipation of changing skill needs in the UK, stretching back some 40 years. Wilson (2008a) provides the details. There is not a single system or approach. Many organisations and stakeholders have been involved and there have been many institutional and other structural changes that have taken place over this period. A number of different approaches have been tried, although there are many common threads.

The UK government has for many years recognised the need for some kind of regular assessment of labour market prospects and for related skills projections at national level. It has therefore funded research to develop models and produce national (and more recently regional) projections on a fairly regular basis since the mid-1970s. Unlike the USA (and a number of other countries) it has chosen not to do this 'in house' within a ministry or government department, but commissioned others to do it, on its behalf. This has certain advantages. It allows the government and others to distance themselves from the results. It also means that those producing the projections do not need to be quite so concerned about the political sensitivities of any results produced. It has also lead to the establishment of a range of organisations competing to provide such services, which can help to reduce costs. However, while the latter may have some advantages, it also tends to result in pressures to cut costs, which can impinge on the quality of the work undertaken.

The institutional framework within which skills anticipation takes place in the UK is complex. Over the past 40 years it has usually been in a state of flux. The government departments and agencies involved have changed many times over this period, and a new round of changes occurred in 2010 with the election of the

new Coalition Government. Wilson (2008a) provides a summary of the position before the changes introduced by the new administration.

National skills forecasting is currently carried out under the auspices of the UK Commission for Employment and Skills (UKCES). UKCES is a government agency, semi-independent of all government departments, although its work in this area is based on funding which is distributed via the Department for Business and Innovation (BIS). The actual skills projections at national level have always been carried out by independent contractors.

For most of the period since 1978 (when the first national level projections were published) this work has been undertaken by the Institute for Employment Research (IER) at the University of Warwick, working closely with Cambridge Econometrics (CE). The latest projections are referred to as *Working Futures*.

Different approaches to anticipating changing skill needs in the UK

There are many possible approaches to anticipating changing skill needs. These tend to reflect both what is desirable as well as what is feasible. No attempt is made here to provide a comprehensive description of all these approaches (for more detailed discussion, see Wilson (2008a)). The focus here is on providing some key insights from the UK experience.

The earliest attempts to peer into the future labour market in the UK adopted model-based quantitative methods (for details see Wilson (2008)). In part this was simply because quantitative results were seen as a key output required by potential users of the results. Such work is of course constrained by the data available ("statistical infrastructure"). More qualitative approaches have also been developed where data are not readily available. While qualitative approaches can provide some insights, they are generally regarded as useful complements to the more fully-fledged, model-based projections, rather than a substitute for them. This highlights the importance of investment in statistical and analytical infrastructure, which is considered in more detail below.

Previous reviews make it clear that an enormous number of different methods and approaches have been used to anticipate education and training needs. Bell (1996) argues that many standard social science research methods, such as surveys, statistical and econometric analysis, participant-observation, focus groups etc., can be used to peer into the future. For example, market researchers ask about consumers' purchasing intentions. This has been extended to cover a much wider range of indicators. Such methods can help to understand the past and present (and then possible futures). They can provide insights into both factual matters, as well as the perceptions and attitudes that people have about the future.

The use of computers has revolutionised the ability of analysts to develop ever more complex models, as well as facilitating the collection, access, analysis and dissemination of more detailed data. Improvements in modelling techniques have been facilitated by the availability of better data, as well as increased computing power. Improvements in the technical means of support for anticipating skill

needs offered by the State, and in particular its statistical agencies, is also crucial, as set out in more detail in Section 1.4 below.

This has enabled empirical estimation of model parameters which represent relationships between the specified variables. Simulations and quantitative computer based models are invaluable in many areas of social science forecasting. This approach can result in a mechanistic approach towards development of alternative scenarios, but has the merit of being grounded in real data. Other more qualitative methods tend to be less constrained and more speculative. In scenario development, for example, the scenarios are seen not so much as outcomes as catalysts for examination and discussion. They are also capable of providing insights and uncovering previously hidden relationships that may have far-reaching consequences.

Quantitative modelling approaches tend to see the future as a set of key indicators and driving factors to be analysed and projected. An important component of much futures work is focused on providing a normative view of possible alternatives. Trends alone cannot be relied upon since trends inevitably "bend". Behavioural models attempt to provide insight into what causes trends to bend, by embedding the models in a theoretical understanding of what drives behaviour and observed outcomes.

General approaches to projecting skills in the UK

The main approaches adopted include:

i. Formal, national level, quantitative, model based projections;

ii. Surveys of opinion of employers or other groups, including setting up "observatories", focus groups, round tables and other Delphi-style methods to reach a consensus view (these approaches may include some quantitative aspects but are generally more qualitative);

iii. Ad hoc sectoral or occupational studies (involving both quantitative and qualitative methods) focussing on the situation in particular areas (which may involve elements of both i and ii).

iv. Qualitative methods based on scenario development exercises or "Delphi" methods (based on expert opinion).

The UK system (if it can be called such) involves elements of all of these approaches. Each approach has its own strengths and weaknesses. Wilson (2008a) summarises these. The IER/CE approach to anticipating changing skill requirements is fundamentally quantitative and model-based (using econometric methods), but also recognises the importance of more qualitative methods and evidence. Details are set out in the following sections.

Most reviews of international best practice in skills forecasting suggest that the use of quantitative methods, based around a multi-sectoral macroeconomic model, is the preferred option. Such models are regarded as essential in order to obtain a robust and consistent sectoral employment scenario, which is the starting point for any comprehensive assessment of changing skill needs.

The advantages of such an approach include:

- the sectoral and other detail it provides;
- the fact that it is typically comprehensive, covering the whole economy;
- logical consistency;
- imposition of accounting constraints;
- recognition of economic constraints and influences;
- the fact that it helps make underlying assumptions explicit;
- consistent scenarios across all sectors.

Such methods do, of course have some disadvantages and problems, including:

- technical limitations, within fixed resource limits;
- limits to current understanding of the way labour markets work;
- the possibly limited relevance of the past (such models being based on an assumption of a continuation of past patterns of behaviour);
- the data requirements of quantitative modelling approaches are substantial (long time series of consistent sectoral data on a range of economic and labour market indicators, especially employment, lie at the heart of any multi-sectoral modelling approach to assessing changing skill needs, ideally linked to other economic indicators within a system of National Accounts) and require many years of substantial investment;
- data limitations (often the data used to build models were not collected with modelling in mind);
- resource costs of development and maintenance.

Quantitative models should not, therefore, be seen as a panacea. Nevertheless, in most of the countries that do conduct regular national assessments of future occupational and skill requirements, such models are regarded as an essential cornerstone. Such models are increasingly being adopted in developing, as well as developed, countries, as the availability of data and the capacity for model building improves.

Quantitative methods also include various non-model based techniques, including surveys of various kinds, intended to elicit robust data on matters of fact (current skill structures and trends) or opinions and perceptions.

These can include:

- surveys of employers and others to establish facts;
- surveys of employers and others to test opinions and perceptions;
- skills audits.

The other main approaches to assessing changing skill needs adopted in the UK can be categorised as follows:

- employer skills surveys;
- detailed in-depth sectoral studies;
- other qualitative methods.

All of these have been tried in the UK with greater or lesser success. Details are given in Wilson (2008a). Examples include the *National Employers Skills*

Surveys (*NESS*) and *Sector Skills Agreements*, and the related *Skills Needs Assessments* (SSA/SNA). The latter have been carried out under the auspices of the various Sector Skills Councils (SSCs) set up by the government to reflect employer views.

NESS has been conducted biannually since 1999. It initially focused on England but there are now similar surveys for Scotland and Wales, and most recently a UK wide approach. *NESS* is focused mainly on current skill deficiencies, although some surveys have also asked questions about performance. Because of the demand for sectoral and spatial detail the surveys are large and expensive. More recently they have focused on Sector Skills Council (SSC) "footprints". They have also attempted to provide estimates of occupational structure, but at a broad level only.

Sector Skills Agreements and related Skills Needs Assessments (SSA/SNA) are documents and agreements between SSCs and others concerning the skill needs of the sectors the SSCs represent. The mapping of skills needs as part of SSAs and the consultations with employers and others conducted by Sector Skills Councils have led to a renewed focus on more qualitative approaches. This can be considered to constitute the main example of the use of a qualitative approach to skills needs assessment in the UK. The approach used by the SSCs involves working with experts and employers in the sector, as well as other specialist institutions. In many cases the emphasis on qualitative as opposed to quantitative methods is a reflection of necessity, as the statistical infrastructure to use quantitative modelling-based methods does not exist. The qualitative techniques used vary widely from one SSC to another. Many SSCs are still finding their way. In most cases the approaches involve a combination of methods and data sources.

The UK Commission for Employment and Skills (UKCES) has established a *Sector Skills Almanac* to provide a "one stop shop" for those looking for sectoral LMII on-line. It contains data from a wide range of sources including *Working Futures* and *NESS*, all presented in a consistent fashion. It is designed to bring together comprehensive, robust and comparable labour market information and present it by theme and sector. It highlights sectoral differences which are fundamental to the sector-focused approach.

Most SSCs use the main tools/outputs provided centrally, including:

- *Working Futures*
- *The National Employers Skills Surveys*
- *The Sector Skills Almanac*

Many SSCs also have their own surveys and models.

Different users and uses

It is important to recognise that there are many different audiences for skills analysis and forecasting, and that their specific and detailed needs for labour market information and intelligence (LMII) may be very different. A key set of questions to be addressed when assessing such needs and systems are:

- by whom (funding and execution);
- for whom;
- how;
- why/what for; and
- when.

The main audiences in the UK include:

- Government, at National and Regional level (policy makers);
- Stakeholders, including Local Bodies, Industry Training Organizations, Employers, Education and Training Institutions, and Careers Guidance organisations;
- Individuals making occupational choices.

The interests of the different audiences may be very different. They include:

- Occupational demand – future employment levels by occupation/skill;
- Replacement demands – job openings (recognising the need to replace those leaving);
- Education and training requirements – qualifications typically needed;
- Supply/demand balances;
- Terms and conditions of employment (pay).

What is done, and how it is done, therefore depends at least in part on who it is being done for and why. Different audiences have very different requirements for both detail and general content. Policy makers are more interested in overall supply demand balances and the general areas where investment in skills is needed. Providers and individuals are interested in much more detailed information about prospects in particular areas.

In the UK much of the work is funded centrally by government departments or agencies, on the grounds that this is a "public good". In the UK, the government has generally chosen not to do the work itself but to distance itself from the execution (by creating agencies, and by contracting the actual work out to academic or commercial research consultancies).

Limited resources mean that the main national projections are intended to serve many different users and purposes. While this cuts costs, it may mean compromises in terms of meeting the specific needs of different users.

1.3. The methodological approach used for *Working Futures*

Economic foundations

The *Working Futures* projections follow international best practice in quantitative anticipation of changing skill requirements. The IER/CE approach to skills forecasting has always been based on the idea that developments in the labour market are crucially dependent on what happens to the economy more generally. This includes developments in the demands for different goods and services and

how technological change influences the ways these are produced and delivered. The typical quantitative modelling approach therefore involves two key elements:

- a regional multi-sectoral macroeconomic model (RMDM);
- modules to translate the results into implications for skills demand and supply.

The Regional Multi-sectoral Macroeconomic Model

RMDM is summarised in Figure 1.1, which emphasises the various links between the various sets of economic and labour market indicators. These include both technical and accounting, as well as behavioural links. The light grey area represents "the world". The dark grey area represents the UK economy and labour market. The boxes within these areas represent broad sets of economic and labour market indicators. Each of these is disaggregated into many categories (industries, commodities, etc). There is also a regional disaggregation (not shown in the diagram).

The various indicators are linked by technical accounting and behavioural relationships, as indicated by the arrows. The nature of these relationships is estimated using econometric techniques. The white boxes include endogenous variables, determined within the model. The black boxes represent exogenous variables such as what is happening outside the UK (levels of world economic activity and prices), demography, government policies (on taxes and expenditure).

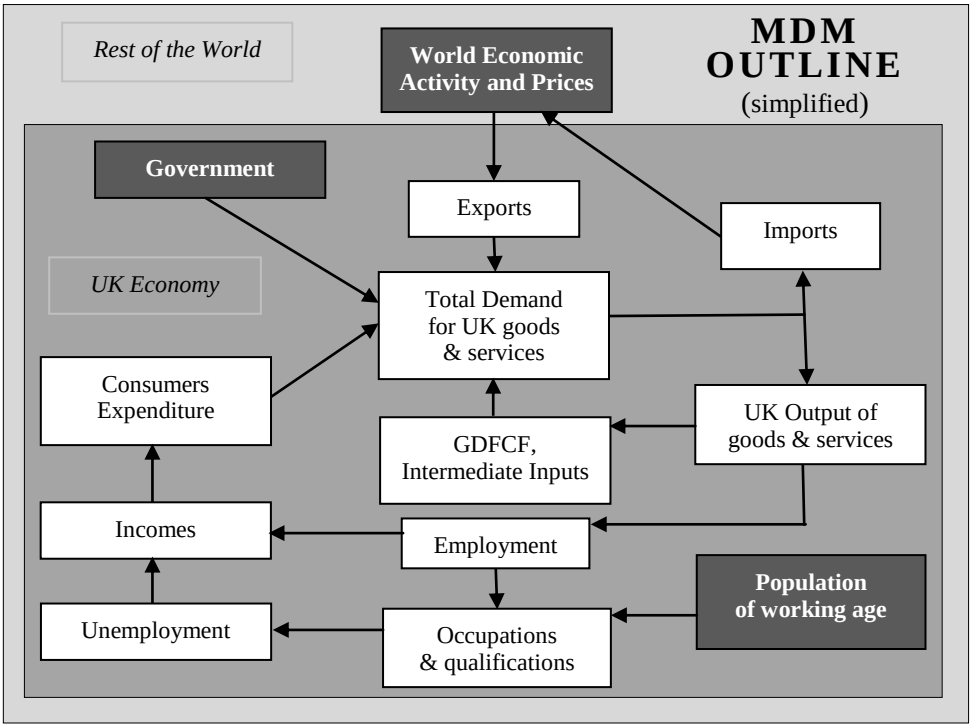
At the centre is the demand for UK goods and services. This depends on demands from consumers, the government, and foreigners (exports net of imports). A key component is a Leontief input-output table, which takes into account the inter-linkages between sectors. The input-output element drives the demand for goods and services from producers, along with Gross Domestic Fixed Capital Formation (GDFCF). Together these then determine UK output of goods and services, which in turn drives employment and incomes. The latter is one of the main drivers of consumers' expenditure, completing one of the main feedback "loops" within the model. The model also includes detailed treatment of prices and wages (not shown in the diagram).

Models such as RMDM are usually estimated using complex and sophisticated econometric methods, although computable general equilibrium models (where parameters are calibrated rather than estimated) are also used in some countries. The key outcomes are consistent projections of employment levels by sector and labour supply by age and gender. Of course, in addition to providing projections of sectoral employment, such models are used for a wide variety of other purposes.

RMDM is used to produce an assessment of the prospects for industries or sectors at a detailed level. RMDM distinguishes 41 sectors, defined using the UK Standard Industrial Classification (SIC). This is broadly consistent with international systems of classification. This approach attempts to reflect the various drivers affecting the prospects for each sector, including the world environment, international competitiveness and government policy.

Figure 1.1

The Regional Multi-sectoral Macroeconomic Model (RMDM)



Notes: own illustration.

RMDM is one part of a broader modular approach to assessing changing skill needs. It helps to provide an understanding of the implications of changes in sectoral employment structure for the demand for skills. While this is not the sole tool required to anticipate future skill needs, it is regarded as an essential part of the armoury in most countries that undertake this kind of activity.

Skill demand and supply modules

RMDM forms Module 1 in Figure 1.2. The other components or modules translate the outcomes from RMDM into implications for the demand for skills. Implications for skills are derived from an analysis of differences in occupational requirements within sectors, and how these are changing over time. Information on occupations is complemented by data on qualification patterns within occupa-

tions.[1] As in many other countries this aspect is much less sophisticated in the UK, mainly due to the more limited nature of data available on skills. In most cases, the focus of attention is limited to occupational (or qualification) employment structures within sectors. Trends in such structures are analysed, using fairly simple techniques rather than sophisticated econometric methods.[2]

Skills supply, as well as demand, is also considered. The supply side is focused upon gender, age and qualifications.

Occupations are classified using the UK's Standard Occupational Classification which is compatible with ISCO. Qualifications are measured using the UK's National Qualifications Framework (NQF). The UK systems of classification are designed to try to differentiate sector, occupation and qualification dimensions.

Figure 1.2 shows the main modules used in *Working Futures*, which are:

Module 2: an occupational model, which focuses on the changing demand for skills within sectors (skills being measured by occupation or qualification);

Module 3: a qualifications module, focusing on the implications for qualification intensities within occupations (demand) rather than the supply side;

Module 4: a replacement demand module, recognising the crucial importance of considering not just changing occupational and qualification employment levels but also the need to replace those leaving the workforce because of retirement, migration and mortality;

Module 5: which covers the supply of skills (measured by qualifications); and

Module 6: which covers the reconciliation of demand and supply.

Full details of RMDM and the other modules used in *Working Futures* are provided in Wilson and Homenidou (2012a).[3]

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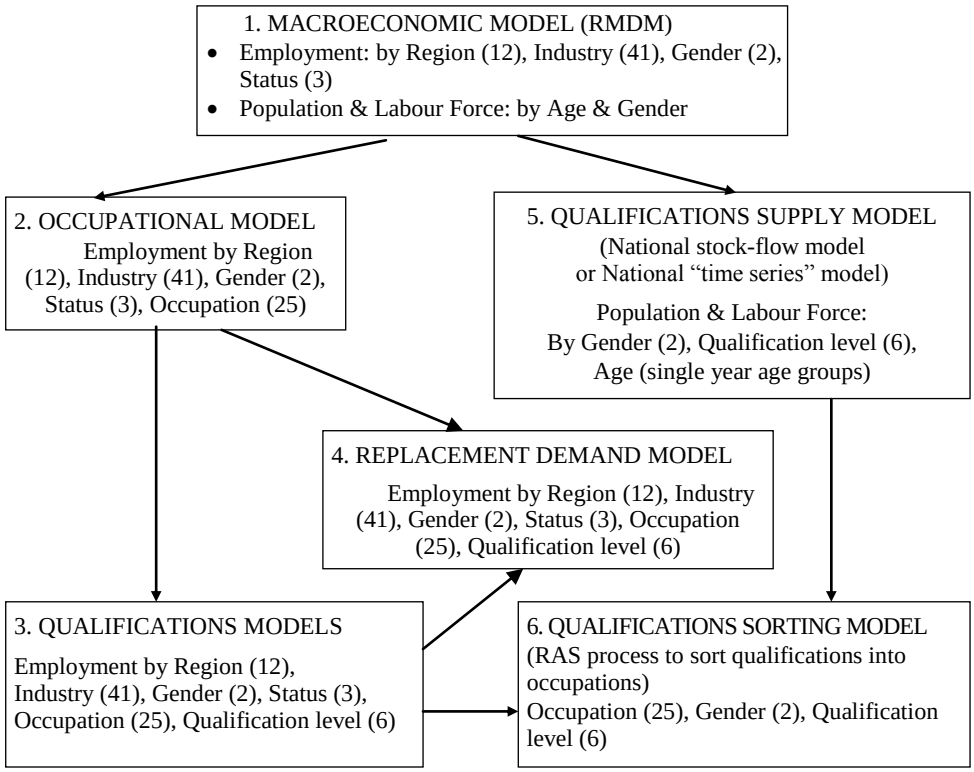
[1] Occupational employment patterns are only one way of measuring skill. From the point of view of training and especially formal educational planning, the types of qualifications typically required are also important. In addition, other aspects of skill are important. These include the kinds of skills people actually require in order to undertake the main tasks in their work, such as physical skills (manual dexterity and strength), general intellectual skills (including literacy and numeracy), as well as social skills (such as communication, team-working, leadership, etc.). These have been variously termed key, core and generic skills. Generally attempts are not made to project such skill needs quantitatively, but many countries including the UK now devote resources and effort to assessing how such skill needs are changing and their different patterns across sectors and occupations.

[2] As noted below, the US BLS makes no attempt to formally model and project occupational employment shares within sectors, but relies on expert judgement of how these shares are changing. The typical approaches used around the world are discussed in more detail in Wilson (2008a).

[3] Other quantitative projections are also produced in the UK, both by, and on behalf of, a variety of organisations, including Sector Skills Councils. These are too numerous to detail here, but they generally adopt similar methods (for a review see Wilson et al., 2004 and Wilson 2008a). This also includes a considerable amount of work at a sub-regional level (see Wilson 2008b for a review).

Figure 1.2

The Working Futures Models and Modules



Source: own illustration. Such understanding finds representation in so-called computerised "models", which take the form of algebraic equations linking key variables. A model is an attempt to provide a simplified representation of reality that can help understanding of the phenomenon of interest (in this case changing patterns of the demand for skills in the labour market). Social scientists attempting to understand how societies and economies work face problems such as:

- Lack of fixed laboratory conditions;
- Lack of good experimental data (they can only observe outcomes).

Replacement Needs

In addition to changes in overall occupational employment levels (so called "expansion" demands), it is important to consider replacement demand. This includes an assessment of the demands arising as people leave the workforce for retirement or other reasons, such as net outward migration, movement into other occupations and in-service mortality. Replacement needs are usually strongly positive, and outweigh by far the "expansion demands" (which for many industries and occupations are negative).

Estimating replacement demand is not straightforward. It requires information on:

- the age and gender structure of occupational employment;
- the rates of outflow due to retirement (and other reasons for leaving the workforce).

Information on age and gender structure is required because many of the flows, especially retirements and mortality, are age and gender specific. Age structures vary significantly by occupation – for example, a higher proportion of managers than IT professionals are likely to be nearing retirement age. Differences in age structure across occupations will clearly influence exits, with more older people retiring, but more younger people changing occupations. Age structure also affects mortality. From the household survey/population census data, it is possible to analyse the demographic composition of each occupation. This makes it possible to estimate specific rates of retirement and mortality for each occupational class.

Retirements: For the purposes of modelling retirements, it can be helpful to consider the fraction of the occupational class that is aged 55 to 65 (say) in a given year and then to assume that some fraction of this group would retire each year. A fairly wide age category is usually used since the samples are quite small in most cases. It might also be possible to measure retirement flows over time, although this kind of approach can suffer because of the sampling errors being too large.

Mortality: To estimate replacement demand arising from deaths in each occupation it is possible to use age- and gender-specific mortality rates over the forecast period.

Migration and mobility: The migration of skilled professionals has been an increasing source of concern in many countries over the past few years. Skills migration is clearly a reality and must also be taken into account in the modelling, as these flows impact both the supply and demand for higher-level human resources.

Econometric techniques and methods

Quantitative model-based methods generally include:

- complex multi-variate time series, behavioural/econometric equations; and
- similar univariate models.

The latter can be further classified into:

- simple extrapolation of past trends (mechanistic techniques);
- more complex time series methods.

Simple extrapolative techniques are used where only limited time series data are available. In some cases, only a very small number of time series observations are available (for example on occupational structure) and this clearly limits what can be done. Where more observations are available, more sophisticated analysis is possible. This can use economic behavioural models or "time series" methods,

which attempt to find replicable patterns in a single time series that can be used to predict its future path.

Time series models are widely used in the business and financial world, although they are much better at predicting short-term changes than longer-term patterns. Unfortunately, history suggests that most linear (or more complex) trend patterns eventually come to an end ("trends bend") and that they should therefore not be relied upon for medium to long-term forecasting.

It is worthy of note that the US Bureau of Labor Statistics (BLS) makes no attempt to formally model occupational employment shares within sectors, but places more reliance on carefully measuring the current position, and then on expert judgement of how these shares may change in the future.

Behavioural analysis is an attempt to move beyond patterns in observed time series data and to provide some understanding of how it is that these patterns have arisen and more importantly, why they may change in the future. Such behavioural analysis draws upon disciplines such as economics and sociology for an understanding of what influences the behaviour of the key actors in the economy and how this is reflected in the key economic and social indicators that can be measured.

The models are built using quite sophisticated statistical and econometric techniques, and using data drawn from largely official sources, including National Accounts and related estimates of employment based on surveys of employers and of households.

Having built such quantitative models and used them to make projections, it is important to recognise what they can and cannot do. On the positive side, such projections can:

- Help to make assumptions about the future explicit and transparent;
- Help to enforce systematic and logical thinking;
- Act as a focus for intelligent debate;
- Provide a useful counterfactual to assess policy impacts (i.e. what would have happened in the absence of the policy intervention).

But they cannot provide:

- Mechanistic "manpower" planning;
- Precise indications of education and training requirements.

Where the data are adequate econometric techniques can be used (co-integration, error correction modelling, etc.). This is a feature of much of the macroeconomic modelling in RMDM (Figure 1.1). This includes the employment functions used to generate the industry employment estimates.

The implications for occupations and qualifications are then developed in modules 2 and 3 shown in Figure 1.2, using more simple extrapolative techniques applied to the employment shares for occupations and qualifications within industries.

Analysis of labour supply by age and gender is carried out in RMDM using econometric methods. These supply numbers are then further disaggregated by

formal qualifications held, to obtain measures of the supply of skills using a stock flow model (module 5 in Figure 1.2) and other more simple extrapolative procedures. Full details of the approach are set out in the separate *Working Futures Technical Report* (Wilson and Homenidou (2012a)).

The *Working Futures* results are intended to provide a sound statistical foundation for the deliberations of all those with an interest in the supply of and demand for skills. This includes individuals, employers, education and training providers, as well as the various agencies and departments of government.

Of course, the future cannot be predicted with precision or certainty. But all the participants in the labour market make plans for the future, even if these are simply based on the default assumption that the future will be the same as the past. The rationale behind *Working Futures* is that a comprehensive, systematic, consistent and transparent set of projections can help to inform everyone about the world they are likely to face.

It is also important to emphasise that the views presented in *Working Futures* are not the only possible future. They represent a benchmark for debate and reflection and as an aid to inform policy development. The detailed projections present a carefully considered view of what the future might look like, assuming that past patterns of behaviour and performance are continued over the longer term. The results should be regarded as indicative of general trends and orders of magnitude and are not intended to be prescriptive. If policies and patterns of behaviour are changed, then alternative (perhaps more desirable) futures can result.

1.4. Quantitative skills forecasting in the UK – data requirements

General data sources for skill forecasting

The UK government provides technical support for anticipating skill needs in a number of ways. The key elements have been:

- The development of standard systems of classification (industry, occupation and qualifications);
- The development of comprehensive systems of national economic accounts;
- The introduction of regular national surveys of households and employers focusing on employment and skills matters;
- The development of means of access to these datasets electronically;
- Investment in general economic modelling techniques.

Classification of Industries, Occupations and Qualifications

A standard system of classifying industries, occupations and qualifications, both over time and across different data sources, is essential to any systematic attempt to assess future skill needs.

Development of Regular National Surveys of Economic Activity

Sectoral information lies at the heart of the multi-sectoral models used in employment projections. Good sectoral information (especially output and employment) is therefore essential. In the UK the government conducts good quality *Censuses* or *Surveys* of Economic Activity, which form the basis of such information. These form a key input into the National Accounts. Note that such information is very different from that obtained in *NESS* (see below).

Input–output tables showing the links between sectors are another key element. These tables describe how one sector purchases inputs from another in order to produce its own goods and services.

Surveys of Households (Censuses of Population, Labour Force Surveys)

As in most other countries the UK conducts regular but infrequent Censuses of Population. For many years this was the only source of detailed information on the occupational structure of the employed workforce. More recently Labour Force Surveys (LFS) have become much more commonplace. These are effectively mini-censuses, although usually completed voluntarily rather than as a legal obligation. The LFS has been a key survey in the UK since it joined the EU. Member states are obliged to conduct such a survey on a regular basis and with a fairly standard set of questions. The gradual improvement in the LFS, and in particular its recent increase in sample size, means that it is now the prime source of data on occupational employment in the UK. However, it is still limited in its ability to provide accurate data for small geographical areas. Compared to the huge survey of establishments (employers) conducted on a regular basis by the Bureau of Labour Statistics (BLS) for the USA, the LFS provides a rather fuzzy and sometimes erratic picture of trends in occupational structure.

Other Surveys and Databases

These include the UK's National Employer Skills Surveys (*NESS*), which are concerned primarily with the patterns of skill deficiencies rather than the scale of economic activity. The UK also has a range of other surveys conducted on a fairly regular basis, which contain relevant data. These include surveys of earnings, as well as various aspects of employment labour supply. This has improved the ability of researchers to monitor trends.

The vast improvements in IT have also resulted in an explosion in the development of databases and primary data collection exercises at a local level. Many of these are intended to assess current positions, but many also look forward into the future. These include major Skills Audits of local areas to supplement and update the information from official sources. Surveys of Employers, intended to assess their skill needs, are also important. These are often focused on specific sectors (under the auspices of the SSCs). In many cases such work is subcontracted to specialist survey companies and labour market consultancies. Although this in-

crease in availability of relevant LMII is to be applauded, there are many problems related to inconsistencies in methodology and definitions. These problems make it much less useful than it might otherwise be. There is a strong case for a more co-ordinated approach that takes advantage of economies of scale and benefits from synergy and cross-fertilization.

Development of means to access data electronically

The UK and other governments are increasingly making data available electronically, via the Internet and other channels. In the UK the National Online Manpower Information System (NOMIS) has been used for many years to make detailed LMII available. The Internet is also being used much more intensively (see for example the UKCES *Almanac*).

Support of economic modelling

The UK government provides general support for economic and related research through the Economic and Social-Science Research Council (ESRC). This has in the past encouraged the development of econometric models, although many of these are now operated on a commercial basis. In the UK this has been done for many decades and the current strengths in that area can be seen as the result of many years prior investment.

Data Requirements for Working Futures

Wilson and Homenidou (2012a) provides a technical description of the sources and methods used to generate the latest set of occupational employment projections presented in *Working Futures*.

Module 1: the regional multi-sectoral macroeconomic model requires very detailed and robust times series data on: the economy (national accounts); employment (especially by sector); input-output tables; and demographic information. These have already been sketched out above and in the previous section.

Modules 2–7: the skills demand and supply modules, require detailed data on employment and other indicators differentiated by industry, occupation qualification and other dimensions. Obtaining such data raises some important issues of confidentiality (UK Statistics of Trade Act, 1948), as well as statistical reliability, in making such detailed data available in the public domain. Issues of the control of confidential information have become of even greater concern in recent years. It is therefore important to address this issue explicitly and carefully, and especially the dissemination of the results, so that confidential information about individuals and individual companies is not released inadvertently, while at the same time providing the intended audiences with robust and useful information. Despite these technical and other problems, it is possible to develop a range of projections that meet the needs of the UK Commission (and those of its partners) for detailed information and intelligence on likely sectoral developments and their implications for skill requirements.

Measuring Changing Occupational and Qualification Structure

Surveys of Employers (enterprises/establishments) and Surveys of Households (Labour Force Surveys) are used to both establish matters of fact, as well as to elucidate opinions. Both have their own advantages and disadvantages for these purposes. Surveys of Employers are used in the UK to measure levels of economic activity and overall employment levels, as well as the structure of employment. They have also been used to assess employers' opinions and perceptions on current skill shortages and occasionally future skill needs (e.g. *NESS*). In most countries, including the UK, Household Surveys have become the norm for obtaining overall measures of occupational employment structure. However, a substantial increase in sample size is often needed to deliver robust statistics at a detailed sectoral and occupational level.[4]

Employer Surveys in the UK provide information on levels of employment and economic activity but are not a useful measure of occupational employment structure within industries. Surveys such as *NESS* also provide information on current recruitment problems and other skill deficiencies.

Household Surveys such as the LFS are used to monitor changes in occupational employment structure. This is a cheaper option as the LFS is required for other reasons. But its limited sample size raises question marks about the reliability of the data and their suitability for trend analysis. This poses a problem with regard to analysing employment change over time, whether sectoral or occupational. One way of dealing with the problem of small sample size is to pool the data from more than one round of the survey. This can enable a more detailed occupation by industry employment matrix to be constructed than would otherwise be possible, but at the expense of information on changes over time.

Analysis of data from ***Censuses of Population*** provides a more accurate picture, but these are expensive and infrequent (normally only once every 10 years). The most recent data currently available in the UK relates to 2001, data from the 2011 Census will not be available until 2012/13. Typically a Census does have considerable advantages when it comes to measuring the structure of employment, not least because of its much large sample size. Another factor to consider, with regard to whether or not the Census is the best option for sectoral and occupational forecasting, is the consistency of classifications used over time, which can often distort time series changes. Changes in classifications over time make estimating trends difficult.

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[4] In the USA this information is gleaned from detailed surveys of employers, (see Wilson 2010). A major concern in the UK is the quality of information available on current occupational structure, and on-going trends, within sectors. This could be improved by carrying out larger and more consistent surveys as in the USA but this is costly. Although there may be some merit in getting sectors involved in this process, there are substantial advantages in centralising this process. These advantages include economies of scale, as well as consistency across sectors.

1.5. Some illustrative results from *Working Futures*

Background

Working Futures are the most detailed and comprehensive UK labour market projections available in the UK. They are the 4th in a series of such assessments that has been undertaken every two–three years since 2002. They focus on a ten-year horizon, providing a picture of the labour market for 2020. The core purpose is to inform policy development and strategy around skills, careers and employment.

The results provide an insight into the prospects for:

- the sectoral pattern of output and employment;
- the occupational structure of employment;
- the magnitude and pattern of job openings across the economy, taking into account employment growth and replacement demands;
- the demand and supply of qualifications;
- the labour markets of the regions and nations of the UK.

The *Working Futures* projections provide a consistent quantitative assessment of prospects for the whole economy. A detailed analysis of prospects by industry and spatial area is presented, including the historical context. As well as summary results for the UK, the results also cover the implications for the devolved nations and English regions, looking forward to 2020. The separate *Sectoral Report* provides more detail about the prospects for 22 individual industries. The latest results include the reclassification of the database to adopt categories based on the latest industrial and occupational classifications (SIC2007 and SOC2010).

Box 1

Working Futures: Main Outputs from the Quantitative Model

The main multi-sectoral macroeconomic model used is one developed by Cambridge Econometrics called RMDM. This has been extended by IER to include various modules covering the skills dimension (both occupations and qualifications)

The main model outputs include:

- Various macroeconomic indicators (gross domestic product, consumer spending, GFCF, etc.), detailed sectoral information (41 sectors, based on the UK Standard Industrial Classification, plus results for SSC footprints);
- Employment is also disaggregated by gender, employment status (FT, PT and self-employment);
- Various supply side indicators including population and workforce by age and gender and unemployment;
- Production and employment, productivity, trade performance by industry;
- Occupations/Qualifications (25 categories based on the Standard Occupational Classification, and 6 broad NQF qualification categories).

Most data are available for various geographical areas, including the various countries and English regions within the UK. Over half a million time series are projected for employment alone.

This section illustrates some of the main findings from the latest *Working Futures* projections. Box 1 summarises the main results available. The results discussed here are much more aggregate. More complete details can be found in the main report (Wilson and Homenidou 2012b). This is supplemented by a *Sectoral Report* (Wilson 2012) and a full *Technical Report* (Wilson and Homenidou 2012a).

Macroeconomic context

In developing any assessment of labour market prospects it is important to set things into a proper macroeconomic context. These projections have been developed at a time of great uncertainty about prospects for the economy and the labour market. They were developed during a period of considerable turbulence in world financial markets. Concerns about the financial system now focus on problems of sovereign debt, and in particular on problems in Greece, Italy and the Eurozone generally. At the time of writing it remains unclear if these problems will trigger a further recession in Europe and the UK. The results presented here assume that such a crisis can be averted.

In such circumstances producing robust economic and labour market projections is particularly difficult. The baseline macroeconomic forecast underlying the results was developed in the first half of 2011. It assumes that a gradual recovery in confidence will bring about renewed growth in the UK economy, and that this will sustain employment growth in the longer-term (2010–2020). This forecast could underestimate the possible short term downturn that might affect the economy if the problems in the Eurozone are not resolved.

They should be regarded as indicative of likely developments, rather than precise forecasts of what will inevitably happen. However, many of these trends are very robust and are not likely to be affected by even the very turbulent conditions currently being experienced. They assume a broad continuation of past patterns of behaviour and performance. The dramatic events in financial markets in the autumn of 2008 had a significant impact on many trends in the short term, although others appear to have continued relatively undisturbed. The continuing uncertainties associated with the sovereign debt crises in Europe continue to cloud the picture. The results summarise changes pre and post these crises. They present a view of medium to longer term trends (5–10 years ahead), reflecting the likely path of recovery from recession and a gradual reversion towards longer-term trends. These issues are elaborated in much more detail in Wilson and Homenidou (2012b).

Despite these uncertainties, the economy is projected to continue its recovery, and to settle down in the medium term to a pattern of modest growth, with only moderate rates of inflation. Measures of economic output such as Gross Domestic Product (GDP) and Gross Value Added (GVA) are projected to display long-term growth rates of around 2½ per cent per annum.

Labour market prospects

Table 1.1 and Figures 1.3 and 1.4 provide a summary of the main macro results for labour market indicators. Table 1.1 shows population, the labour force, employment and unemployment in the UK from 2000 to 2020. Employment is

projected to rise slowly but steadily over the decade as a whole, driven by a significant increase in population levels. The long-term rate of employment growth (jobs) is expected to be around ½ per cent per annum, resulting in around 1½ million additional jobs by 2020.

Table 1.1

Population and Labour Force in the United Kingdom

	2000	2005	2010	2015	2020	Percentage change over period			
						2000-05	2005-10	2010-15	2015-20
Male					000s				
Population	28,691	29,494	30,533	31,530	32,576	2.8	3.5	3.3	3.3
Population 16+	22,563	23,555	24,622	25,499	26,272	4.4	4.5	3.6	3.0
Labour Force	15,638	16,318	16,937	17,175	17,508	4.4	3.8	1.4	1.9
Activity Rate (%)	69	69	69	67	67	0.0	-0.5	-1.4	-0.8
ILO Unemployment	940	882	1,458	1,650	1,316	-6.2	65.4	13.2	-20.2
ILO Unemployment (%)	6	5	9	10	8	-0.6	3.2	1.0	-2.1
Employment (headcount)	14,698	15,436	15,479	15,524	16,192	5.0	0.3	0.3	4.3
Labour Market Residual	953	957	830	994	776				
Female									
Population	30,196	30,742	31,536	32,355	33,278	1.8	2.6	2.6	2.9
Population 16+	24,364	25,097	25,900	26,604	27,259	3.0	3.2	2.7	2.5
Labour Force	13,088	13,758	14,425	14,803	15,296	5.1	4.8	2.6	3.3
Activity Rate (%)	54	55	56	56	56	1.1	0.9	-0.1	0.5
ILO Unemployment	653	596	1,011	1,138	905	-8.7	69.6	12.6	-20.4
ILO Unemployment (%)	5	4	7	8	6	-0.7	2.7	0.7	-1.8
Employment (headcount)	12,435	13,162	13,414	13,666	14,390	5.8	1.9	1.9	5.3
Labour Market Residual	1,325	1,336	936	861	833				
Total									
Population	58,886	60,236	62,068	63,884	65,854	2.3	3.0	2.9	3.1
Population 16+	46,927	48,651	50,522	52,102	53,531	3.7	3.,8	3.1	2.7
Labour Force	28,726	30,076	31,362	31,978	32,804	4.7	4.3	2.0	2.6
Activity Rate (%)	61	62	62	61	61	0.6	0.3	-0.7	-0.1
ILO Unemployment	1,593	1,478	2,469	2,788	2,222	-7.,2	67.1	12.9	-20.3
ILO Unemployment (%)	6	5	8	9	7	-0.6	3.0	0.8	-1.9
Employment (headcount)	27,133	28,599	28,893	29,190	30,582	5.4	1.0	1.0	4.8
Labour Market Residual	2,278	2,293	1,766	1,855	1,608				

Source: *Working Futures*, CE estimates and projections, MDM C111 (revision 7146).

Notes: (a) Levels are in thousands except for the activity and unemployment rates, which are in percentages.

(b) The Labour Market Residual is the difference between employment (number of jobs) and head count employment.

(c) Changes are percentage difference over the period except for the activity and unemployment rates which are percentage points.

The working age population and the workforce are also projected to rise significantly. Labour market participation rates are defined as the proportion of the number of those economically active (i.e. those in employment or actively searching for work) expressed as a proportion of the working age population (those aged 6+). They are projected to fall slightly. This reflects the overall aging of the population. Declining trends for males, despite the efforts of government to postpone retirement ages, are offset by increases amongst some female age categories.

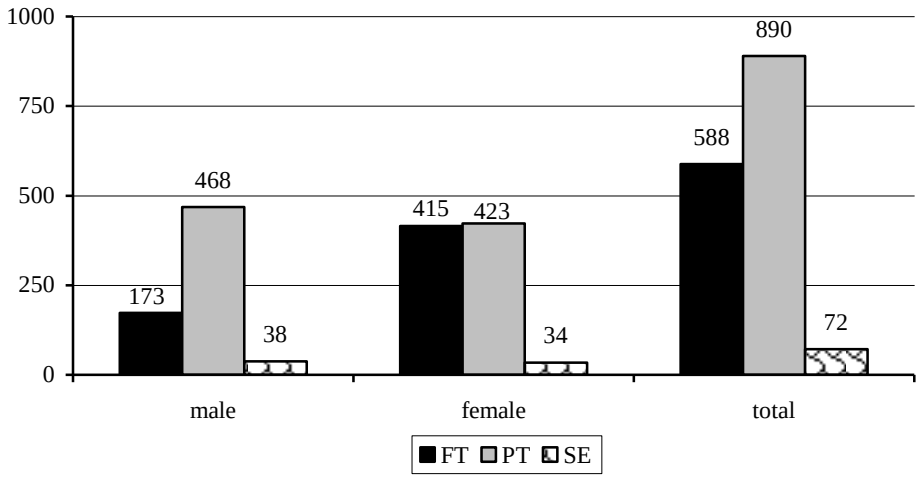
The rate of unemployment on the ILO basis (i.e. those actively searching for work as a percentage of the labour force) is expected to peak in the early part of the period, and then to fall slowly over time, to reach around 6 per cent by 2020.

Full-time employee jobs will remain the dominant status among males in 2020, accounting for 35% of all jobs. Over 2 million jobs will be held by men employed part-time and around 3 million as self-employed (8 per cent and 10 per cent of total employment, respectively). Female self-employment will account for only about 4% of all jobs. In total, females will account for just under 50 per cent of all jobs, with a fairly equal split between those in full-time and part-time jobs.

The overall share of jobs by status is not expected to change greatly by 2020. Full-timers are expected to account for 57 per cent of all jobs in 2020, 66 per cent of all jobs held by men and 47 per cent of those held by women. Part-time work is projected to make up 16 per cent of male employment (a 2 percentage point increase from 2010).

Figure 1.3

Changes in Employment in the UK by Status, 2010–20 (000s)

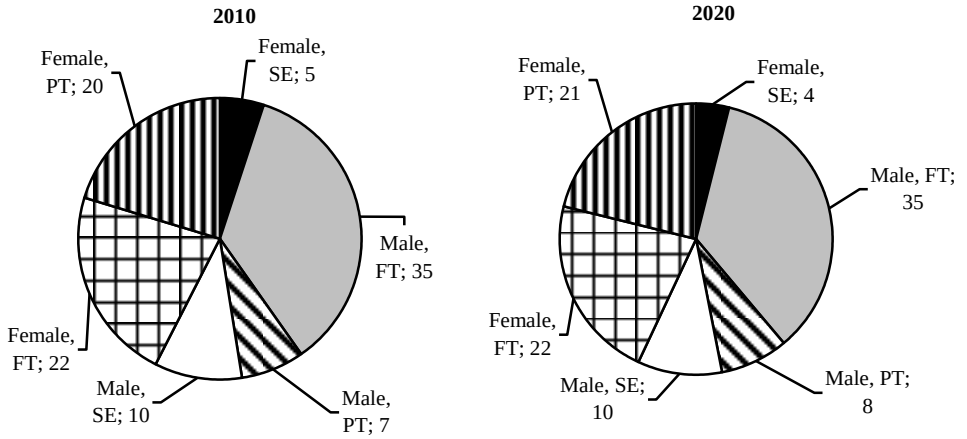


Source: *Working Futures*, Cambridge Econometrics, MDM revision 7146.

Figure 1.3 shows the net change in employment by gender and status between 2010 and 2020. The greatest increase in full-time work is expected for females (415,000 jobs) and there is an expected increase of more than 400,000 jobs each for men and women. Self-employment is set to increase by 38,000 for men and 34,000 for women over the ten years to 2020.

Figure 1.4

Employment Status in the UK, 2010 and 2020 (% shares)



Source: *Working Futures*, Cambridge Econometrics, MDM revision 7146.

The shares of total employment accounted for by full-time males and part-time females are expected to fall in the ten years to 2020, whilst the shares of part-time males and self-employed females are expected to increase between 2010 and 2020 (see Figure 1.4).

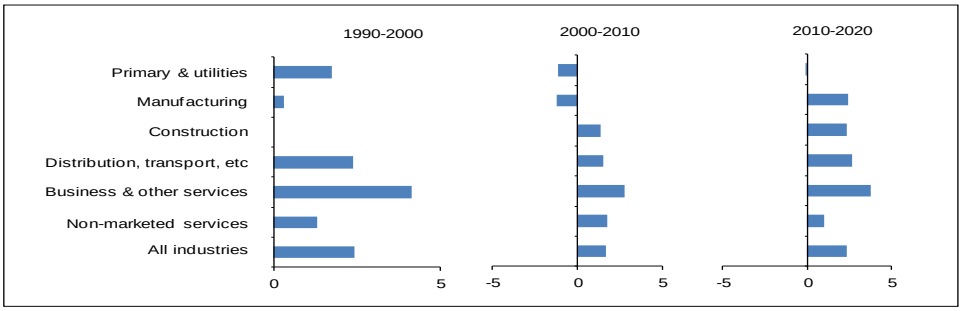
Sectoral prospects

Figure 1.5 illustrates the prospects for different industries (here aggregated to just 6 broad sectors). Changing patterns of employment by sector are largely dominated by longer-term trends in the demand for goods and services. Increasing demand for a sector's output can be expected to result in increasing employment levels (and conversely) all else being equal. However rising output is not a sufficient condition to guarantee increasing employment levels. Employment prospects also depend upon how rapidly productivity rises in the sector. While productivity growth is a key element in maintaining competitiveness and reducing costs, it also has a direct impact on employment levels. All else being equal, increases in productivity imply fewer people employed.

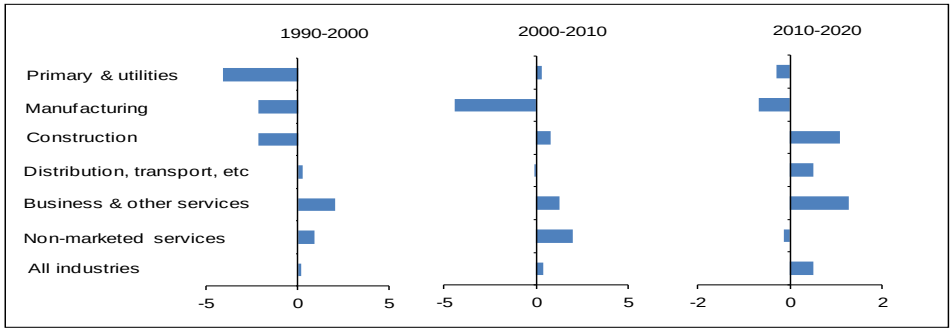
Figure 1.5

Changes in UK Output and Employment by Sector (per cent p.a.)

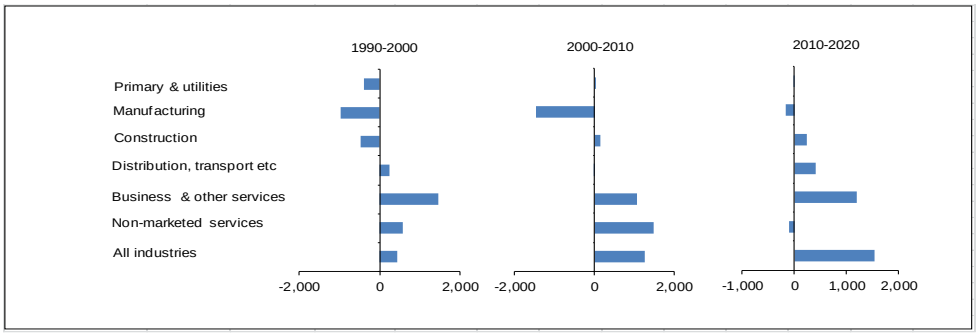
Output



Employment (% p.a.)



Employment (000s)



Source: *Working Futures*, CE estimates, MDM Revision 7146.

Output is expected to grow in almost all of these between 2010 and 2020, but this positive effect is offset by productivity gains (the same output produced with less labour input). This means that economic growth is "jobless" in many parts of the economy, with sharp employment declines in some sectors. There is a continuing shift in employment from primary and manufacturing industries towards services. However, there are some notable shifts in the prospects for the next decade compared with the last, especially the much gloomier employment prospects for the public sector (reflecting the impact of the crisis in public sector finance).

The prospects for growth in output and employment over the decade to 2020 in the 6 broad sectors identified in the analysis can be summarised as follows:

- The primary and utilities sector (which includes agriculture, etc., and mining and quarrying. electricity, and gas and water) is projected to see only modest output growth over the decade. This obscures sharp declines for mining and quarrying, offset by somewhat better prospects for electricity, gas and water, and in agriculture, etc. Primary and utilities is expected to continue to experience job losses in the next decade;
- Manufacturing output growth is projected to average around 2½ per cent per annum. There is faster growth in some technology and R&D-related industries, such as parts of chemicals and engineering, but other sectors such as textiles, clothing and metals & metal goods, etc. are expected to perform much less strongly, reflecting continuing intense international competition. Long-term decline in employment in manufacturing is expected to continue, with a loss of around 170,000 jobs over the coming decade (a rate of change of around 3/4 per cent per annum). Textiles and clothing displays one of the largest job losses but there are significant declines in many other industries as well;
- Construction is projected to exhibit a similar rate of growth to the manufacturing sector in the medium to long-term. This is in spite of the immediate uncertainties in the housing market, because the sector is expected to benefit from strong demand for major infrastructure projects. Output growth is projected to average around 2 per cent per annum. The sector benefits from positive features such as the public expenditure on projects such as the Olympics, despite being hard hit by the immediate fallout from the credit crunch. Over the longer term, employment is projected to increase slightly by 240,000 jobs over the coming decade (around 1 per cent per annum);
- Trade, accommodation and transport includes a diverse range of industries, including transport and communications, hotels and restaurants and distribution. Prospects in terms of output and employment growth are equally diverse. Communications is the sub-sector displaying the strongest growth. Output in the sector as a whole is projected to grow by 2.7 cent per annum. Employment is projected to increase by over 400,000 jobs over the decade to 2020 (about ½ per cent per annum), with most of the growth accounted for by jobs in distribution, retailing and hotels and restaurants;
- Business and other services also incorporates a diverse range of industries, including computing services as well as business and finance. It was initially hard

hit by the fallout from the credit crunch and subsequent recession, especially in the areas of banking, finance and real estate. Despite this the sector as a whole is expected to stage a significant recovery, being projected to grow in output terms by almost 4 per cent per annum over the longer term. Employment in the whole sector is projected to increase by around 1.2 million by 2020 (a rate of growth of 1.3 per cent per annum). Other business services (which includes computing services) are expected to see the fastest growth;

- Non-market services comprise public administration and defence, as well as health and education services. Output in the sector as a whole is projected to grow by just 1 per cent per annum over the coming decade, much slower than in the previous decade. This disguises declines in most parts of the sector in the short-term, as public expenditure cuts take effect. While the short-term prospects are bleak for public sector employment, things do pick up over the longer term as the economy recovers from the recession and the effects of the financial crises, especially in areas such as education and health services. Employment in non-market services as a whole is expected to decline only slightly over the coming decade (by around 100,000 in total, just over -0.1 per cent per annum). Within this broad grouping, most of the projected job losses are accounted for by public administration and defence.

Projected changes in occupational structure

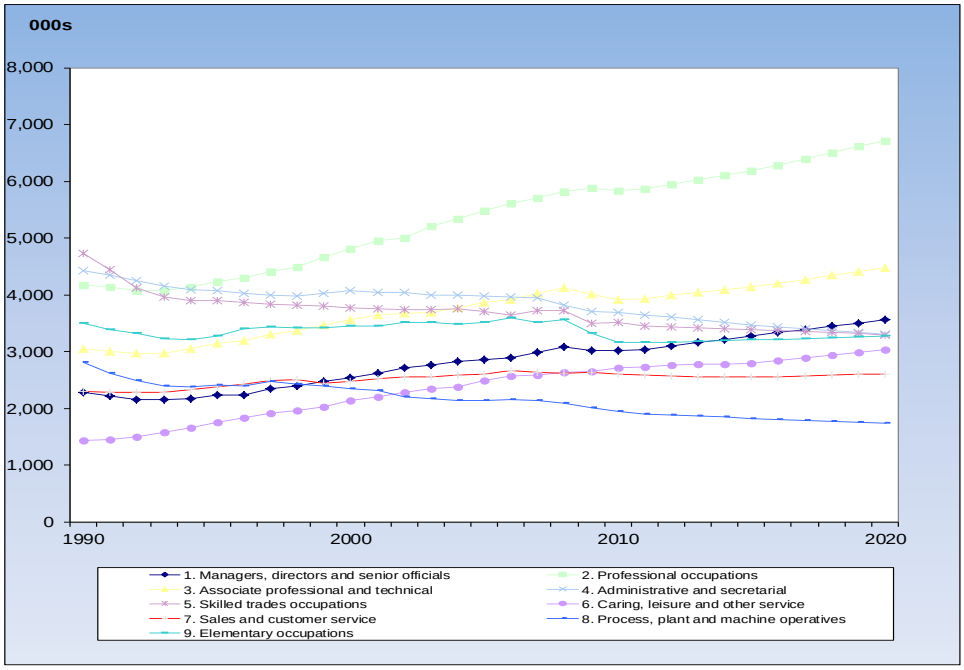
Changes in occupational employment between 1990 and 2020 are shown in Figures 1.6 and 1.7. The period 2010 to 2020 is expected to show a continuation of past trends. Between 1990 and 2000, there was increased employment in most occupations with the greatest gains for professional occupations, associate professional and technical occupations, and also for caring, leisure and other service occupations. The largest decreases in employment were found for skilled (manual) trades occupations. Between 2010 and 2020, there was greater expansion in the higher level occupations, but less decline in skilled trades occupations compared to the previous 10 years. However, there was a greater decline in elementary occupations than in the period 1990 to 2000. The *Working Futures* estimates indicate that the fastest growth by occupation will be even more concentrated in the upper three occupations in the coming decade. There will also be some growth in caring, leisure and other service occupations and elementary occupations. The latter represents a markedly different pattern compared to previous decades. The 10 years to 2020 is also expected to show faster decreases in administrative and secretarial occupations than previous periods.

Changing patterns of employment by occupation are largely dominated by longer-term trends rather than the cyclical position of the economy. Structural changes in the sectoral patterns of employment are a key driver (notably the shift towards a service economy). However, this has become less important in recent years than changing patterns of skill demands within each of the sectors. The latter has been driven by a combination of technological change and organisational

change. Skill-biased technical change linked to information and communications technology has been a particularly significant factor, although this has been partially offset by factors leading to some polarisation in skill demands, with growth in some relatively less skilled jobs in services (such as in hotels and restaurants), as well as in high skilled ones.

Figure 1.6

Occupational Trends, 1990–2020



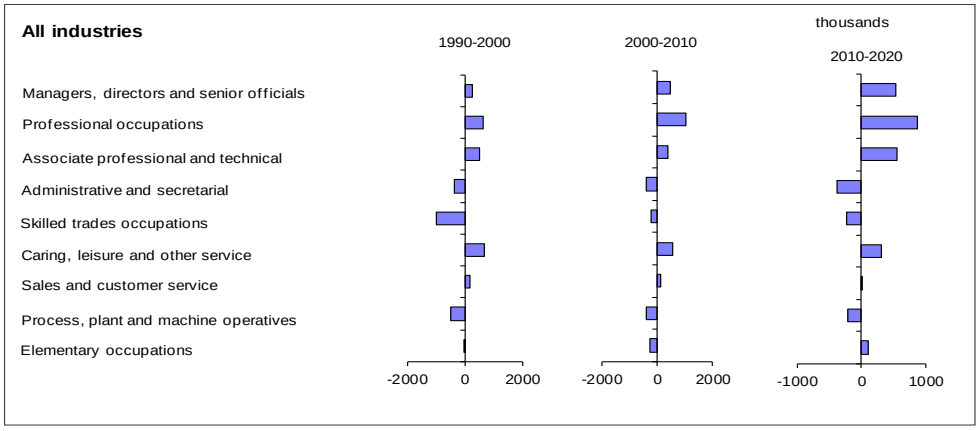
Source: *Working Futures*, IER estimates, MDM Revision 7146.

The results take full account of the latest information on changing patterns of occupational employment structure from the LFS and other sources. This includes a reclassification of occupational categories using the new 2010 Standard Occupational Classification (SOC2010). The change in SOC has resulted in some significant changes to the way some jobs are classified. Despite this, the latest evidence suggests that the changes in prospects for the next ten years are only slightly different compared to previous projections.

In general, there is expected to be a slightly faster pace of change in occupational employment structure than was the case in the previous projections, but the overall patterns remain very similar.

Figure 1.7

Changes in Occupational Employment Structure, 1990–2020



Source: *Working Futures*, IER estimates, MDM Revision 7146.

The groups that are expected to show the most significant increases in employment over the next decade (2010–2020) are higher level occupations, namely:

- managers, directors and senior officials (+544,000, 18 per cent);
- professional occupations (+869,000, 15 per cent);
- associate professional & technical occupations (+551,000, 14 per cent).

Caring, leisure and other service occupations are the other main beneficiaries of employment growth, with projected increases of around 313,000 jobs (12 per cent).

Administrative and secretarial occupations are projected to see significant further job losses of around 387,000 jobs (-11 per cent), although this category will still employ well over 3 million people in 2020.

Declining employment levels are also projected for:

- skilled trades occupations (-230,000, -7 per cent);
- process, plant & machine operatives (some -213,000, -11 per cent).

Elementary occupations are now projected to see a slight increase in employment, as the service sector in particular generates more such jobs. This polarisation of demand for skills, with growth at both top and bottom ends of the skills spectrum, appears to be an increasingly common feature across developed economies. On the other hand, the continued restructuring of the retail and distribution sectors appears to be leading to a much less optimistic picture for many lower level sales occupations.

Replacement demand

Employers also need to replace many of their workers who leave due to retirement, career moves, mortality, or other reasons. This so called replacement demand can easily outweigh any losses resulting from structural changes. In the latest *Working Futures* results replacement demand is almost 8 times larger than the net changes projected over the decade to 2020 (see Table 1.2). The net requirement or total number of job openings, taking replacement demand into account is expected to be more than 13 million compared with the overall increase in employment levels of around 1½ million.

Retirements are the principal component in this estimate. It excludes job openings created by people transferring from one occupation to another or other outflows due to migration (some of which will be filled by similar means). Table 1.2 illustrates the importance of replacement needs for 9 broad occupational groups. While so-called expansion demands for some occupations are negative (employment is projected to decline between 2010 and 2020), replacement needs are always strongly positive and generally outweigh the expansion demands by an order of magnitude.

Table 1.2

Changing Composition of Employment by Occupation, 1990–2020

SOC2010 Major Groups, United Kingdom Employment Levels (000s)	Total					2010–2020		
	1990	2000	2010	2015	2020	Net Change	Replacement Demands	Total Requirement
Managers, directors and senior officials	2,284	2,540	3,016	3,279	3,560	544	1,247	1,791
Professional occupations	4,181	4,820	5,843	6,189	6,712	869	2,280	3,149
Associate professional and technical	3,050	3,561	3,926	4,138	4,476	551	1,412	1,963
Administrative and secretarial	4,437	4,078	3,698	3,466	3,312	-387	1,601	1,214
Skilled trades occupations	4,736	3,767	3,526	3,389	3,295	-230	1,284	1,053
Caring, leisure and other service	1,446	2,142	2,719	2,801	3,032	313	1,145	1,458
Sales and customer service	2,309	2,479	2,608	2,555	2,610	2	919	921
Process, plant and machine operatives	2,819	2,349	1,950	1,829	1,737	-213	800	587
Elementary occupations	3,504	3,454	3,173	3,209	3,274	101	1,224	1,325
Total	28,768	29,192	30,458	30,855	32,008	1,550	11,911	13,461

SOC2010 Major Groups, United Kingdom Employment Levels (000s)	Total					2010–2020		
	1990	2000	2010	2015	2020	Net Change	Replacement Demands	Total Requirement
Percentage Shares	**1990**	**2000**	**2010**	**2015**	**2020**	**Percentage Changes**		
Managers, directors and senior officials	8	9	10	11	11	18.0	41.3	59.4
Professional occupations	15	17	19	20	21	14.9	39.0	53.9
Associate professional and technical	11	12	13	13	14	14.0	36.0	50.0
Administrative and secretarial	15	14	12	11	10	-10.5	43.3	32.8
Skilled trades occupations	16	13	12	11	10	-6.5	36.4	29.9
Caring, leisure and other service	5	7	9	9	9	11.5	42.1	53.6
Sales and customer service	8	8	9	8	8	0.1	35.2	35.3
Process, plant and machine operatives	10	8	6	6	5	-10.9	41.0	30.1
Elementary occupations	12	12	10	10	10	3.2	38.6	41.8
Total	100	100	100	100	100	5.1	39.2	44.2

Source: *Working Futures*, IER estimates, MDM Revision 7146.

It is possible to identify two broad groups of occupations:

- In the first group positive replacement demand outweighs negative expansion demand. This applies, for example, to administrative and secretarial occupations; skilled trades; and process, plant and machine operatives.
- In the second group replacement needs simply serve to reinforce positive employment trends to create even higher net requirements for new job entrants. This applies, for example, to managers; professionals; associate professionals; and caring, leisure and other service occupations.

Implications for qualifications (demand, supply and mismatches)

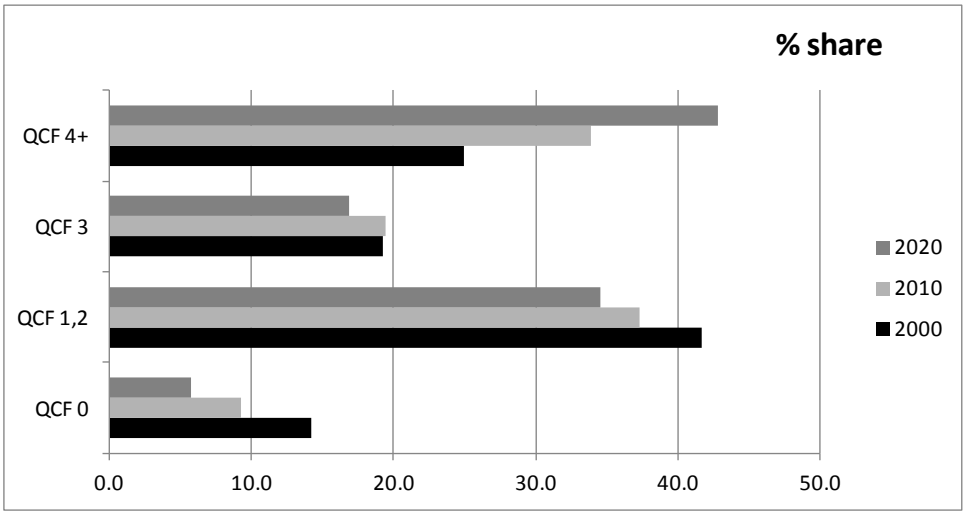
Skill supply, as measured by the highest formal qualifications held by those economically active, is rising rapidly. Many more young people in particular have been encouraged to stay on in education longer and to acquire more qualifications at a higher level. The recession reinforced this pattern as job opportunities for young people dried up.

The demand for skills as measured by occupation and qualification is also projected to rise. The numbers of jobs in occupations typically requiring a degree continue to grow while the graduate intensity of many other jobs is rising steadily. How much this reflects demand as opposed to supply trends is open to debate.

Table 1.3 and Figure 1.8 show the pattern of qualifications held by those in employment for 2000, 2010 and 2020. Changing patterns of educational participation mean that the overall qualification profile of the workforce will improve significantly over the next decade. The proportion and numbers of people qualified at higher levels will rise substantially. In contrast, the proportion and number of those in the workforce with qualifications at QCF (Qualifications Credit Framework) level 1 or below will fall.

Figure 1.8

Changing Patterns of Qualification of those in Employment



Source: *Working Futures*, IER estimates, MDM Revision 7146.

Notes: The estimates shown are based on LFS shares applied to *Working Futures* data on employment levels (jobs). QCF is the Qualifications Credit Framework used to classify qualifications. Levels 4+ are equivalent to a university degree.

The increase in the proportion of employed persons with QCF Level 4 or higher that was observed between 1990 and 2010 is expected to continue to 2020 with the share rising from less than 25 per cent in 1990 to more than 30 per cent in 2010 to more than 40 per cent in 2020. The share with no qualifications is expected to fall to just over 5 per cent in 2020. Decreases in the share of employed

persons qualified to QCF Levels 1, 2 or 3 are also expected to continue to 2020, with less than 20 per cent of the workforce in employment expected to be qualified to Level 3 in 2020, and just over 35 per cent to Level 1 or 2.

Table 1.3

Patterns of Qualification of those in Employment 2000, 2010 and 2020

Qualification level	2000	2010	2020
QCF 0	14.2	9.3	5.7
QCF 1,2	41.7	37.4	34.5
QCF 3	19.2	19.5	16.8
QCF 4+	25.0	33.9	42.9
All quals	100.0	100.0	100.0

Source: *Working Futures*, IER estimates, based on LFS data, MDM Revision 7146.

It should be noted that these results are also sensitive to the assumption made about net migration, since the qualifications patterns of inward migrants are significantly different from the domestic population. The significant difference in qualification levels amongst the employed workforce also reflects changing patterns of requirements in most jobs.

The balance between demand and supply influences is more difficult to predict. The most recent evidence available suggests that rates of return to higher qualifications have shown some signs of falling recently, although they still indicate significant positive benefits towards investing in such education and training, and have generally held up quite well.

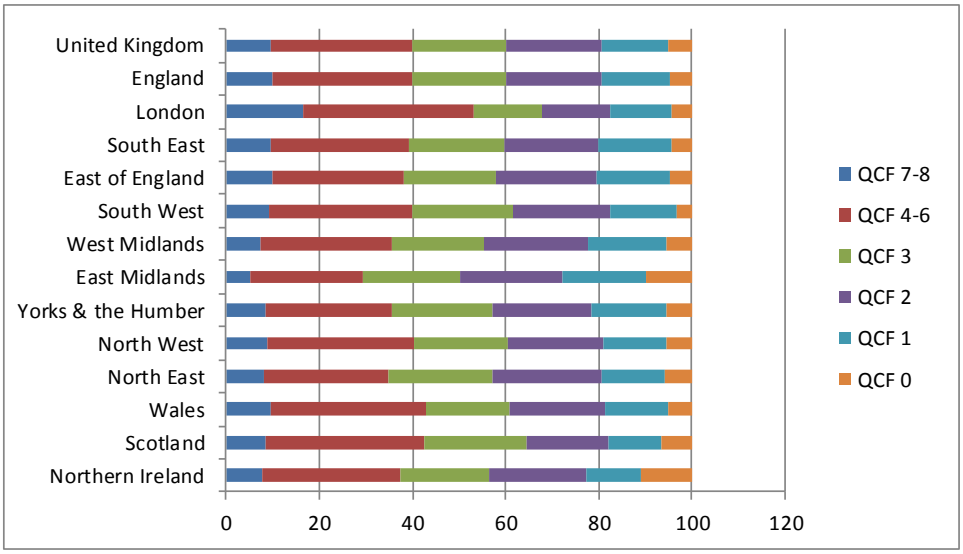
There are some significant differences in qualification profiles across both sectors and spatial areas. These are primarily driven by differences in their employment patterns by occupation (and sector in the case of spatial areas). Nearly all sectors and spatial areas are projected to see significant improvements in average qualification levels, with increased proportions and numbers employed at QCF level 4+ and reductions at levels 0 and 1.

Spatial variations

The results in *Working Futures* also cover the individual countries and regions with England that make up the UK. Similar results are available to those for the UK as a whole. Figure 1.9 and Table 1.4 illustrate some of the variation across geographical areas. The projections of output for the regions and nations of the UK between 2010 and 2020 indicate a continuing pattern of the southern parts of England (particularly the south-east corner) being relatively advantaged, with the remainder (especially northern England and the devolved nations) falling further behind in relative terms.

Figure 1.9

Spatial Patterns



Source: *Working Futures*, IER estimates based on LFS data, MDM Revision 7146..

The impact of the cut-backs in public spending upon the non-market services sector will be greatest in the north and west of the UK. However, the revival of employment in the primary sector and utilities and manufacturing industry will benefit these regions and nations in the north and western parts of the UK. Growth in employment in managers, directors and senior officials, professional and associate professional occupations will primarily benefit the south-eastern corner of the UK.

Table 1.4

Long-term Changes in Macroeconomic Indicators

	GVA		Employment	% p.a.
	2000–2010	**2010–2020**	**2000–2010**	**2010–2020**
London	2.6	3.0	0.4	0.7
South East	1.2	2.9	0.3	0.6
East of England	1.2	2.8	0.8	0.7
South West	1.5	2.7	0.7	0.7
West Midlands	0.7	2.5	-0.2	0.4
East Midlands	1.7	2.6	0.4	0.5
Yorks & the Humber	1.2	2.4	0.5	0.3
North West	1.1	2.6	0.4	0.3
North East	1.4	2.2	0.7	0.0

	GVA		% p.a. Employment	
	2000–2010	**2010–2020**	**2000–2010**	**2010–2020**
England	1.5	2.7	0.4	0.5
Wales	0.9	2.2	0.7	0.5
Scotland	1.5	2.2	0.4	0.2
Northern Ireland	1.4	2.5	1.0	0.5
United Kingdom	1.5	2.7	0.4	0.5

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Source: *Working Futures*, CE/IER estimates, MDM revision 7146, CrossRegional.xls (Table R.1).

Notes: GVA (output) is measured on a residence basis, employment is on an establishment (workplace/jobs) basis. Under the European System of Accounts 1995 (ESA95), the term GVA is used to denote estimates that were previously known as gross domestic product (GDP) at basic prices. Under ESA95 the term GDP denotes GVA plus taxes (less subsidies) on products, i.e. at market prices. The Regional Accounts are currently only published at basic prices, so the figures are referred to as GVA rather than GDP.

Key issues to emerge from the results

The working age population and workforce are projected to rise significantly but labour market participation rates are expected to fall slightly, reflecting the aging of the population. Despite the current economic climate, it is expected that employment levels will rise slowly but steadily over the decade as a whole, driven by a significant increase in population levels. Private sector services are projected to be the greatest contributor to employment growth. The long-term rate of employment growth (jobs) is expected to be around ½ per cent per annum, resulting in around 1½ million additional jobs by 2020.

Replacement demand created as people leave the labour market through retirement and/or for family reasons is projected to generate almost 8 times as many job openings over the same period. This is equivalent to almost two-fifths of current employment. This dwarfs the level of anticipated additional jobs ("expansion demand"). Even in industries and occupations in which the level of employment is expected to decline, such as the manufacturing sector and skilled manual occupations, there will still be job opportunities for appropriately skilled individuals. This also has important implications for individuals who may be considering their future career and education and training options, since even those occupations where employment is projected to decline may still offer good career prospects.

Manufacturing is projected to maintain its share of total output but to exhibit a falling share of employment between 2010 and 2020. It is important to note that manufacturing is expected to remain a critical sector in terms of its economic significance, retaining its share of UK output (around 11 per cent) and playing a critical role in terms of the UK's balance of trade. Employment will decline as a result of increasing productivity in the sector, as it responds to global competitive pressures. Its share of employment is projected to fall from 8 to 7 per cent of the total as a result. Performance and competitiveness vary across the different indus-

tries in manufacturing and some parts of the sector are expected to outperform the sector average in output and employment terms. Finally, there will still be a significant level of job openings for new entrants to manufacturing due to replacement demands.

Private services are expected to be the main source of jobs growth, with employment in this part of the economy projected to rise by more than 1.5 m (+9 per cent) during the full period of 2010–2020, increasing its share of total employment from 55 per cent to 58 per cent. Business and other services will be a particularly crucial component, with growth of more than 12 per cent, equivalent to more than 1 million additional jobs.

The period is expected to see a shift in the balance of the economy away from public sector activities. The share of total employment accounted for by non-market services is projected to fall from 27 per cent in 2010 to 25 per cent in 2020.

There is expected to be continued employment growth in higher skilled, white collar occupations, including managers, professionals and associate professionals. Around 2 million additional jobs in these occupations are projected by 2020, which is expected to increase the share of this group to around 46 per cent. This finding reinforces the importance of investment in higher level skills to meet the needs of the future labour market, focusing on the economically valuable skills that employers need.

Continuing sharp declines in employment are expected for skilled and semi-skilled manual roles, including in skilled trade occupations and process, plant and machine operatives, but these declines will be offset to a degree by replacement demand. About 400,000 such manual jobs are expected to disappear between 2010 and 2020 in a slight acceleration of the existing trend. This means that the share of employment for this group is projected to reduce to around 16 per cent. It is important to note that there will still be a large number of job openings due to replacement demands, and a need in sectors like advanced manufacturing for technician workers who possess the ability to apply an in-depth understanding of a particular technical field in a practical setting.

Administrative and secretarial occupations are projected to see a loss of almost 400,000 jobs, a fall of around 11 per cent, largely as a result of the continuing impact of technology in the workplace. There are still expected to be around 3 million jobs in this occupational area by 2020, but its share of employment will have fallen from 12 per cent to 10 per cent, according to the projections.

Lower skilled jobs will remain a significant feature of the labour market. There is expected to be an increase of more than 300,000 jobs in caring, personal and other service occupations (+10 per cent) and 100,000 (+3 per cent) in low-skilled elementary jobs between 2010 and 2020, again mostly in service-based areas. Lower-skilled jobs are expected to be a major source of job creation in sectors like hospitality and care of the young and elderly. Improving the quality of these jobs is important since they represent a key route for those seeking to move

out of unemployment and progress through the labour market and for people looking to work part-time. These jobs also experience high labour turnover, requiring constant skills replenishment and in some cases up-skilling to meet heightened customer expectations and to meet product/service quality demands.

The projections indicate that the demand for skills, as measured by formal qualifications will continue to increase between 2010–2020, driven by the growth of jobs in higher level occupations. However, it is also clear that the supply of qualified people will increase significantly. These trends could lead to an increase in the deployment of well-qualified people in lower level jobs. This outcome is far from certain, though, not least because there is some evidence to suggest that the nature of jobs may be changing to make higher qualifications more necessary.

The southern part of England is expected to see more rapid employment growth than the devolved nations and the northern regions of England. Almost half of the growth in jobs in higher level occupations will occur in London, South East England and the East of England.

1.6. Conclusions: evaluation of UK skills projections

Overall assessment of the UK system

Many years of investment by the UK Government in basic data and related systems have established a solid foundation for skill need assessments in the UK. Although there is still considerable room for improvement compared to best practice worldwide, the UK is comparatively well served.

The key elements include:

1. A well-established system of national economic accounts (essential for economic/econometric modelling at a detailed sectoral level);

2. Standard systems of classification for both industries and occupations that enable measurement of changing structures over time;

3. Reliable estimates of employment by sector based on censuses or large representative surveys of employers (including detailed breakdowns by industry and geographical area);

4. Acceptable estimates of occupational and qualification structures based on the Census of Population and regular household surveys (Labour Force Survey);

5. Regular surveys of employers to assess current skill deficiencies and skill gaps;

6. Occasional surveys of employers and employees to consider generic skills within jobs.

Based on this foundation, the UK Government has charged agencies such as the UKCES to carry out a systematic assessment of changing skill needs. To facilitate this, it has also supported analysis, model building and the production of regular quantitative projections based on such methods. Such support has includ-

ed general research funding, channelled primarily through universities (going back many decades), as well as a series of projects and programmes of more applied research. The latter has included since 1975 detailed national level employment projections, such as *Working Futures*. Substantial prior investment has therefore been made in quantitative modelling, via academic research and competitive tendering, including a substantial and on-going research programme focused on skills.

The main problems and gaps relate to:

- The limitations of 4. (especially detailed data on occupational employment structure due to problems of limited sample size), compared to best practice elsewhere, such as the regular US surveys of employers which deliver a much finer and more precise estimate of changing occupational structure within sectors;
- Problems with 2. (systems of classification), caused by the fact that SSCs have been defined with little regard for existing systems of classification, with the consequence that existing official data often fail to match SSC "footprints" and are therefore not fit for the SSCs purpose;[5]
- A failure to recognise the common nature of many skills issues across both sectoral and geographical dimensions, with the consequence that often too much emphasis has been placed on such detail for its own sake, resulting in the very large and expensive National Employer Skills Survey (*NESS*) which in many respects has become a "sledgehammer to crack a nut";
- Too great a focus (especially in *NESS*) on the issue of current skill shortages, which are often marginal and ephemeral phenomena);
- Limited resources compared with some other countries (such as the United States).

Strengths and Weaknesses

Strengths:

- well established statistical infrastructure including a number of quantitative data bases, (the result of many years of investment);
- long established quantitative model-based framework with a well-established track record and reputation for high quality;
- a revised institutional framework with clearly defined responsibilities and management structures;
- co-operation of many institutions, including employers;
- existence of agreements on joint procedures;
- a relatively good accessibility to the outcomes on the internet;
- use of external consultants can help ensure objectivity, independence and neutrality.

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[5] This has resulted in some organisations trying to develop their own systems of classification. However these attempts often fail to recognise the complexities of developing such classifications and the huge amounts of effort that have gone into developing current standards.

Weaknesses:

- the system is very complex and generally in a constant state of flux, resulting in lack of stability and confused and conflicting responsibilities between various government departments and agencies;
- no single portal for the general public providing information about future skills needs;
- there is the possibility of influencing the government by lobbying on the part of employers' associations, (however this is seen as an objective (ensuring employer engagement) rather than a weakness);
- lack of detail in key areas (notably occupations);
- the role of sectors remains to be fully established compared to some other countries such as Germany where employers have always been involved much more integrally in the process of training (many SSCs have yet to establish themselves);
- the competitive tendering process for commissioning projections has disadvantages as well as benefits.

General lessons

Based upon the review of best practice worldwide, the use of nationwide, multi-sectoral modelling methods to provide a comprehensive, national overview of the changing demand for skills should be the cornerstone of any systematic approach to assessing changing skill needs:

- More basic methods should be used for modelling occupational structure within sectors, recognising the limitations of existing data but making recommendations for further improvements in data collection;
- It is important to include an explicit treatment of replacement demands, although recognising the limitations of existing data;
- Some limited analysis of the implications for other aspects of skills such as qualifications might be undertaken;
- A satisfactory treatment of key/generic skills is best left to more qualitative approaches for the foreseeable future.

Other more qualitative approaches are also relevant and useful. They should be regarded as complements rather than substitutes for quantitative methods, adding more detail and subtle insights. The sectorally focused system for anticipation of changing skill needs developed in the UK relies on both quantitative and qualitative methods, as well as a substantial prior investment in statistical infrastructure. Most SSCs rely on these prior investments and particular products such as *Working Futures* and *NESS*. The review of the system itself suggests that it has a number of advantages but there have also been many teething and other problems. There are a number of detailed lessons that can be learned about how and how not to set up such a system.

Forecasting Errors

The employment estimates and projections make use of a wide variety of sources and methods involving many equations. As a consequence, it is not possible to calculate precise margins of error. From an analysis of previous projections (Wilson, 2005) it is clear that these margins can be quite large. The results of this analysis suggest that:

I. Employment by industry:

- Industry employment levels are typically projected within ±10 per cent over a 5–10 year horizon;
- The directions of change are projected correctly in around 90 per cent of cases;
- The errors in terms of annual percentage growth rates are usually of the same order of magnitude as the observed changes;

II. Employment by occupation:

- Occupational employment levels are typically projected within ±7 per cent over a 5–10 year horizon;
- The direction of change is correctly projected in about 80 per cent of all cases;
- Occupational shares are usually projected within ±2 percentage points, (the typical share is around 4 per cent).
- Historical revisions to the data account for a very large part of the forecast errors.

It is important to appreciate that the purpose of the projections is not to make precise forecasts of employment **levels**. Rather, the aim is to provide policy analysts with useful information about the general nature of **changing employment patterns** and their implications for skill requirements. The UK projections have generally achieved this objective.

Changing patterns of employment by sector and occupation (as represented by shares of total employment) are largely dominated by longer-term trends rather than the cyclical position of the economy. Results from projections such as *Working Futures* can therefore be used as a robust guide to likely future developments in the structure of employment, even though the effect of the slowdown and subsequent recovery on employment **levels** may remain somewhat uncertain. They present a plausible picture of future developments over the coming decade.

Such results provide a useful benchmark for debate and policy deliberations about underlying employment trends. They should be regarded as indicative of general trends and orders of magnitude, given the assumptions, rather than precise forecasts of what will necessarily happen. Many years of international research have demonstrated that detailed manpower planning is not a practicable proposition. Even where forecasting is carried out using hard-nosed, quantitative methods, those involved usually stress that such projections should be seen as part of an on-going process rather than the final word, and recognising the importance of

incorporating more qualitative insights. No skills forecasters claim that they can predict the detailed skill needs in different sectors with great quantitative precision. Rather, they suggest that they can provide the various participants in the labour market, as well as policy makers, with useful insights into how labour markets are developing in response to various external influences. It is important to recognise that accurate and precise forecasts are a chimera.

The key question to ask is not whether or not such projections are **accurate**, but whether or not they are **useful**. The revealed preferences of national governments from all over the world, which support such activity with substantial funding, suggest that they are regarded as of considerable value. It is also clear that such work is seen as having a wide variety of different audiences and users, including careers guidance, as well as general labour market policy formation and planning education and training programmes. Few, if any, countries now regard such work as resulting in information that can be used to plan the scale and pattern of education and training provision with any precision. Rather it can help to inform all those involved about how economic and other forces are shaping the labour markets and the general implications for those skills that will be required.

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2. EMPLOYMENT FORECASTING IN FINLAND

2.1. Brief discussion of the history of employment forecasting in Finland

The history of labour demand and supply projections dates back to the late 1950s and early 1960s. Labour force surveys were initiated in Finland in 1959 and even though there were some earlier forecasts, this time point opened new possibilities. After that, before 1990 there had been demand or supply projections made as well as such which combined demand and supply-side. Projections were made for short, medium, or long time horizons, partly in connection to forecasting the national economy. The organisation which carried out the projections changed. Furthermore, regional and occupational projections have been made.

The Long-Term Labour Force Model (LTM, or PTM in Finnish), developed at the Ministry of Labour by Pekka Tiainen, has been in use since 1990. Moreover, other kinds of projections, and especially short-term forecasts, have been made by many organisations. In this paper, the focus is on the PTM/LTM modelling, because it is a new way of making labour demand and supply projections in connection with the national accounts, and this basic methodology has continued ever since.

The calculation model for medium-term and long-term projections of labour demand and labour supply was developed in connection with the Labour Force 2000 project. The National Board of Education's anticipation studies employ a version of what is known as the labour force requirement method. In Finland, this method was first used as a tool for planning education and training at the end of the 1960s. The Planning Secretariat, which operated under the auspices of the Ministry of Education, further elaborated the method and used it to prepare several forecasts of demand for educated labour. Under the National Board of Education's anticipation project, this method was further enhanced by adding new elements and by making the processing of the background material applied in the model more accurate. For example, the impact of the unemployed population and occupational transitions was accounted for more precisely than ever before. The method uses extensive statistics and calculations to determine future demand for educated labour. For this purpose, a Windows-based program was developed to perform the required calculations.

The model, data and calculations have been updated continuously, although the basic structure of the model has remained unchanged. It has been used to make projections and calculations both for specific purposes of the Ministry of Employment and the Economy (medium-term and long-term growth projections and labour force projections, budgetary planning, employment effect estimates, assessing the effects of integration on the labour market) and for other users at the ministerial and regional levels.

The model can be used for calculations also for different regions or countries provided that the necessary data are available. The same basic idea is present in CEDEFOP's skill needs projections. However, there are some differences between these systems in modelling applications and classifications.

Employment figures from the previous applications of the LT-model are being used as part of the calculations for the Labour Force 2017 project. In the latter project, the figures are combined with previous sector-specific outcomes to determine economic growth factors over the period from 1860 to 2030.[6]

2.2. Required input data and external forecasts

Data are generally based on the national accounts (for the demand side) and on the population census, statistics, and labour force surveys (for the supply side). Job statistics are well developed, highly disaggregated at the regional level, and thus very useful. A special occupational structure data set has been applied since 1970, and other statistics are also used. Basically, the projections are numerical and quantitative, but include some qualitative aspects as well. Information from the global economy is employed in background analyses.

The long-term historical data set is based on the PTDATA-set including the long-term national accounts and other Finnish statistics. In Finland data are generally of high quality due to the long history of Finnish statistics. Changes in statistical classifications are a problem in time series analysis, and much work has been done to make time series consistent.

Variables on the demand side at the sectoral and aggregate levels for 1990–2030 include:

- Output (GDP) by industry and at the aggregate level;
- Employment by industry and at the aggregate level;
- Working time per employed person by industry and at the aggregate level;
- Hours worked by industry and at the aggregate level;
- Productivity by industry and output per employed at the aggregate level;
- Productivity and output per hour worked at the aggregate level.

The calculation level is highly disaggregated (56 industries). However, the results are published at more aggregated levels, by sectors such as agriculture, for-

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6 See (Tiainen 1999).

estry, industry (electronic, other metal, forest, other), construction, traffic, trade, financing, business services, education, welfare services.

To calculate sources of growth, total factor productivity and other inputs (including labour) as well as some other variables are needed:

- Capital input at the aggregate level;
- Nominal GDP;
- Labour costs and labour income share of output (capital income share is calculated);
- Quality of labour in certain dimensions and relative earning levels in these categories.

Total factor input, including quality of labour, is then calculated by using these data and total factor productivity (TFP) as output divided by input, or here, GDP per total factor input (TFI).

On the labour force supply side, the data used for 1980–2030 are:

- population in five-year age groups by sex and, at the aggregate level, birth rate, mortality, and net immigration;
- labour force and basic categories outside labour force (pension, education, household work) in five-year age groups by sex;
- unemployment.

The population data set contains five-year age groups by sex. The model uses the most recent population forecast released by Statistics Finland, with the necessary changes. It can be modified by adjusting assumptions about immigration, birth rate and mortality. This data set also contains labour force participation rates for men and women and the labour force divided into five-year age groups.

Labour force projections are based on labour force surveys, while demand side calculations essentially rely on national accounts. Employment by industry is transformed to be consistent with numbers from the labour force survey.

There are also calculations in which employment and unemployment are divided into age groups. Furthermore, there is a data set on the occupational structure by industry used for occupational structure projections. Also information on withdrawal from the labour market because of retirement and other reasons by occupation is needed, so that job openings or the need for new labour force can be calculated by adding up expansion demand and permanent withdrawal from the labour market.

The working time data set first shows general working time factors that are the same for all age groups. Age-group-specific factors are presented separately for men and women in five-year age groups. The figures are given as days worked per employed person, broken down into five-year age groups.

It is not possible to reiterate such age-group-specific calculations in all calculation circuits, but it is necessary to take care of these aspects.

In the calculation process the results of earlier projections constitute the starting point for subsequent ones. The necessary updating and other changes are made, and then iterations are repeated until individual parts of the model are consistent with the aggregate values. Some variables of the model are fixed at the

start of the procedure and then the model is estimated. If estimation results show that there is a need to change some fixed variables, the necessary corrections are introduced. For instance, as the population is forecasted separately, net immigration is changed if labour demand deviates from the original calculation. In this sense, immigration is made partly endogenous.

2.3. Methodology, the microeconomic foundations and the econometric techniques

The basic structure of the model has remained stable for a long time. Estimations are based on yearly time series. Every year new actual data are included in the database of the model once they are published; thus, projections are re-estimated taking into account new data.

The main method

- There are two interlinked models: the Long-Term Labour Force Model used by the Ministry of Labour (population and labour force supply by age, GDP, labour productivity and employment by industry, regional application) and the Mitenna Model used by the Finnish National Board of Education and the Ministry of Education (occupations and education); calculations on the regional level are conducted by the Ministry of Interior Affairs;
- Skills of total working population are considered – it is important to analyse the skills of the employed, the inactive and the unemployed separately.

Total demand, expansion demand and replacement demand

- Expansion and replacement demand is considered; the latter takes into account replacement due to retirement and death;
- New jobs are increasing employment, some of them substituting job losses. Some job losses are attributable to retirement, while some to aged people losing or leaving their jobs. These classifications and dynamics should be clarified.

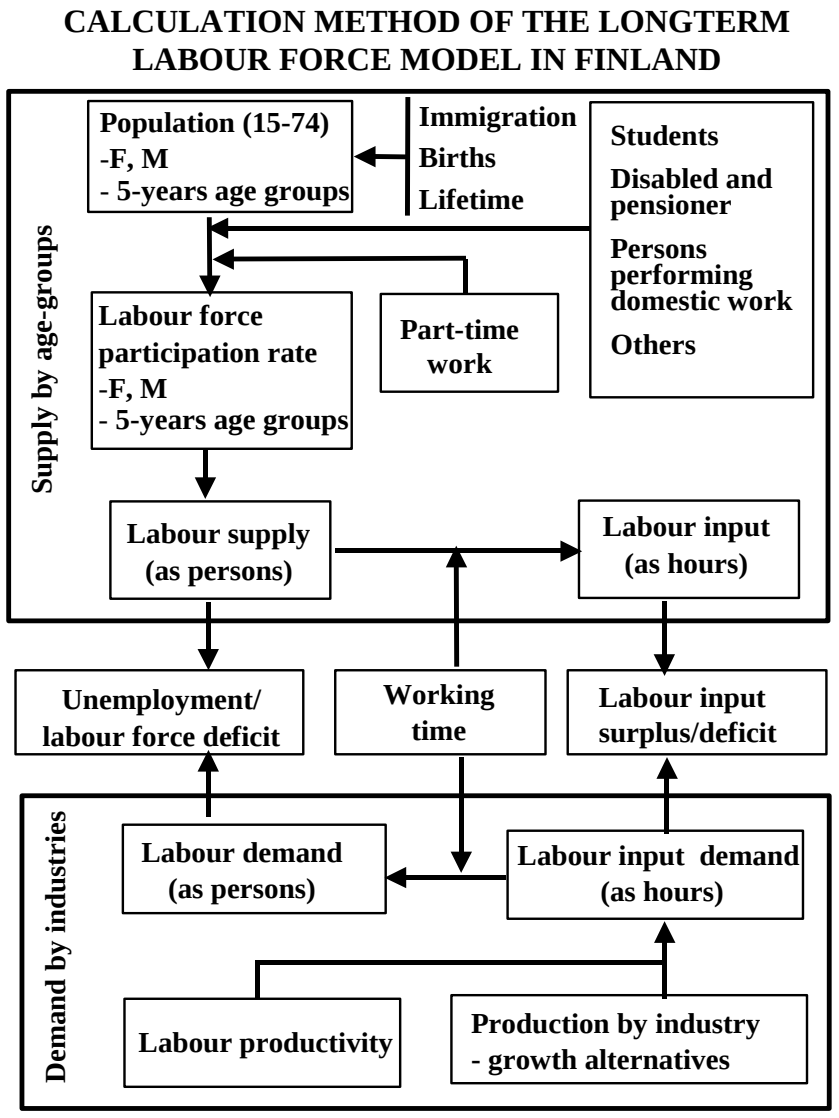
The supply side and interaction between supply and demand

- The supply side is reflected in the Long-Term Labour Force Model based on population and labour force participation developments (broken down into five-year age groups). The demand side is based on the sectoral level. Demand and supply are changed to inputs in the form of hours worked by using working time. The interaction between supply and demand creates an imbalance, and demand influences supply. This influence differs during the business cycle and over the long term;
- Skills of working age population are calculated in the Mitenna model;
- Labour force migration processes are an important issue as they are motivated by both supply and demand side causes.

Employment is calculated by dividing GDP by labour productivity. Labour productivity is defined as labour productivity per hours worked divided by yearly working time per employed person. Unemployment is defined as labour force minus employment.

Figure 2.1

Long-Term Labour model in Finland



In demand side estimation, GDP is forecasted by using demand variables. In supply side projections, labour input multiplied by labour productivity yields GDP. When the balance between demand and supply is analysed, the demand side is calculated separately and the supply of the labour force based on population growth is multiplied by labour force participation rates broken down into age groups.

Output divided by labour productivity broken down into sectors of economic activity yields hours worked by sector. By summing up these hours, one arrives at the aggregate number of hours worked. The supply of working hours, obtained from the working time data set, represents the long-term maximum of hours worked: if output grows too fast in relation to the supply of hours worked, growth will be hindered, while the opposite case allows for higher output growth. Trend correction is used here: for the year 2030, aggregate hours worked are replaced with the number of working hours available. For the intervening years, a coefficient is used, gradually approaching the 2030 ratio of working hours available to hours worked. The number of hours worked for each sector of economic activity is multiplied by the series of ratios obtained. Subsequently, output time series for each sector of economic activity are multiplied by the corresponding ratio, and a match is achieved between the level of output and the long-term restriction imposed by the number of working hours available. To achieve a match between aggregate GDP growth for the next several years and the growth projections, the output growth figures by sector of economic activity for those years are multiplied by the relevant ratio. Each time the situation changes, adjustments must be made to match the level of hours worked, in the long term, to the level of working hours available.

The employed and unemployment

The data set on the demand side (employment) contains working time, hours worked and the employed by sector of economic activity. If we divide employed by the "working time" time series for particular sectors of economic activity, we will obtain the number of persons employed in the different sectors of economic activity at the national accounts level. Working time varies by sector of economic activity. Technically, working time is set for all sectors of economic activity at the same level in the very long term, and the working time by sector of economic activity approaches this level using a coefficient of steady change computed for particular sectors.

The employment data set also contains information on the labour force provided by the Labour Force Survey. The numbers of persons employed, in line with the national accounts, are adjusted to correspond to the Labour Force Survey figures and classifications. The labour force is calculated on the basis of labour force participation rates and population, and it is obtained from the population forecast. Some of the change in the unemployment rate is eliminated by making an adjustment of the labour force projection. In the adjustment procedure it is assumed that elasticity is distributed between different processes: one third of the

elasticity is assigned to the fall of unemployment, while one third of the effect will be seen in the growth of labour supply. Using elasticity of change in employment, change in employment is reflected in the supply of labour services with a weight of one fifth. The weight is smaller than that for unemployment when changes in unemployment are smaller than those in employment. The ratio varies with the business cycle, and it can be changed when necessary. Unemployment can be obtained in a similar way, as the difference between the labour force and the employed.

Working days are then multiplied by projections for the number of persons employed, yielding an aggregate number of working days. The above figure multiplied by the number of working hours per working day yields aggregate hours worked. The number of persons employed is obtained here by adopting basic data on the labour force under conditions approaching low unemployment. The unemployment rate approaches full employment, and employment increases accordingly.

Supply side

The supply side of the model uses data from the Finnish Labour Force Survey and includes the population broken down into five-year age groups, the number of persons not in the labour force, labour force participation rates, the number of persons in the labour force, and working time. The demand side uses data from the national accounts and includes productivity by sector of economic activity, output at constant prices, hours worked, the number of persons employed and the balance of manpower resources. The time series of the model at the annual level include short-term projections; thus, any adjustment in them affects the medium-term and long-term outcomes. These time series continue to the year 2030.

The labour force is the product of age groups and labour force participation rates, the latter being taken from the labour force participation data set. The labour force and labour force participation rates are adjusted to match the computed labour demand, for demand affects supply.

Base projections

The underlying principle is that the baseline projection is produced including all the relevant elements. According to standard practices, there is also a target line with better employment and other desired targets. In this case the idea is to show the basic variables and measures that should be modified in order to accelerate development. The rationale is that this exercise should also serve policy-making. Furthermore, the effects of different kinds of business cycles are analysed as well as the influence of major fundamental changes in the environment of the national economy, such as its membership in the EU and the EMU.

Importantly, when new actual data are used, the baseline projections are not totally changed if the newly published data deviate from the figures forecasted for the same date. The idea is that in the very long term a neoclassical balance holds whereby the labour force is in full use with only low unemployment and produc-

tivity growth, and the labour force defines this long-term balance. So after a short-term deviation from the forecast, long-term development still approaches this long-term balance. It is an issue of analyses how long deviation lasts. For instance, if there is a deep recession, as in 2009, it is analysed how fast the recession affected particular industries causing a decrease in output, or whether there were industries which grew slowly on a permanent basis because of structural change. Some industries can grow more rapidly than before being weighted. When industry level is aggregated to GDP, it is assumed that the rate of growth approaches the long term balance. Therefore, short-term changes do not automatically affect long-term growth rates, which are limited by resources and productivity. Thus, short- and medium-term imbalances are connected to balance in the very long term. Changes in population projections or productivity outlook are examples of factors that may influence balance in the very long term.

Sensitivity analyses

In sensitivity calculation, some basic variables are changed and the response to these changes is analysed. Examples of these are changes in net immigration and productivity growth (making it faster or slower).

The idea underlying sensitivity calculations is to identify crucial issues which can have a major influence on development, and analyse their possible outcomes.

For example, let us analyse changes in population. They may be connected with, i.e. increase in immigration, which in turn leads to production growth. They may also be taken into account in a rough manner through labour force time series, based on different population forecasts, which put a restriction on the available number of working hours. Another technique would be to leave the restriction of working hours available unchanged even if there are changes in the projected output growth for whatever reasons. In this situation, the difference between hours worked and working hours available tells us whether the number of working hours required by production exceeds or falls short of the number of working hours available, and by how much.

Occupations, education and job openings

In the calculation of educational needs over working life, the starting point is the **forecast of labour demand by industry**. This forecast is obtained from output forecasts describing the overall growth of the national economy, allowing for the joint influence of forecasted value added in output and labour productivity growth. These in turn are based on a set of economic change factors.

The next step is to anticipate the **future occupational structure in each industry**. This is accomplished by examining the present occupational structure and changes that have previously occurred in it, and by anticipating future developments. In addition, international and other comparisons and forecasts of occupational structure are utilised, together with research information and opinions on changes expressed by experts in different fields. The difference between the antic-

ipated and present occupational structure indicates the change in the occupational structure during the forecast period.

Along with changes in the occupational structure, **natural withdrawal of labour force from the labour market** is investigated. This parameter describes the proportion of those in an occupational group who will permanently leave the labour force due to retirement (through old age), disability, or death.

Total demand for new labour (job openings) is calculated for the forecast period by adding up change in the occupational structure and replacement demand. This means that the volumes of new labour are estimated by occupational group to meet the needs of the demand side of the labour market during the forecast period. The significance of replacement demand is dominant in this respect, accounting for about 70–90% of the calculated total demand.

Forecasts for occupational groups and data on changes concerning working life are converted into data conforming to the classification of educational disciplines by using a **correspondence key to match occupational groups to education** (the key was specifically constructed for that purpose).

Regional projections

Projections are regionalised by county in two stages. First, by using LTM/PTM regional growth model, productivity and employment by industry, and also labour force, are projected in a similar way as at the country level. Then, by applying employment by industry and occupations by industry, projections for the occupational structure are derived at the county level.

Total factor productivity calculations

The starting point here is again the decomposition of growth, measured in terms of net domestic product in real values, into the contributions of the quantities of three production factors (labour, capital, land), input-related qualitative factors and total factor productivity, consisting of the measured components including the scale effect and non-measurable factors included in the final residual. The three production factors are further divided into their subcomponents and indices are constructed for all of them. Their shares in the output of particular production factors are used as weights for production factor indices.

2.4. An illustration of the results

Real net domestic output grew over the years 1900–1990 by 3.2% per year. In 1948–1974 the annual growth rate was 5.1%. In 1990–2010 the growth rate was 1.9% a year, so the average yearly growth in 1900–2010 was 2.8%. Analysis revealed that the significance of labour input measured by working hours and average change was fairly high in the earlier periods, but low after the year 1965. The

contribution of capital was found to have been largest before World War II and from 1948 to 1964.

During the recession in the early 1990s, Finnish GDP decreased by 11% and employment by 20% over three years. The collapse of exports to the Soviet Union was only one of the reasons, because it had already been decreasing since the year 1983. Exports to the west also decreased – there was a banking crisis and the service sector was undergoing structural change. Public expenditure cuts were a mistake and deepened the crisis; moreover, consumption declined with decreasing wages. Thus, all demand components shrank. Then, in the 15 years from 1993 to 2008 employment increased to 1990 levels (except for worked hours) to fall by 5% in 2009. The average annual GDP growth rate in 1990–2010 was 1.8%, if the last recession is included.

In 2009 Finnish GDP decreased by 8%, while exports and imports by more than 30%. Employment fell only by 5% because working time shortened, and labour productivity fell. Firms had more labour force than needed. Also the labour force participation rates decreased.

The contribution of total factor productivity was substantial throughout the post-World War period. In 1860–1900 the TFP share was 45% as compared to 63% in the years 1900–2000. The TFP share was perceptibly smaller in 1938–1948, while in 1975–85 it soared to 90%. The average for the 150 years from 1860 to 2010 was about 50% and close to that value for 2000–2010. Periods of more rapid growth were connected to more rapid input growth and, at the same time, to an even faster increase in TFP and its share in output growth. Thus, its contribution was greater during periods of strong growth, also based on a more substantial increase in input.

The recession of the 1970s and the period after that was an exception, as structural change raised the share of total factor productivity.

During the next two decennia in base calculations, the share of total factor productivity was more than 75%, while the average growth rate was about 2%. Therefore, historically, the share of total factor productivity is very high. Higher employment, greater investments and higher total factor productivity growth are needed to achieve a growth rate higher than 2%, although the TFP share can be lower than 75% because of the more substantial contribution of input factors.

The contribution of total factor productivity was substantial throughout the post-World War II period. In 1900–1948 its share in total growth was 38%, in 1948–1985 – 60%, and in 1900–1985 – 51%. Interestingly, while in 1975–85 its share amounted to as much as 90%, in 1985–90 it dropped to only 40%.

During the recessions in the second half of the 1970s and at the beginning of the 1990s, the growth of total factor productivity did not slow down dramatically. After the recession at the beginning of the last decade, the growth of total factor productivity accelerated, but employment also increased.

2.5. Conclusions and discussion of the evaluation of forecast quality

Ex-post evaluation of the quality of results shows that many long-term developments have been projected quite accurately – especially in terms of the direction of change. The observed average growth rates have been quite close to the forecasted values.

Business cycle forecasting is more difficult, but average growth and structural change are projected in a more reliable manner. Net immigration has been larger than in earlier projections made more than 20 years ago. The structural change has been stronger, although its direction has been quite well defined in projections. Employment is lower than the targets, but is quite near the base line in many periods.

It is very important that the calculation process is continuous; thus, changes can be taken into account flexibly, although reports have not been published very often.

One of the theoretical method of analysis economic variables, next to applied statistics, is growth accounting. It allows economic growth factors to be analysed in line with sectoral classification of economic activity. The long-term model of labour force projections yields projections of future demand for, and supply of, labour. It can also be used to derive projections for the size and development of other economic variables, e.g. the balance of resources and expenditures, calculated by sector of economic activity. The classification of sectors of economic activity under the PTM model is slightly coarser than that used in growth accounting, but the correspondence between them enables the two calculations to be combined with little effort.

The growth of the Finnish economy has been studied extensively, but there has been very little research into long-term economic growth. Neither growth accounting nor growth theories in general have been applied to long-term studies of the economy as a whole. Research has usually been restricted to specific issues or sectors of economic activity without attempting to achieve a more comprehensive or integrated interpretation of factors influencing the process of economic growth. Factors affecting technological development and the effect of technological development on growth may not have been studied from all available angles, either. Advances in theoretical thought and the availability of better data have opened new prospects for the study of factors that have long-term effects on growth. Thanks to the database at hand, these calculations can be made on uniform data collected since the early days of industrialisation.

Many basic ideas of the methodology presented in the Chapter are nowadays included in CEDEFOP reports on skill needs.

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3. EMPLOYMENT FORECASTING IN THE CZECH REPUBLIC

3.1. Introduction

Projections of employment by occupation or by qualification requirements have not a very long tradition in the Czech Republic. One of the reasons for this was a lack of consistent and continuous databases of information on the development of occupations, as the valid classification of occupations was often and most inconsistently changed[7]. Only after the societal changes in the country, in 1993 the Czech Statistical Office (CZSO) began to use classifications used in Western Europe, for example the classification of occupations ISCO, the industry classification ISIC, and the classification of education ISCED. After a short trial period, since 1995 our data have been statistically reliable and relatively consistent over time.

This has been also the reason why only since the second half of the 1990s some institutions and agencies have begun to address issues of employment projections by occupation and by qualification requirements. Particularly two European projects, *Future Skill Needs in Europe* (carried out in the years 2006–2008) and *Forecasting skill supply and demand in Europe* (2009–2012), gave a major impetus in this direction, and in both the Education Policy Centre at Charles University in Prague (EPC) has been actively involved (including both authors of this study). For quite a long period of time, it has been thus possible to learn from colleagues from other European countries, develop the necessary knowledge, skills and competence, elaborate and strengthen the methodology and build the necessary database.

This phase of our work has been successfully concluded at the end of 2011 allowing the EPC to prepare an overall coherent projection of industry, occupation and qualification requirements in the Czech economy for the 2010–2020 decade. Moreover, our conceptual, methodological and data capacity based at European level (for example an integrated database for all European countries in the years 1995–2010 covering the development of industry at the second level of NACE classification, the development of occupations on the third level of ISCO classifi-

[7] Symptomatic is, for example, that regular post-war Population Censuses, carried in former Czechoslovakia every ten years between 1950–1990, used every time different and absolutely not comparable classifications of occupations.

cation, and containing qualification profiles for all jobs defined by NACE and ISCO) allows the EPC to prepare similar independent projections for other European countries, for example for Poland.

3.2. History of employment forecasting in the Czech Republic

In connection with the fall of Communism in 1989, the Czech Republic went through a dramatic economic reform in the transition from a centrally planned economy to a market economy. In 1993, Czechoslovakia split into the Czech Republic and Slovakia. Relevant historical data are therefore available for the Czech Republic from 1993 on, i.e. for the past 18 years as of this writing.

At the present time, however, no institution exists in the Czech Republic which would perform regular, medium-term forecasting for developments on the labour market on a long-term basis. The basic problem with creating forecasts in the Czech Republic is that there are no official medium-term forecasts for developments in the number of jobs by individual economic sectors. Such forecasts are not available even from the Czech Statistical Office (CZSO) or the Czech National Bank. The main government organizations attempting to introduce a permanent and repeated prognosis system in the Czech Republic are the Ministry of Education, Youth and Sports (MoEYS) and the Ministry of Labour and Social Affairs. These two government branches have commissioned several projects dedicated to labour market forecasts in the last 10 years. The projects were organized by the Education Policy Centre, Charles University in Prague (EPC), the National Training Fund and Research Institute for Labour and social Affairs.

In 1999–2001 in the Czech Republic the project *Regular Forecasting of Training Needs: Comparative Analysis, Elaboration and Application of Methodology (LABOURatory)*[8] took place as a two-year survey and analysis project funded by the European Commission under the Leonardo da Vinci programme. The aim of the project was to investigate the labour market information system and methods used for forecasting education and training needs in four EU member states (France, Germany, Ireland and the Netherlands), and to compare them with the data availability and the methods applicable in three pre-accession countries (Czech Republic, Poland and Slovenia). This project was organized by The Czech National Observatory of Vocational Education and Labour Market (National Training Fund).

The EPC put together the information on developments on the labour market in the Czech Republic from 1995 to 2006 and development forecasts through 2016. The results of the project are available on the EPC website[9] (only in Czech).

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8 http://old.nvf.cz/publikace/pdf_publikace/observator/eng/forecast_methodol.pdf.

9 http://www.strediskovzdelavacipolitiky.info/default.asp?page=svp&KID=78.

The outcome of the project was the publication of *Medium-Term Forecast of Qualification Requirements on the Labour Market in Europe* (available only in Czech, *Střednědobá projekce kvalifikačních potřeb trhu práce v Evropě*).

The Czech Future skills! portal[10] also engages in labour market forecasts. This website contains a section on forecasting labour market trends, including three industry studies and links to some forecast practices abroad.

The most significant and most widely used is the output from the Information System regarding the Position of School Leavers on the Labour Market (available only in Czech, *Informační systém o uplatnění absolventů škol na trhu práce*, ISA). The project's output is available on the website[11], which has been online since September 2007. Anyone interested can find not just available schools and fields of education, but also professionally prepared analyses regarding the needs of the labour market and sample real working environments, which can aid them in choosing a course of study.

A summary publication from the project is also available[12], containing the most important findings and results of the research and analyses. It was published in 2008 and provides information regarding the industry and the educational structure of students, the opinions of high school leavers regarding the choice and quality of their studies, the transition of school leavers from high schools, secondary vocational schools with a high school leaving exam, and colleges and the situation of such individuals on the labour market. It also provides a summary of employers' requirements in relation to the readiness of school leavers and detailed information regarding the development of the industry, occupational and educational structure of employment in the Czech Republic and in comparison with other EU countries. The publication *Development of Qualification Requirements on the Labour Market in the CR and Abroad* (available only in Czech, *Vývoj kvalifikačních požadavků na pracovním trhu v ČR a v zahraničí*)[13], which is entirely concentrated on the issue of analysing past development and forecasts for the labour market in the Czech Republic, was also published in 2008. Unfortunately, the website and both publications are available in Czech only.

The Czech Republic also had or still has regional information systems (RISA). As with ISA, the main goal of RISA is to create a (regional) information system regarding the position of school leavers on the labour market in the given region. The information system is available online and intended for school leavers, applicants for study programs, and unemployed people, but also for employers, schools, advisory systems, employment offices and municipal up through regional offices. It aids applicants for study programs in choosing a course of study.

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10 http://www.budoucnostprofesi.cz/en/index.html.

11 www.infoabsolvent.cz.

12 http://www.nuov.cz/uplatneni-absolventu-skol-na-trhu-prace-2008.

13 http://www.strediskovzdelavacipolitiky.info/download/Kvalifikacni_pozadavky_Final.pdf.

This type of project took place in the Moravian-Silesian region between 2002 and 2004. However, at present it is no longer active. A RISA website has been available for the Liberec region since June 2007 and is still online[14] (only in Czech).

Since 2011, the Education Policy Centre, Charles University in Prague has been conducting a project entitled *Analysis of the Development of Job Structure in the CR* (Analýza vývoje struktury pracovních míst v ČR). The project was commissioned by the National Institution of Technical and Vocational Education (Národní ústav pro vzdělávání, školské poradenské zařízení a zařízení pro další vzdělávání pedagogických pracovníků, NUOV) and the results will be incorporated into the new version of the ISA website. The goal of the project is to prepare updated methodology for analysing qualification requirements on the labour market and for forecasting qualification requirements on the labour market. On the basis of the classifications, methodology and information in the database, the project will then analyse the changing qualification and educational demands in the Czech Republic and selected EU countries between 1995 and 2010 and make a forecast for further development of qualification requirements on the labour market in the Czech Republic through 2020. The output of the project will also serve as background material for the ISA website.

3.3. Required input data and external forecasts

Many data sources can be used to create forecasts for occupational groups in the Czech Republic. The main source is the **Labour Force Survey** (Výběrové šetření pracovních sil, LFS). The Labour Force Survey used by the CZSO is a source of information on the labour market. The survey provides information collected in households of respondents. The methodology of indicators measured by the LFS is in line with the definitions and recommendations of the International Labour Organisation (ILO) adopted in October 1982 as a basis for direct international comparability of labour market characteristics in various countries. At the same time, the implementing methodology of Eurostat, which explains the contents of particular labour market characteristics, is respected in full. The LFS is a continuous survey, results of which are evaluated and published quarterly. In each quarter of 2011 the sample contained more than 25,000 households on average in the territory of the whole Czech Republic (over 0.6% of all permanently occupied households), in which almost 58,000 respondents of all age groups were surveyed. Almost 50,000 of them were aged 15+ years. All persons usually living in the sampled households, irrespective of the type of their residence, were subject of the LFS. Since the research pertains only to persons living in households, it does not apply to persons living long-term in group accommodation facilities. For this reason, the data for certain segments of the population, in particular foreign nation-

[14] http://www.risa-lbc.cz/novinky.do?chR=1.

als living and working in the CR, are available only to a limited degree. In certain economic sectors (particularly in construction), this can lead to underestimating the number of employees. This shows up in the data, and subsequently in the forecasts regarding the number of employees by sector as well as by occupation.

Another source is **data from employment offices.** Employment offices register the current numbers, sector and occupation of unemployed people. They also have information regarding whether a company intends to recruit or, on the contrary, make redundant a large number of employees in the near future. These data are useful primarily for regional analysis and also for creating short-term forecasts. The disadvantage of these data is that not all unemployed people are registered with the employment office. For example, unemployed managers or doctors rarely look for new employment via the employment office.

Another data source is **employer surveys.** Employers state in the surveys how they see the current situation in their sector of business as well as what trends they expect to come. This source is also useful mainly for short-term predictions and more for regional than national forecasts.

Job advertisements can also be used as a supplementary information source. They mainly give an idea of what employers require for individual jobs. They also provide data regarding salaries for individual occupational groups. The disadvantage of this data source is that, similarly as data from employment offices, they do not include all occupational groups, being typically aimed at the less educated. People with tertiary education, such as those in the highest management positions, usually do not seek employment through the employment office or through advertisements, but rather use their contacts or are targeted by head hunters from recruitment agencies.

Sector studies are another valuable source of information. Each sector study is a detailed investigation of the situation in a selected sector of the economy. They include qualitative as well as quantitative data. They contain expert predictions regarding development in the given sector and detailed outlines of possible development scenarios in the sector in the coming years. Three sector studies focused directly on the Czech Republic resulted from the NVF (Národní Vzdělávací Fond) project (see above). They were created for the Energy, Electrical Industry and ICT Services sectors, although there is also a set of sector studies focused on development in the entire EU. As part of the New Skills for New Jobs initiative, the Commission has published a series of 18 sector-based studies (two of them – *Automotive sector* and *Defence industry* as pilot studies) that look at emerging and future skill needs up to 2020[15]. The results of these studies have been discussed and validated by panels of experts from industry, academia and sector organisations including workers and employers' representatives with expertise in the sector and in skills. All sector studies were published as part of a series of forward-looking sector studies on New Skills and New Jobs in the framework of

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15 http://ec.europa.eu/social/main.jsp?catId=784&langId=en.

the project Comprehensive Sector Analysis of Emerging Competences and Economic Activities in the European Union. Each report is part of a series of future-oriented sector studies on innovation, skills and jobs under the same heading, commissioned by the European Commission (DG Employment, Social Affairs and Inclusion). Eleven of these studies were executed by a core consortium led by TNO (Netherlands Organization for Applied Scientific Research), two by Economix, one by Alphametrics, one by IKEI and one by Oxford Research. Sector studies therefore offer a lot of very helpful and interesting information about the past as well as the expected future development of each sector. However, it must be pointed out that there are certain major **drawbacks** and **limitations** as regards the use of sector studies. These are, above all, the following:

- **Incompleteness.** Not even an aggregate of all sector studies can provide a basis for drawing specific conclusions as to what changes will take place in the European economy as a whole.
- **Inappropriate definition.** Another problem related to the use of sector studies as a support source of high quality information for forecasts lies in the insufficient specification of the occupational groups analysed as part of the sector studies. It is very difficult and practically unfeasible to define selected occupational groups from the relevant EC sector study using ISCO classification. Some occupations in the sector studies correspond to the 4th ISCO level (e.g. *Locomotive engine drivers* (ISCO 8311) in the *Transport* sector), whereas in other cases the 1st ISCO level is used, for example *Managers*. Moreover, their number in individual sector studies varies – e.g. there are only 5 groups defined in *Other Services*, while in *Computer, Electronic and Optical Product* for example, there are 15 groups identified.
- **Lack of specification concerning development of occupations.** In the analyses of changes in the number of employed, sector studies only state for each occupational group (and each scenario) whether the number will increase, decrease or remain the same in the period until 2020. However, it is no clear how large this change in the number of employed in the given sector will be. It is therefore impossible to compare the development within the same occupational group as presented in two different sector studies.
- **Other international surveys and projects** – such as the International Social Survey Programme (ISSP), the OECD International Adult Literacy Survey (IALS) from the nineties, or the new OECD Programme for International Assessment of Adult Competencies (PIAAC) just under way in many OECD countries – should been analysed and taken into account as well.

One very important issue in making an occupational forecast is how detailed the classification of occupational groups should be chosen. There is always a compromise to be made between statistical reliability of the data and validity of the categories used. If too few occupational groups are chosen, the data used will be statistically solid, but the results will be too general to be very useful for interpretation. However, if too many occupational groups are chosen, many of them will consist of few individuals. Considering that calculations are usually made using LFS, a sample survey, the probability of various statistical errors in calcula-

tion and thus skewed interpretation is too great. The ideal number of occupational groups for the Czech Republic is approx. 60–100, so it would be appropriate to use the third level of the ISCO classifications (approximately 105 groups) and possibly merge some smaller groups together. The problem with statistical reliability is even greater in regional forecasts.

Another problem occurs in international comparisons. The same occupations are sometimes understood differently in different countries and are therefore classified differently. One example is *Skilled agricultural and fishery workers* (ISCO 6), which is nearly non-existent in Ireland, where a large number of people (compared to other countries) are employed as *General Managers* (ISCO 13). Varying educational requirements for certain occupations can also cause problems. For example, the group *Nursing and midwifery professionals* (ISCO 223) does not exist in the Czech Republic, because nurses in the Czech Republic only have a secondary level of education, not high. They are thus classified in the group *Nursing and midwifery associate professionals* (ISCO 323). In contrast, in some EU countries (such as Poland or Spain), the group ISCO 323 is empty and all nurses are classified as ISCO 223.

Another troublesome complication is the change in NACE and ISCO classifications. Both classifications have been modified in the last several years (NACE Rev. 1 to NACE Rev. 2 and ISCO88 to ISCO08). Because there are no clear converters between the old and new versions, it is very difficult to construct consistent time series.

3.4. Methodology of projection

All projects in the Czech Republic, in which employment forecasts have been made (by occupation and/or by sector) use the same basic methodological principle: the top-down approach. Forecasts for the macroeconomic variables influencing the number of employees (GDP, GVA, export, import, R&D expenditure, labour productivity, consumption, investment etc.) are performed first, and changes in those are used to determine the change in the number of employees in the sectors of the Czech Republic economy. The next step is creating the occupational and, if appropriate, educational structure of employees (education attainment and fields of study).

As stated above, there is no official macroeconomic forecast in the Czech Republic. All research teams have to deal with this problem. In principle, there are only two ways to handle this problem. The research team can either create its own forecast, usually using econometric and mathematical approaches (see the EPC report for the ISA website 2005–2007) or it can use the development forecast for the Czech Republic created by a foreign department (as in all other projects stated in section 3.1).

The project currently running in the Czech Republic (*Analysis of the Development of Job Structure in the CR*, conducted by EPC) uses a macroeconomic

forecast borrowed from the international *Forecasting skill supply and demand in Europe* project initiated by CEDEFOP for 2009–2012. The project output will primarily serve the European Commission. The main investigator on the project is the Institute for Employment Research (IER, United Kingdom), along with Cambridge Econometrics (CE, United Kingdom), the Research Center for Education and Labour Market (ROA), Maastricht University (the Netherlands) and Alphametrics (Belgium and United Kingdom). The Education Policy Centre, Charles University in Prague is also an important investigator on the project.

The *Forecasting skill supply and demand in Europe* project follows the previous two CEDEFOP projects in the area of forecasting the needs of the labour market. The first took place in 2006–2008 and focused on forecasting for the demand side of the labour market (i.e. number of jobs). The second (2007–2009) made a supply-side forecast (i.e. number of people). The original intention was to compare the results of both forecasts and thus determine any imminent discrepancies between the supply and demand sides. However, the projects ended up being performed using different data and non-comparable methods, meaning it was not possible to compare the results. One of the main goals of this new project is to repeat both forecasts and compare the results, thus identifying potential mismatches in the labour market. The whole forecast process is based on a modular approach. Figure 3.1 shows relationships between the modules.

The macroeconomic forecast is based on the output from the E3ME model created by Cambridge Econometrics. E3ME is a large-scale computer-based econometric model covering all EU27 member states plus Norway and Switzerland (and four EU candidate countries), and featuring detailed disaggregation into 42 economic sectors, consistent with the NACE 2-digit classification. Interaction between economic sectors takes place through input-output relationships and links between countries are formed through international trade equations.

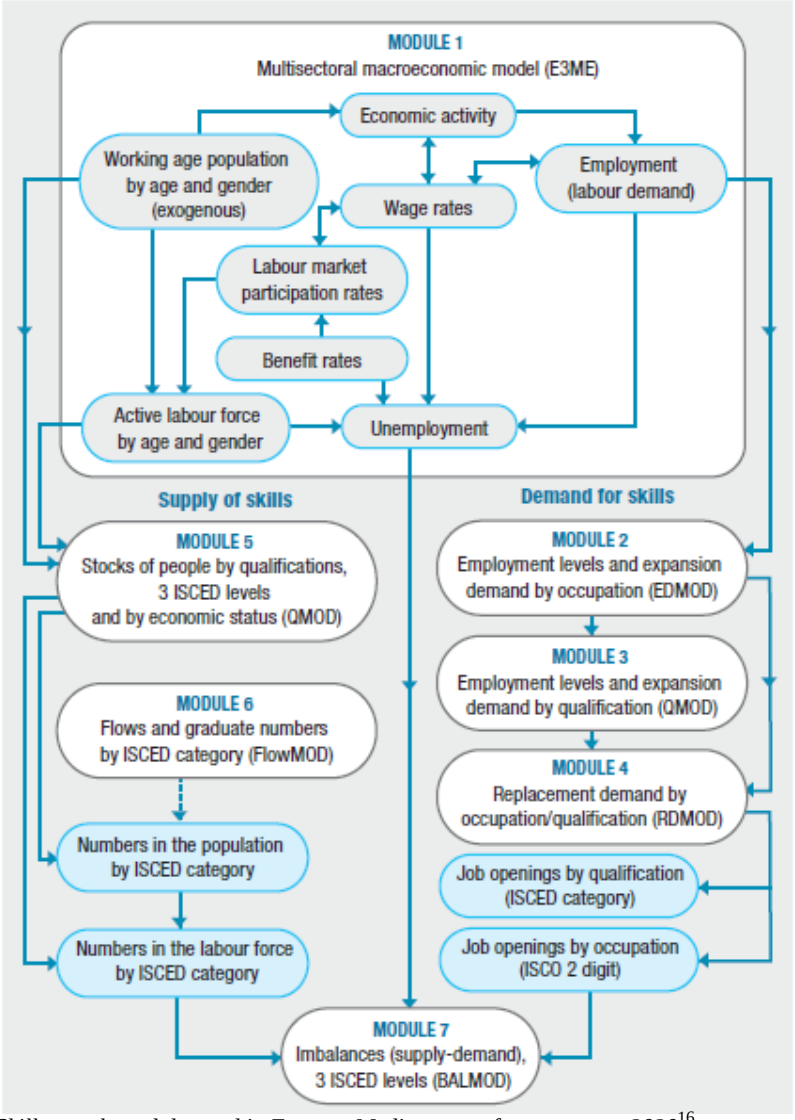
The structure of the model is based on the ESA95 system of national accounts and includes detailed two-way linkages between Europe's economies, energy systems and the environment. The economic system is closely tied to the way the model treats Europe's labour markets and E3ME includes estimated equation sets for employment demand, wage rates, average working hours and rates of labour market participation.

The econometric specification of the model makes it suitable for short and medium-term forecasting and policy analysis. E3ME is estimated and solved on an annual basis, with historical databases covering the period 1970–2009. In this exercise, projections are generated up to 2020.

The primary source for economic data remains the Eurostat National Accounts branch. Other data sources include the European LFS, AMECO database, the World Bank and the IMF. Data for employment are taken from the Eurostat National Accounts breakdown branch. The Eurostat National Accounts provides economic and employment data, including most of the necessary sectoral disaggregation required for the E3ME model. Population data (including projections) are also sourced from Eurostat and are discussed further below.

Figure 3.1

Conceptual framework of modelling the demand for and supply of skills



Source: *Skills supply and demand in Europe; Medium-term forecast up to 2020*[16].

[16] http://www.cedefop.europa.eu/EN/Files/3052_en.pdf.

The European LFS is used for labour market participation rates, which provide a measure of supply when multiplied by population. However, the LFS is not used to provide data for employment.

Data for unemployment are taken from the AMECO database that is maintained by DG ECFIN. A statistical residual value (supply minus demand minus unemployment) is calculated to take into account differences between the sources. This is held constant throughout the projections.

The CEDEFOP project mainly takes the employment rate (number of people employed in sectors) from the E3ME model. The employment rate is a function of gross production, labour costs, average number of hours worked, energy costs and technological progress. All these explanatory variables, with the exception of energy costs, are defined for the individual country and industry. The results of this model are forecasts for all years between 2011 and 2025. The forecast is made with several scenarios, each with a different assumed development of the explanatory variables. However, the employment forecast is in no way tied to work productivity in this model, which is one of the major drawbacks of the project. The relationship between work productivity and the employment rate should be stable on a long-term basis, although in the short term this may not be so. Another weakness of this model is that it focuses only on the demand side, so the supply side (the labour force) is not taken into account and the forecast resulting from the E3ME model may well not correspond to the development of the number of people based on demographic forecasts. This is addressed by other modules of the whole approach.

In the next module, a forecast of occupational structure is made using LFS data. The proportion of 27 occupations is determined in each of 41 industries for each country individually. Then logarithmic regression is performed, which helps to forecast the proportion of occupations in future years. Based on proportions so calculated, the total numbers of jobs acquired for the industry as a whole in the first step is then divided into individual occupational groups.

As mentioned above, the result of the forecast created by the project for CEDEFOP is the numbers of employees, divided into 41 economic industries and 27 occupational groups. For the purposes of the project conducted by EPC, however, more detailed, industry-specific occupational information must be acquired on the ISCO88 3-digit level. Therefore, the results of the CEDEFOP forecast should be further disaggregated into approx. 105 occupational groups. This breakdown is performed using historical data available from LFS. The calculation of the number of employees in an industry-specific occupational group is performed based on the following relationship:

$$z_{opct} = z_{orct} \times \frac{z_{opct_r}}{z_{orct_r}},$$

where z is number of employed, o is sector, p is occupational group based on ISCO88 3-digit level, r is occupational group based on ISCO88 2-digit level, c is

country, *t* is year of projection and *tr* is reference year (in our case, the summary for the years 2008–2010).

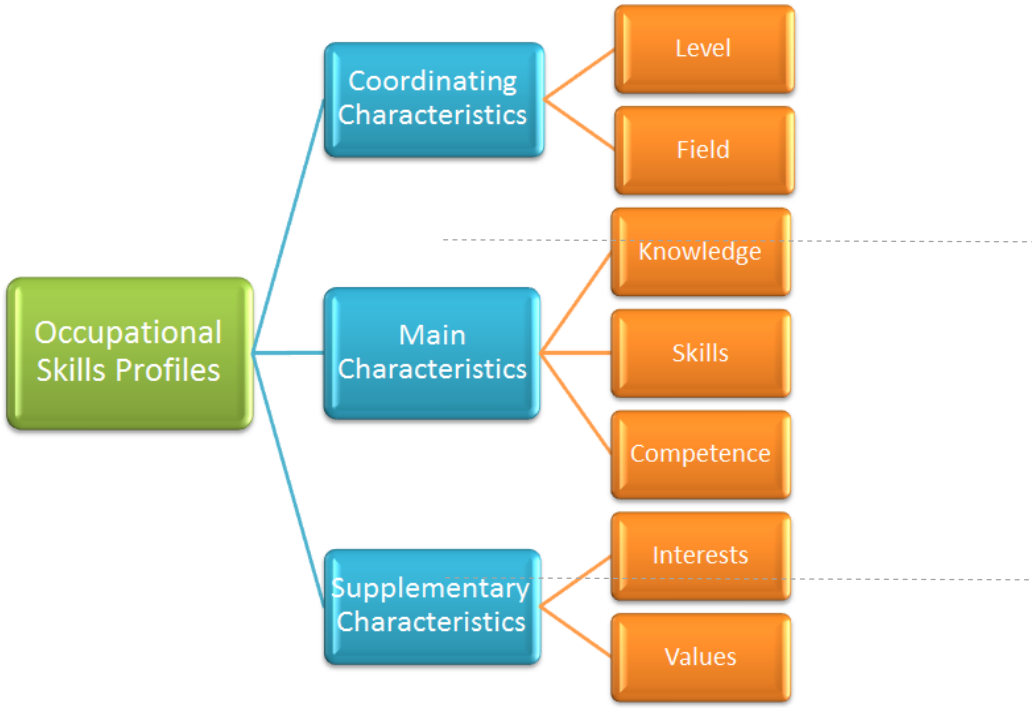
From the standpoint of occupational structure, however, the forecast of the number of employees is not the only important element Also development of **occupational skills profiles** is significant.

Since 2007 the Education Policy Centre has been developing a new concept of qualification profiles as a comprehensive and standardised way of describing requirements of a specific occupation (or occupational group, sector, and even a whole economy) concerning education, qualification and personal qualities of prospective job holders. When this is applied to the project *Forecasting of skill supply and demand in Europe to 2020*, the new concept is referred to as occupational skills profiles.

An *occupational skills profile* summarises the essential characteristics required for a given job: the level of education and training required (and hence the complexity of the occupation); the field of education and training required; the main and supplementary requirements concerning knowledge, skills, personal abilities, attitudes and values (see Figure 3.2).

Figure 3.2

Occupational Skills Profile – Main dimensions



Source: own illustration.

Occupational skills profiles of specific occupations can be aggregated into occupational skills profiles of occupational groups, further into occupational skills profiles of sectors, then into occupational skills profiles of national economies, and finally to a Pan-European level.

Occupational skills profiles have been developed for analysing, projecting and forecasting skill needs, for determining and measuring education/skills matches and mismatches in different countries, sectors or occupations, and for comparing and monitoring differences between European countries as well as for determining change over time, identifying past and future developments. Their application, however, is far wider. They can be also used for preparing educational and training programmes, both school- and enterprise-based, for the choice of a concrete job or of the best way of preparation for it. They can be used by all main labour market partners, as decision makers, employers, educational institutions and individual students and workers.

In order to be able to serve their purpose, occupational skills profiles have to meet simultaneously certain specific requirements, which makes them quite unique:

- they are defined at such a level of occupational classification that allows the identification of distinct, occupation-specific features adequately, while at the same time they can be transposed both to other classification levels and to other classification systems as necessary;
- their characteristics are not only quantifiable and measurable, but they are regularly measured, that is, they are supported by available statistics and data sets, allowing the creation of time series and identification of changes over time;
- they are consistent as far as possible with the concepts, classifications, and instruments used in Europe, in particular with the European Qualification Framework.

As all the requirements have to be met at the same time, many problems have to be dealt with. These include in particular: how to define the appropriate level of classification, how to find usable and fitting data, how to transpose safely from one level and/or system of classification to another, and how to achieve reasonable consistency between data and frameworks coming from different sources.

The EPC approach uses data from different sources, typically both from Europe and the US. To fully understand it and accept it, it has to be taken into account that any system of occupational skills profiles or requirements (be it US, European or of any single country) cannot describe all jobs in a given occupation. It always has to select only some representatives and will always be subject to certain fluctuations. One and the same occupation can and does have slightly different contents and qualification requirements; for instance, in the West and in the East of the United States, as well as in the United Kingdom and the Czech Republic, or in Spain and in Finland, and even in different regions or enterprises of a country (e.g., there are large differences between regions in Poland). It is affected, for example, by national or even local tradition and the environment of other occupations, by the character of the enterprise and its participation in the global trade, or by a different technology and technical equipment (as proved for example by an international survey of graduate positions at the labour market CHEERS

and REFLEX). This is another reason why the EPC is convinced that information describing the contents and complexity of different jobs and occupations coming from the US – that is, from a country that is so diverse – is no worse than information coming from a European country or even from an international European survey.

The EPC has thus put together and used various types of information: different international and national classifications of occupations and of sectors, data gathered by the European Social Survey, American BLS data and German BIBB data and those contained in the US information system O*NET as well as in the Italian and Czech surveys.

In order to be able to use O*NET data also in Europe, a correspondence table for classifications of occupations has been completed using information and other support from the US Bureau for Labor Statistics. It has thus been possible to utilise the main benefit of the O*NET system that is able to define and quantify about 700 occupational units, far more than in Europe where only data at ISCO 3-digit level structured into 110–120 occupational groups are available.

The more detailed contents of occupational skills profiles structured in seven dimensions and the way how they have been quantified can be found in English on the EPC web[17].

3.5. Forecast of a supply side

The Institute for Information on Education (*Ústav pro informace ve vzdělávání, UIV*) was established in the Czech Republic in 1991 as a semi-budgetary organization directly managed by the MoEYS. Its mission was to provide reliable information regarding the school system and education to the ministry, regions and municipalities, schools and teachers, students and their parents, journalists, the Czech Statistical Office, as well as public and international institutions. The Institute organised statistics on schools, gathered and processed data from various statistical surveys and comparative studies of education, and works with foreign partners. The UIV processed analyses, surveys and predictions of the state and development of the educational system and educational policies, participates in international studies and represented the Czech Republic in international information systems in the area of education. The UIV was terminated as of January 1, 2012 pursuant to a decision of the MoEYS. The MoEYS has taken over its agenda related to data collection and processing. Data will be collected in the same manner and data from previous years are still available. As of January 1, 2012, MoEYS also carries out forecasts regarding the number of school leavers from individual schools.

School leavers, however, are not the only part of the supply side on the labour market. Newly created or vacated jobs can also go to people already active on the

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[17] http://www.strediskovzdelavacipolitiky.info/default.asp?page=svp&KID=91

labour market, whether unemployed or employed and transferring from one job to another. This raises the issue of employee transferability, regarding which the EU published *Transferability of Skills across Economic Sectors: Role and Importance for Employment at European Level*[18] in 2011. The project analysed the role and importance of transferable skills with regard to the employability, adaptability and occupational mobility of people on the labour market. This publication analyses the role of such skills in career pathways and the labour market, and the levels of skill transferability across sectors in the current context and during the years leading up to 2020. It also looks at the roles of actors involved in promoting transferability and methods for enhancing job mobility, before making final recommendations. The project addressed an interesting question when it studied how similar individual occupations are in the sense of skills required, which were divided into soft, generic hard and specific hard skills. It did not come to any specific conclusions, however, and the results remained purely in the theoretical and methodological realm. Employees are transferable in both directions between some occupations and in only one direction between others. For example, it is relatively easy to imagine a high school teacher transferring to the position of a high school principal and vice versa. A bus driver could also easily transfer to the occupation of car driver, but the opposite transfer might very well not be possible.

In 2012, the EPC is completing a project for the Ministry of Education Analysis and projections of education and qualification of the workforce in the Czech Republic up to the year 2020, compared with EU countries and the US, with an emphasis on higher education by level and field of study (in fact, a 2010–2020 supply side projection). The development of education and qualification of labour force is linked to the results of projections of skill needs (demand side projection 2010–2020 finalised at the end of the year 2011). Comparison of both projections then show and evaluate potential structural and positional imbalances/differences (mismatches) in the levels and fields of education (again in comparison with other European countries and the US) and draw attention to possible pitfalls of further development.

3.6. Illustration of the results

This section describes the results of the forecast of qualification requirements on the labour market in the Czech Republic through 2020. This EPC forecast is closely tied to the newest forecast made within the large European *Forecasting skill supply and demand in Europe* project conducted in 2009–2012.

The Czech Republic is expecting a slight increase in the number of employed persons by 2020. This would mean about 3%, i.e. 162,000 people in comparison with 2010. It does not, however, mean that only these new jobs on the labour

[18] http://ec.europa.eu/social/BlobServlet?docId=7124&langId=en.

market will need to be filled in the next several years. Jobs vacated by retiring employees or vacated for other reasons (such as maternity leave, leaving the country, death, etc.) will also have to be filled. In the Czech economy, approximately 2.5% of all jobs each year are vacated for these reasons. Between 2010 and 2020, approximately 1.25 million jobs on the Czech Republic labour market will be vacated for the above reasons and will then have to be filled.

In looking at employment forecasts by occupational group, an increase is expected by 2020 mainly in the number of people in occupations with higher qualifications. The greatest growth is expected in *Technical and associate professional* (ISCO 3). In 2020, the Czech Republic should have 257,000 more employed in this occupational group than in 2010, which represents a growth of more than 21%. An increase by 7% is also expected in the number of *Professionals* (ISCO 2) employed. The number of *Legislators, senior officials and managers* (ISCO 1) should increase by nearly 5% by 2020. Other occupational groups should see a decline in number of employed. The number of *Craft and related workers* (ISCO 7) will decline by 73,000 by 2020, i.e. by more than 8%. Nearly 25,000 fewer people will be employed as *Service workers and shop and market sales workers* (ISCO 5). There will be 23,000 fewer *Elementary occupations* (ISCO 9) employed in the Czech Republic in 2020 than in 2010. The number of *Clerks* (ISCO 4) will decline by 19,000. The number of *Skilled agricultural and fishery workers* (ISCO 6) will only decrease by 8,000 by 2020, but given the size of this occupational group, this represents a loss of nearly 11%. The final main occupational group, *Plant and machine operators and assemblers* (ISCO 8), should lose approximately 13,000 people employed by 2020. With regard to the number of machine operators, however, this represents a decline by less than 2%.

Table 3.1. shows a detailed breakdown (ISCO88 3-digit level) of the occupational groups with the greatest or most dynamic changes expected.

Table 3.1

Employment forecast for the Czech Republic

Czech Republic		Employment (in thousands)			Change
		2000	2010	2020	2010–2020
Occupations with the largest job growth	Administrative associate professionals (ISCO 343)	206	273	348	75
	Finance and sales associate professionals (ISCO 341)	80	181	240	59
	Physical and engineering science technicians (ISCO 311)	176	227	282	55
	Personal care and related workers (ISCO 513)	24	63	102	39
	Business services agents and trade brokers (ISCO 342)	57	106	144	38
	Cashiers, tellers and related clerks (ISCO 421)	53	62	88	26

Czech Republic		Employment (in thousands)			Change
		2000	2010	2020	2010–2020
Occupations with the largest job declines	Secretaries and keyboard--operating clerks (ISCO 411)	62	50	35	-15
	Material-recording and transport clerks (ISCO 413)	91	102	87	-16
	Blacksmiths, tool-markers and related trades workers (ISCO 131)	158	148	130	-18
	Nursing and midwifery associate professionals (ISCO 323)	86	84	65	-19
	Managers of small enterprises (ISCO 131)	221	177	137	-41
	Fashion and other models (ISCO 521)	276	219	158	-61
Fastest growing occupations	Life science professionals (ISCO 221)	10	17	29	65.7%
	Personal care and related workers (ISCO 513)	24	63	102	61.8%
	Cashiers, tellers and related clerks (ISCO 421)	53	62	88	42.8%
	Production and operations managers (ISCO 122)	63	76	107	40.5%
	Client information clerks (ISCO 422)	22	32	44	37.4%
	Business services agents and trade brokers (ISCO 342)	57	106	144	36.4%
Fastest declining occupations	Textile, garment and related trades workers (ISCO 743)	65	29	20	-30.9%
	Wood-processing and papermaking-plant operators (ISCO 814)	17	13	9	-35.0%
	Manufacturing labourers (ISCO 932)	74	19	12	-35.9%
	Miners, shotfirers, stone cutters and carvers (ISCO 711)	18	12	7	-37.7%
	Mining and construction labourers (ISCO 931)	26	15	9	-39.5%
	Travel attendants and related workers (ISCO 511)	15	9	5	-42.5%

Source: own calculations.

As EPC is prepared to make an employment forecast not only for the Czech Republic but for other European countries too – Table 3.2 with preliminary results of occupational projection for Poland is attached. One can easily compare differences in the development of these two countries.

Table 3.2

Preliminary employment forecast for Poland

Poland		Employment (in thousands)			Change
		2000	2010	2020	2010–2020
Occupations with the largest job growth	Building frame and related trades workers (ISCO 712)	251	449	607	157
	Building finishers and related trades workers (ISCO 341)	251	445	599	154
	Physical and engineering science technicians (ISCO 921)	84	111	201	90
	Nursing and midwifery professionals (ISCO 223)	169	303	392	89
	Machinery mechanics and fitters (ISCO 434)	253	320	407	87
	Administrative associate professionals (ISCO 134)	350	488	565	76
Occupations with the largest job declines	Wood treaters, cabinet-makers and related trades workers (ISCO 742)	129	124	55	-69
	Market gardeners and crop growers (ISCO 611)	569	470	400	-70
	Blacksmiths, tool-makers and related trades workers (ISCO 722)	260	271	201	-70
	Managers of small enterprises (ISCO 131)	358	335	258	-76
	Domestic and related helpers, cleaners and launderers (ISCO 913)	433	420	283	-137
	Crop and animal producers (ISCO 613)	1597	1314	1117	-196
Fastest growing occupations	Agricultural, fishery and related labourers (ISCO 921)	84	111	201	80.6%
	Health professionals (except nursing) (ISCO 222)	114	204	281	37.2%
	Building frame and related trades workers (ISCO 712)	251	449	607	35.0%
	Building finishers and related trades workers (ISCO 713)	251	445	599	34.7%
	Public service administrative professionals (ISCO 247)	36	91	118	30.0%
	Nursing and midwifery professionals (ISCO 223)	169	303	392	29.3%
Fastest declining occupations	Messengers, porters, doorkeepers and related workers (ISCO 915)	122	126	96	-24.3%
	Blacksmiths, tool-makers and related trades workers (ISCO 722)	260	271	201	-25.9%
	Protective services workers (ISCO 516)	211	226	160	-29.4%
	Electrical and electronic equipment mechanics and fitters (ISCO 724)	201	181	125	-30.8%
	Domestic and related helpers, cleaners and launderers (ISCO 931)	433	420	283	-32.6%
	Textile, garment and related trades workers (ISCO 743)	262	195	129	-33.6%

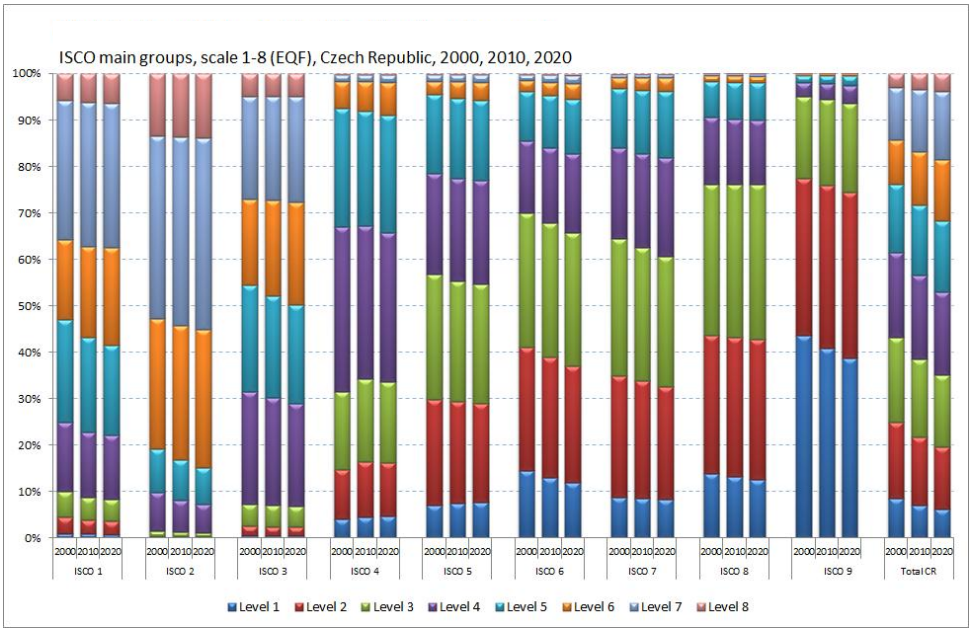
Source: own calculations.

The change in occupational structures has a substantially higher influence on the level of qualification demands than on industries, because occupations – as compared to industries – are usually much more closely tied to a certain required qualification. This fact is also confirmed by Figure 3.3, which shows the qualification demands of the main occupational groups. The differences in qualification requirements (degree of qualification requirements 1–8) between the individual main occupational groups are even more obvious than in individual industries or sectors.

On the other hand, it is logical that the differences in time are diminishing, because they already contain only two types of changes: changes brought on by the changing structure of occupations within the large occupational groups and changes in qualification demands taking place within individual occupations.

Figure 3.3

Distribution of Jobs by Qualification Requirements in the Czech Republic

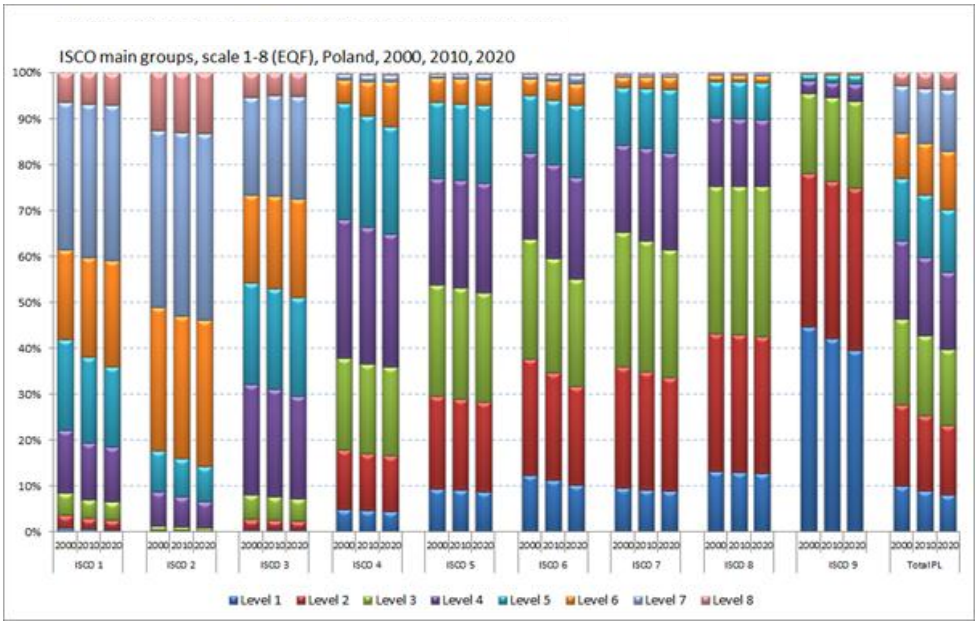


Source: own calculations.

And for the sake of comparison, Figure 3.4 for Poland is given below.

Figure 3.4

Distribution of Jobs by Qualification Requirements in Poland



Source: own calculations.

3.7. Evaluation of the quality of the forecast

The future cannot be predicted with precision or certainty. But all the participants in the labour market make plans for the future, even if these are simply based on the default assumption that the future will be the same as the past. The rationale behind any forecast is that a comprehensive, systematic, consistent and transparent set of projections can help to inform everyone about the world they are likely to face.

As stated above, there is still no regular or repeated forecast of the development regarding the number and structure of employees on the labour market in the CR. Therefore, it is not possible to compare different versions of the forecast prepared by the same author to determine how the forecast is gradually modified and how close or far it is from the actual situation on the labour market. Moreover, the evaluation of the existing forecasts was deeply affected by the economic crisis, as obviously no medium-term forecast took into account such a fundamental change in development. The economic crisis that hit in the autumn of 2008 has had a great impact on the economic development of almost all countries in Europe,

which in turn has had an impact on the labour market. The labour market reacts to changes in GDP with a slight delay, meaning that the decline in employment occurred in 2009 instead of the end of 2008.

The economic crisis most affected people employed in construction, which saw an acceleration of a declining trend in jobs that occurred in construction before the economic crisis broke out. A marked downturn related to the crisis also occurred in manufacturing (primarily the automotive industry), but the consequences of the crisis also had a clear impact on the number of employees in the finance and banking sector as well as business, transport and telecommunications. Compared to the first quarter of 2008, 4.3 million fewer people were employed in the European Union in the first quarter of 2009. Out of this total number, the number of employees in manufacturing declined by nearly 2 million and in construction by 1.3 million. The number of employees in business, transport and telecommunications dropped in the EU year-on-year by 1.2 million and the decline in the financial and banking sector was 600,000 employees for the same period. In contrast, the number of public sector employees increased (by 800,000) in the EU for the same period.

The crisis put the Czech economy roughly back at the level from the beginning of 2007. Some other countries, of course, are even worse off. For example, the euro zone is at 2006 levels and Britain's figures are the same as at the beginning of 2005. Czech gross domestic product peaked in the third quarter of 2008 and then took a sharp dive.

When figuring in the economic growth predictions by ČNB, the climb back to the top should last a total of thirteen quarters. The domestic economy is not improving evenly: improvement is faster in manufacturing than in construction. Recovery on the labour market also lags behind the real economy.

One important question in evaluating the forecasts is how to recognize a good prediction. Simply comparing predicted values with actual facts can sometimes be quite misleading. A truly high-quality forecast must address its target group (policy makers, educational institutions, employment offices, etc.) at the time it is published. Then, the target group can react to imminent problems and mismatches and attempt to eliminate them. Therefore, they change their behaviour and priorities (supporting employment in selected sectors, changing the structure of employment programs, etc.) based on the forecast. This can have a significant effect on the future structure of the supply side as well as the demand side of the labour market and thus differ from the original results of the forecast. Yet this type of forecast, which successfully addresses and influences specific target groups, is in fact the most successful.

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4. EMPLOYMENT FORECASTING IN GERMANY – DEMAND FOR LABOUR

4.1. Historical development

Projections or forecasts are seen as a sophisticated tool for anticipatory planning in every policy area. However, it has been shown that forecasts have to be considered with reservation because they have some limits in their construction and adaption. Those limits mainly concern the uncertainty and fuzziness of the forecasts that occur even if elaborated scientific methods are applied. Long-term forecasts – this includes long-term labour market forecasts – are always conditional forecasts. This means that the projected development will only happen if certain and clearly specified conditions hold over time. All forecasts are therefore 'if-then' propositions.

If the limits of forecasts are kept in mind, projections are legitimate and useful – even if they do not come true in reality, e.g. because policy induced counteractions to overcome a projected skill shortage. If someone is not aware of these reservations pertaining to forecast, projections can lead to misunderstandings and false conclusions. This is why the Institute for Employment Research (IAB) has always had the philosophy of calculating alternative developments and offering different scopes for designing the future. It has never been the point to construct a prognosis of a 'most likely' and not susceptible future.

The following Chapter not only describes the development and progress of long term labour demand forecasts in the IAB but also illustrates how the interests in forecasts sustainably changed during the last decades. Theoretically, we can distinguish the past developments in five steps:

1. Step: The beginnings were affected by the belief in the controllability of the economic process (stability law). Labour demand forecasts were considered 'if-then' propositions and estimated the demand of labour through an expected or politically aspired economic growth. Imbalances were identified by balancing the demand with the supply of labour. As a result of forecasts, policy could either accept a perennial employment deficit or try to activate domestic and foreign labour supply.

2. Step: The second step of forecasting reacted to the external shock of the first energy crisis in 1973/74 and the following recession that resulted in a loss of full employment. The energy crisis pointed to the vulnerability of the German national econ-

omy. For the IAB, this was the hour of birth of alternative prognostics. Forecasts now illustrated long-term impacts of different assumptions on economic growth, work time volume and productivity on employment and underemployment.

3. Step: The 1980's were affected by the fear of breaks in the trend of structural change through new technologies, e.g. microprocessors, and the question, whether those new influences would, on balance, create or destroy jobs. In the system of vocational education and further training the debate emerged whether there would be a polarisation towards higher or lower qualifications. Would Germany experience a skill-biased technological change? To answer these questions, the IAB cooperated with the Prognos AG and constructed 'semi econometric system projections' on an iterative basis. In two cooperation projects, the IAB published perspectives of labour demand and labour market balances together with the Prognos Institute. In this step, demand forecasts became more meaningful as they were differentiated into industries, qualifications and task profiles.

4. Step: Unemployment rising from business cycle to business cycle led to a loss of belief in the controllability of the economic process. As a result, it was not only requested to model different paths of alternative developments on the labour market but also to evaluate the economic development and the consequences resulting for the labour market. Labour market processes had to be analysed and projected in a circular interrelation. Therefore, the IAB established a macro econometric model, the so called IAB/Westphal version of the SYSIFO-model, which was developed together with Prof. Westphal, University Hamburg. Economic events could now be explained in a national economic context meaning that effects could be related to causes. Besides the forecasts themselves, it was necessary to estimate the effects of different political measurements on the economy and the labour market (policy simulation and development of the IAB strategy bundle).

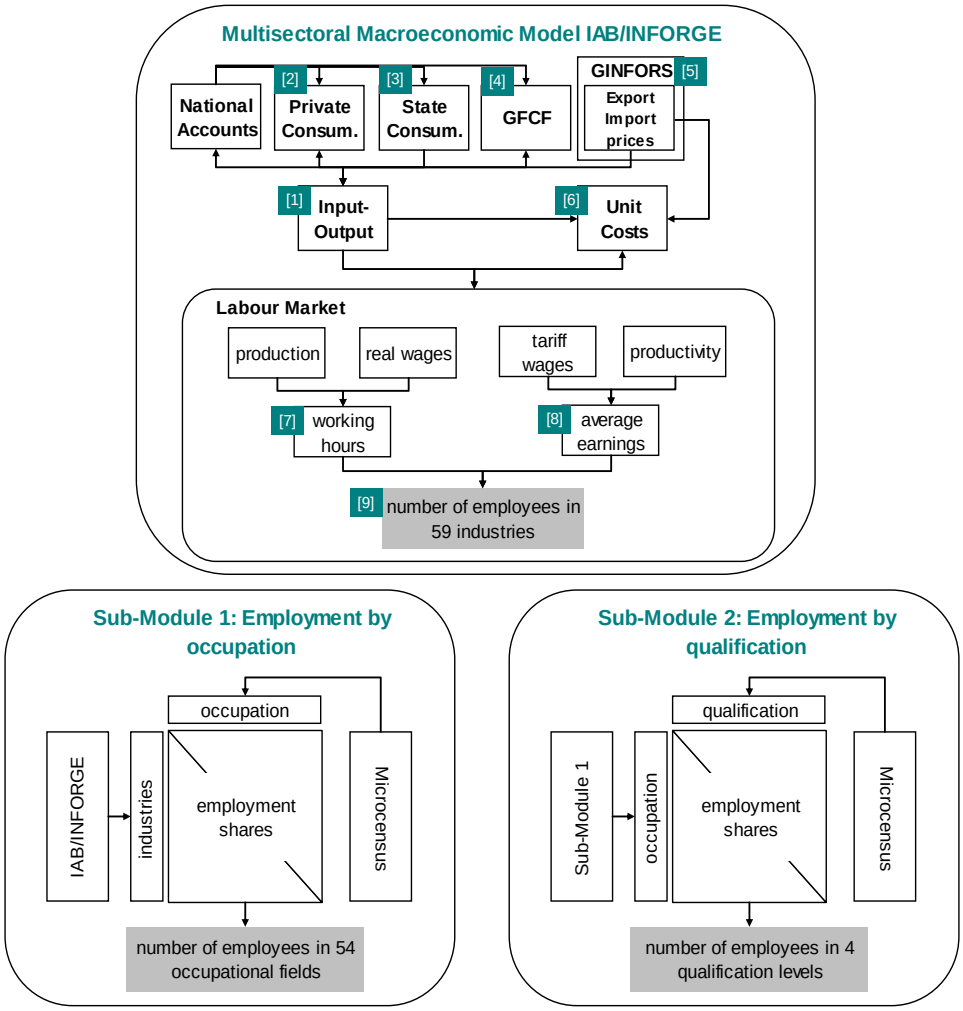
5. Step: The current state of labour market forecasting was reached in 1996 with the deeply disaggregated macroeconometric IAB/INFORGE-model (INterindustry FORecasting Germany). The model-based projection and simulation system captures the complexity of the national economy and completely represents the macroeconomic markets of commodities, currency and labour. It will be described in more detail in the next section.

4.2. The modelling framework of the IAB/INFORGE model

The IAB/INFORGE model follows a standard approach to forecast manpower requirements in Germany until 2025 by applying an econometric model. We have chosen a model-based forecasting system for the projection not only because econometric models have become a standard tool for economic forecasting but also because they are the best instrument at hand in order to capture the economic complexity in its multitude of linkages and feedbacks between economic actors and sectors. Consistency in the results is perceived.

Figure 4.1

Simplified Illustration of the Modelling Framework



Source: own illustration.

The projection at hand concerns the years from 1991 to 2006[19]. Yearly forecasts are estimated from 2007 to 2025. The projection does not claim to portray the future exactly or forecasts developments that cannot be influenced. Instead,

[19] The new forecast is based on data from 1996 until 2009. However, the forecasting method remains unchanged.

the results of the paper should be interpreted as an 'if-then' scenario, considering the underlying assumptions of the projection.

The IAB uses the multisectoral macroeconomic model IAB/INFORGE for forecasting employment by industrial level. The conversion from employment by industry to employment by occupational field and qualification level is implemented in two sub-modules, whereas the projection of employment by occupational field is intermediate to the forecast of employment by qualification field. Whereas the IAB/INFORGE model itself is basically constructed as a bottom-up model, the overall modelling framework follows a top-down approach with no feedback from employment by occupational fields and/or employment by qualification levels at the current state of the methodology. Figure 4.1 shows an overview of the modelling framework. In the subsequent sections, a closer description of the modelling methodology is given, starting with a detailed description of the multisectoral macroeconomic core-model IAB/INFORGE.

4.2.1. The multisectoral macroeconomic model IAB/INFORGE

The IAB/INFORGE model is an econometric forecast and simulation model for Germany, deeply disaggregated into production branches and categories of goods. It has been developed by the Institute for Economic Structures Research (GWS mbh) and is integrated in an international model framework. The construction principle is based on a 'bottom up' approach and 'full integration'. 'Bottom up' means that every sector is modelled in-depth (about 600 variables for each of the 59 sectors) and that macroeconomic variables are constructed via aggregation in the modelling framework (Distelkamp et al., 2003; Ahlert et al., 2009). For this reason, it is possible to describe consistently every sector in a macroeconomic coherency and in an intersectoral interdependence by defining the national economy as the sum of its sectors. 'Full integration' means that the model structure completely represents the intersectoral interdependence and explains the use of income of the private households from the income origination of each sector. The global economic development as well as the relation of Germany with the global economy is modelled through GINFORS, a bilateral trade model. GINFORS is based on bilateral trade matrices with 25 production branches as well as for the trade of services for all OECD countries and the ten most important partners of the OECD countries. The economic core of the IAB/INFORGE model is a macromodel and an input-output model. The model is highly endogenised. The approximately 200 exogenous variables are mainly instrumental and concern the fiscal policy, e.g. tax rates. On the labour market, the labour supply potential is also considered to be exogenous. As far as foreign trade and payments are concerned, exchange rates are fixed exogenously, and all other variables are derived endogenously from the international system. The advantage of the newer version of the IAB/INFORGE model over the former version is that the demand of labour is now first determined on a time volume basis (IAB work time account) and converted into headcount afterwards.

4.2.2. Modelling of the labour demand by occupational field and qualification

For the future development of labour demand by qualification, it is not only the structural change of the sectors which must be taken into account, but also the changing of occupational fields within the sectors and the changing of qualifications within occupational fields:

- Economic (sectoral) structural change plays a role, because occupational and qualification structures are extremely different in each industrial sector;
- However, the need for highly qualified workers can also increase in individual sectors where other occupational fields and qualifications are in demand (e.g. IT specialists);
- Finally, the activities can also require an increasingly high level of requirement in individual occupational fields.

On the occupational level, the classifications of BIBB occupational fields (Tiemann et al., 2009) are applied: they consist of 54 occupational fields which show comparable job characteristics and industry dominance when grouped at the level of occupational categories (3-digit codes from the official German classification of occupations 1992 (KldB 92)). They are thus characterised by greater intra-homogeneity and, at the same time, greater inter-heterogeneity in contrast to the classification of occupations put forward by the KldB 92 (see also the next chapter).

On the qualification level, differentiation was made on four levels, in line with the ISCED classification:

- People without vocational education and training (VET) (ISCED 1,2,3a);
- People with completed VET (ISCED 3b, 4);
- People who have qualified as a master craftsman or technician or have completed technical college (ISCED 5b);
- People with an academic degree (ISCED 5a, 6).

Furthermore, people still in school or in vocational training were reported separately because they would otherwise have come under the first category, 'without VET'. As the majority of this group will receive a certified vocational qualification, however, and cannot therefore be counted among those with few or no qualifications for the purposes of extrapolation, their categorisation under the first group would distort the results.

The data on occupational fields and qualifications are based on long time series from the microcensus (labour force survey). A large sample is necessary, particularly with regards to occupational fields, so that the required number of cases can be attained. For this purpose, the most suitable data set in Germany is the microcensus, which is a one per cent sample of the total population and which, above all, provides results for the entire range of employment (including the self-employed, assistants, civil servants and soldiers). However, only the respective

structures (percentages) from the microcensus are used for the final result, as the data on the employed from the IAB/INFORGE model which are taken as a starting point, are based on the benchmark figures from the national accounts.

On the basis of data from the microcensuses from 1996 to 2007 it was ascertained how many people were employed in each occupational field in each industrial sector, and how many of those employed in each occupational field had what kind of qualifications. This gives rise to shares that reflect the distribution of occupational fields in the economic sector for each year, and the configuration according to the highest qualification for each occupational field.

To forecast the future labour demand, these shares are considered to follow a time trend[20]. The implicit assumption is that observable developments in the past can be transferred to the future. Variations from a long term monotone trend are considered as random. Based on this theoretical consideration, each share $o_i(t)$ respectively $q_k(t)$ will asymptotically approach a long term saturation level with an increase in t. However, it must be noted that:

1. $o_i(t)$ respectively $q_k(t)$ can only have a value between 0 and 1, and

2. they must add up to 1 in every industrial sector or occupational field at all times.

To meet these requirements the optimal solution would be simultaneous estimation of $o_i(t)$ in each sector and respectively $q_k(t)$ *in each occupation field.* However, due to data restrictions, it was not possible to estimate meaningful long term trends simultaneously, so that a logistic trend extrapolation[21] had been used to estimate the trend of occupational shares in each industry separately:

$$o_{ij,t} = (1+\exp(a_{ij} + b_{ij} \times t))^{-1} \Big/ \sum_{i=1}^{54} (1+\exp(a_{ij} + b_{ij} \times t))^{-1} \qquad (1)$$

in which $o_{ij,t}$ represents the share of labour in occupational field i (i = 1, ..., 54) within industrial sector j (j = 1, ..., 59) at time t with a_{ij} and b_{ij} as the parameters to be estimated. Accordingly, the formula for qualification shares is as follows:

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[20] Due to data restrictions, time trends instead of a multinomial logistic approach are considered to hold the most robust results in estimating occupational trends within industries (see Cedefop, 2009: 92).

[21] Other tested adjustment functions were an exponential function, a reciprocal quadratic function and a Gompertz function.

$$q_{ki,t} = (1+\exp(a_{ki} + b_{ki} \times t))^{-1} \Big/ \sum_{k=1}^{5} (1+\exp(a_{ki} + b_{ki} \times t))^{-1} \quad (2)$$

in which $q_{ki,t}$ represents the share of labour with qualification level k (k = 1, ..., 5) in occupational field i (i = 1, ...,54) at time t with a_{ki} and b_{ki} as the parameters to be estimated.

Given this definition it is assured that the requirements

$$\sum_{i=1}^{54} o_{ij,t} = 1 \quad \text{and} \quad \sum_{k=1}^{5} o_{ki,t} = 1$$

are met. Of course, results are more stable for occupations (qualifications) with a higher share within the industry (occupation) than for occupations (qualifications) with a lower share because it is more likely that low shares suffer from a higher degree of variance. However, low shares are mostly due to a small amount of people working in the relevant combination of industry and occupation or occupation and qualification, so the influence of time trends estimated erroneously due to data variability on the overall results of occupations and qualifications is considered to be rather small.

The aggregate effect arising from this is the result of three different, and in part directly opposed single effects. The aggregate effect can be split up into an effect of industrial sectors, an occupational field effect and a qualification effect via shift-share analysis (see Dunn, 1960). The effect of industrial sectors indicates change in the number of people employed in an occupational field, a change which arises purely due to the changing structure of the industrial sectors. In this regard, the structure of industrial sectors for 2025 is applied to those employed in 2007. We therefore investigate how the structure of an occupational field or qualifications would have changed if the structure of the industrial sectors of 2025 had already been in place in 2007. Accordingly, the occupational field effect results from the fact that the demand for occupational fields changes due to altered production processes within industrial sectors. To quantify this effect, we apply an occupational structure – that is, the percentages of all occupational fields in industrial sectors – from 2025 to those employed in 2007. It is assumed that nothing will have changed by 2025 apart from the percentages of the occupational fields in the industrial sectors. In 2025 there is still the same industrial sector structure as in 2007 and the total number of people employed is also unchanged. The qualification effect also demonstrates how the qualification structure changes merely

by the fact of technical progress within the individual occupations rendering a new (generally higher) level of job specifications necessary. Here we apply the qualification structure of 2025 to those employed in 2007.

4.3. Labour market developments until 2025

4.3.1. Labour demand by industries

On average, gross value added in real terms grows by 2.25 per cent per annum across all sectors at the beginning of the projection time period. The forecast supports previously recorded basic tendencies concerning the sectoral development of wage earners in Germany (Fuchs and Zika (2010)):

- A further drop in employment in 'agriculture and forestry' and 'mining' (-0.2 million combined);
- During the recent global economic crisis the productivity growth in the manufacturing industry was not exploited – on the contrary: hourly productivity fell due to extensive labour hoarding. Because companies must first counterbalance this, the considerably increasing value added is still accompanied by a loss of around 0.9 million jobs. The majority of industrial sectors are affected by this to a greater or lesser extent;
- After a slight increase in the number of jobs in the construction industry in recent years, around 0.3 million jobs will be cut by 2025;
- Job losses are also to be expected in the high-productivity industries in the service sector, such as 'credit and insurance industries' (-0.1 million), 'transport and communications' (-0.3 million) and 'trade, repair and maintenance of vehicles and consumer goods' (-0.5 million);
- Further jobs will be cut in the area of 'public administration, defence and social security' (-0.3 million);
- Employment gains will be particularly strong (1.6 million) in the field of corporate services due to the on-going process of outsourcing parts of companies and operational functions. These services include: software companies, hardware consultancy services, data processing services, repair and maintenance of office machines, data processing equipment and devices, Research and Development, legal, tax and management consultancies, market research and opinion polling, auditing, Public Relations, engineering, advertising agencies, and also professional labour recruitment and provision of personnel which contribute greatly to employment gains;
- Very good employment prospects (+0.6 million) emerge for health and social services. The main reason for this is the ageing society, which will lead to

a great increase in demand for health services and will mean employment growth in care homes for the elderly and ambulatory healthcare services;

- Employment will remain static for other public and private service providers and those offering household services. This area of employment is very heterogeneous (radio and television broadcasting, services for private households, such as cleaning, day care and political organisations like parties, associations, unions, religious organisations).

However, the trend towards a service society is not to be mistaken with deindustrialisation. The gross value added in the manufacturing industry will also show above-average growth rates in the future. The possibilities for rationalisation in this industry allow above-average increases in productivity together with lower employment of labour. Furthermore, in the past companies outsourced production-related services and the value added gained here is therefore no longer assigned to the manufacturing industry.

4.3.2. Labour demand by occupational fields

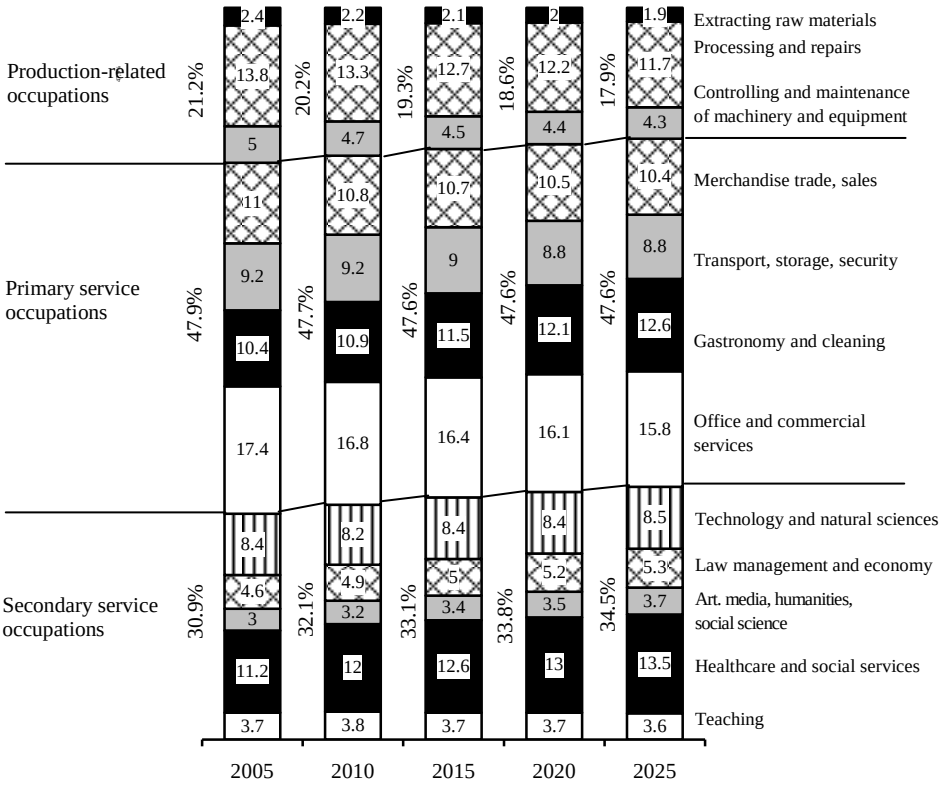
Extrapolating the development of the number of workers by occupational field within sectors shows a continuation of the developments to date which have been observed for a long time (Figure 4.2).

The production-related occupations concerned with 'extracting raw materials', 'processing and repairs' and the 'controlling and maintenance of machinery and equipment' have nosedived and will only employ 7.0 million people in 2025 – around 0.9 million fewer than 15 years earlier. Their share of 20.2 per cent sinks to 17.9 per cent in 2025 accordingly. In contrast, the number of wage earners increases by almost the same amount in absolute terms (+1.0 million) in the secondary service sector in occupations concerning 'merchandise trade and sales', 'transport, storage and security', 'gastronomy and cleaning' and 'office and commercial services'. Thus, the number of people employed in primary service occupations remains almost constant (-0.1 million).

In absolute terms, among production-related occupations, those concerned with 'processing and repairs' are the most greatly affected by the decline (-0.6 million). Accordingly, their share in all occupations falls from 13.3 per cent in 2010 to 11.7 per cent in 2025. This is mainly due to the fact that it is not only the effect of industrial sectors which has a negative impact, but also the occupational field effect (Figure 4.2). Occupations concerned with 'extracting raw materials' (-0.1 million), although the occupational field effect has a positive influence, are dominated by the effect of industrial sectors, which has a very negative impact. In contrast, in occupations concerned with 'controlling and maintenance of machinery and equipment' (-0.1 million) the occupational field effect does not play a role. In total their share falls by 0.3 and 0.4 percentage points, respectively.

Figure 4.2

Labour demand by main occupational fields – Shares in per cent



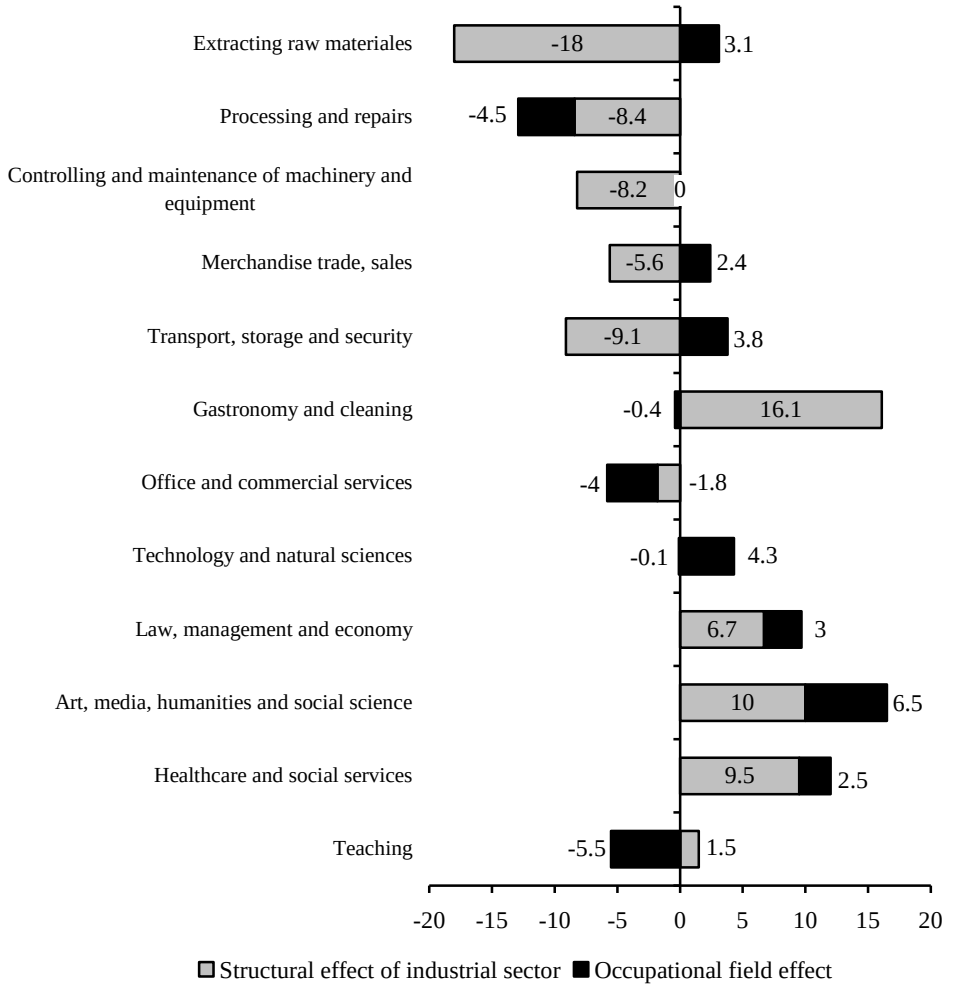
Source: IAB/INFORGE model, own calculations.

The development of the primary service occupations is heterogeneous. The number of occupations concerned with ‘gastronomy and cleaning’ will increase by 0.7 million, increasing their share from 10.9 to 12.6 per cent. Again, this is mainly due to the structural change in the economy. Occupations concerned with ‘transport, storage and security’, ‘merchandise trade and sales’ and ‘office and commercial services’, on the other hand, will lose significance (-0.4, -0.4 and -1.0 percentage points respectively), which will lead to corresponding job losses (-0.1, -0.1 and -0.3 million people respectively). However, they differ with regard to individual effects (Figure 4.3). Considered separately, the occupational field effect would have a positive impact on occupations concerned with both ‘transport, storage and security’ and ‘merchandise trade and sales’, i.e. there will be increased demand for these occupations in individual industrial sectors. However,

this effect is outweighed by the negative impact of the effect of industrial sectors. Therefore, industrial sectors with demand for these occupations will lose some of their significance in the future. For occupations concerned with 'office and commercial services', however, both effects show a negative impact, with the occupational field effect being the more dominant one.

Figure 4.3

Effects of industrial sectors and occupational field effect from 2010 to 2025 in per cent



Source: own calculations.

Almost all main occupational fields in the secondary service sector show growth. Thus, the number of occupations concerned with 'technology and natural sciences' (+0.1 million), 'law, management and economy' (+0.2 million), 'art, media, humanities and social science' (+0.2 million) and 'healthcare and social services' (+0.6 million) increase – the latter by a considerable amount – and their shares increase accordingly. The only occupational field which does not fit into the picture is the 'teaching' profession. Here, jobs are lost rather than gained (-0.1 million people or 0.2 percentage points). Again, this can be explained by the individual effects. Whereas the occupational field effect has a positive impact on all the other main occupational fields in the secondary service sector, it has a very negative influence on the 'teaching' profession, i.e. there are organisational and/or structural changes in the production process in the industrial sectors which reduce the demand for teaching jobs. Nor can this effect be counterbalanced by the slightly positive effect of industrial sectors. With the exception of occupations concerned with 'technology and natural sciences', the industrial sector effect is the dominant factor in the other main occupational fields.

Overall, the trend towards more challenging occupations will continue. Furthermore, the massive increase in the numbers of people employed in gastronomy and the cleaning profession testifies to the increasing significance of leisure and wellness offerings in the future.

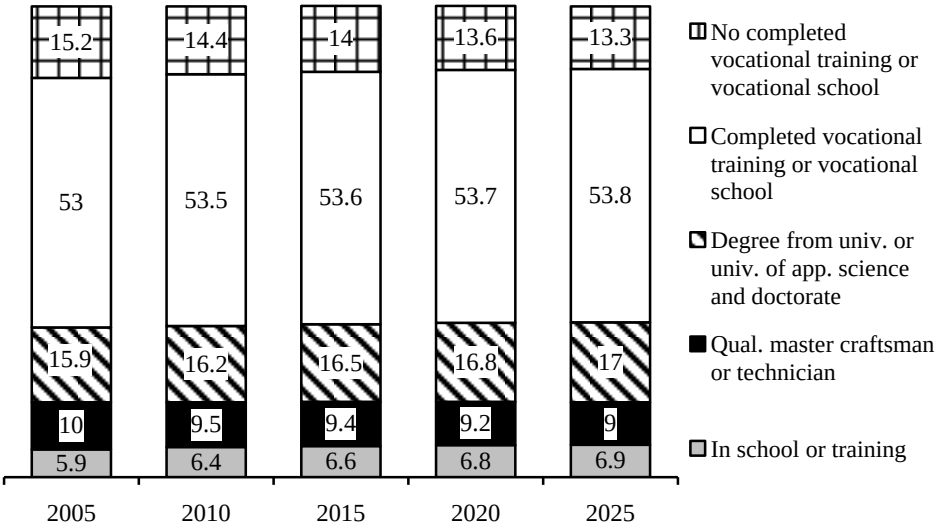
4.3.3. Labour demand by qualification levels

The forecast of labour demand by highest professional qualification until 2025 supports previously proposed trends towards higher qualifications (Figure 4.4, also Dustmann et al., 2009). The share of people with a qualifications from a university or university of applied sciences (ISCED 5a & 6) will continue to rise from 16.2 per cent in 2010 to 17.0 per cent in 2025. The reason behind this is a 0.3 million increase in the number of working academics to a total of 6.8 million. If one considers the individual effects (Figure 4.5), this increase in employment is based on sectoral development (effect of industrial sector), the trend towards more challenging occupations within the industrial sectors (occupational field effect) and the fact that the level of requirements in the occupational fields is becoming increasingly high (qualification effect).

The demand for people who have completed their vocational training or vocational school (ISCED 3b & 4) remains almost constant. With a share of 53.8 per cent or 21.3 million employees, those with this level of qualification will still make up the majority of wage earners in about 15 years. This means that dual vocational training or its academic counterparts will remain the dominant form of training in Germany. Although the medium qualification level will lose shares in employment due to changes in the structure of both industrial sectors and occupational fields, these losses will be counterbalanced by the qualification effect, so more jobs within individual occupational fields will be filled with people who have completed their vocational training.

Figure 4.4

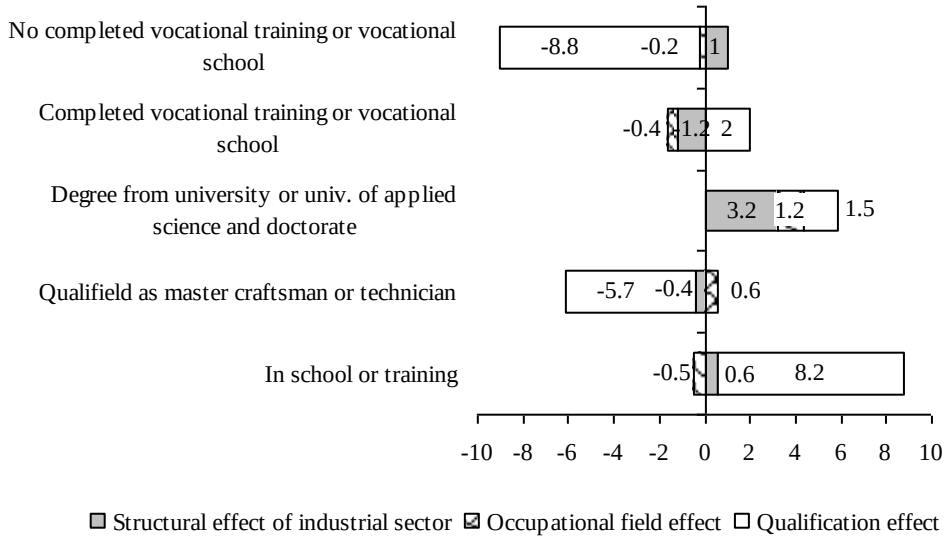
Labour demand by qualification levels – Shares in per cent



Source: Microcensus from the German Federal Statistical Office, own calculations.

Figure 4.5

Effects of industrial sectors, occupational field effect and qualification effect from 2010 to 2025 in per cent



Source: own calculations.

Technical colleges (ISCED 5b) show slight losses. Their share in total wage earners will fall by 0.5 percentage points to 9.0 per cent, which represents a loss of 0.2 million jobs. This decline is based almost exclusively on the qualification effect. It becomes clear that this form of training is under pressure from two sides simultaneously. On the one hand, skilled workers are increasingly able to do the same tasks as master craftsmen or technicians, although the abolition of the master certificate requirement certainly plays a role, and on the other hand, many tasks for which training at a technical college was once sufficient are becoming increasingly more complex and challenging. Finally, not least due to the introduction of the Bachelor's degree and the increasing permeability of the education system with regard to obtaining academic qualifications, more and more of these tasks are being taken over by graduates of universities or universities of applied science.

The above-mentioned developments entail further losses of 0.5 million jobs for people with no formal qualifications (ISCED 1, 2 & 3a). Their share in the total number of wage earners will continue to shrink and will reach only 13.3 per cent by 2025. In future, therefore, it will be even harder for those without any qualified training to find a job. Even today the risk of becoming unemployed is more than twice as high for low-skilled workers as it is for those who have completed their professional training, and six times higher than for academics (Reinberg and Hummel 2007). Analysis of individual effects shows that people with no professional qualifications almost always lose their jobs because of the qualification effect and hence mainly as a result of the development in the occupational fields towards tasks which have become more challenging due to technological change. This means that as part of structural change no more jobs for low-skilled workers will be cut due to increasing tertiarisation – on the contrary, jobs will be created.

However, there is one more ray of hope for those with low qualifications. As the model calculations show, the demand remains constant for workers who are also still at school and/or in training. As the number of young people and therefore the number of school pupils, students and trainees is falling as a result of demographic change, this demand will no longer be met, which could mean that more employment opportunities will be available for low-skilled workers in the future.

To conclude, it should be noted that the transition from wage earners by occupational field to wage earners by formal qualification has the disadvantage of combining a demand-side characteristic with a purely supply-side characteristic. One possible solution to this would be to take the level of requirements as a characteristic instead of formal qualifications. This way the effects of job characteristics could be illustrated more reliably than by using formal qualifications because the aspect of further training, such as learning-by-doing, etc., could be accommodated. Representing the job specifications would also allow one to avoid overestimation of future demand for highly qualified personnel due to the inadequate state of employment which already exists (Konsortium Bildungsberichterstattung,

2006: 119). However, as concerns the level of requirements, on the one hand there is the problem of measurability, which is still an issue, and on the other hand the matrix occupational field by level of requirement only exists for one point in time (2005) in the microcensus data, so there is no time series.

4.4. Regionalisation of the labour demand forecast

The presented results exist only for Germany as a whole. However, theoretically it is also possible to apply the forecast on a regional level. The QUBE-projects members already developed some thoughts to establish a forecasting model for the demand of labour differentiated between industries, occupations, qualifications and regions, but we have not implemented them yet. Nevertheless, I will describe our thoughts in the following.

The IAB/INFORGE-model contains an integrated module called LÄNDER. This module is an enlargement of the analysis and forecast of the structural change in Germany to the level of the 16 states (Bundesländer). The module LÄNDER illustrates by default the development of labour within 16 industries consistent to the results on federal level.

The central data base of the LÄNDER-module is the 'National Accounts of the Länder (states)'. Additionally, the model includes industry specific information from all persons subjected to social security contributions from the employment history of the Federal Employment Agency (BA). The core of the model is the explanation and projection of dynamic differences between greater regions and Bundesländer respectively and the federal level. This happens through a bottom-up method on sectorial level. To explain the dynamic differences, it has to be analysed how historically observable developments in region specific sectors within a specific industry can be explained by region specific differences, e.g. demographical factors or incomes. The detected influence structure is then used to forecast the regional development. From a methodological point of view, we can consider the module LÄNDER as a regression analytical analogue to the classic shift-share approach. The structural block of the model finally determines the gross value added, the amount of employed persons, the labour force and wages of the employed persons differentiated into 14 sectors. Based on the structural block, we have a macroeconomic block with the aim to determine and extrapolate the development of the region specific incomes. Those region specific incomes are then used as a potential explainer of dynamic differences in certain economic sectors.

After extrapolating the development of the labour force in sectors and states (Bundesländer) consistent to the federal level, we estimate the regional development of the labour force, disaggregated to qualifications and major occupational fields. As data sources, we use the German microcensus and the employment history of the BA to identify the distribution of the labour force in sectors, qualifications and major occupational fields. The structure of the labour force in sectors,

qualifications and major occupational fields is then extrapolated on the federal level. Hereby we assume that e.g. a proportional increase of the major occupational field 'technical scientific occupations' on ISCED level 5 and 6 in the processing industry on the federal level has an proportional effect on the increase of this occupation at the same ISCED level in the production sector in the corresponding state (Bundesland). Because we use the module LÄNDER to estimate the development of the labour force demand in sectors within the states, we are able to project the development of the labour force broken down into sectors, qualifications and major occupational fields corresponding to the approach on the national level. The development on the state level is then adjusted to the development on the federal level.

4.5. Conclusions and recommendations

Given the experience on the forecasting method implemented by IAB and forecasting in general, there are six recommendations to conclude with. The first four recommendations concern the methodology of forecasting, the fifth pertains to the planning process and the last one applies to the communication of forecasting results.

The first recommendation may seem very trivial: it is absolutely necessary to consider both labour market aspects, the supply and the demand of labour, to draw conclusions about the future labour market development. However, by studying the political and public discussion, it seems that this recommendation is often ignored. In the German case for example, newspapers lately report repeatedly Germany would suffer from a labour shortage of about six million persons in 2025. If we have a closer look on the study itself, we can see that the result is based on a pure supply approach with constant participation rates and a migration balance of zero. It is completely disregarded that the demand of labour will also decline given a decrease of the population and labour supply. The same also holds for independent demand forecasts: information on growing or declining sectors or occupations may be interesting from a scientific point of view, but for policy recommendations it has to be compared with the corresponding development on the supply side.

The necessity to consider both the demand and supply of labour leads to the second recommendation: *the balance of supply and demand requires on the one hand common databases on both sides and on the other hand a variable that can be meaningful interpreted and projected by both demand and supply models.* In Germany, it has not been possible to forecast occupations for a long time. The classifications of occupations from 1988 and 1992 did not distinguish enough to forecast on occupational level, because employers could choose from persons with different kinds of vocational education and training for a job that required a certain combination of tasks. For this reason, demand forecasts focused on the projection of tasks rather than occupations. However, this resulted in another

problem: it was now possible to determine the amount of tasks that needed to be done in future but there has been no information about a potential supply that could examine these tasks. Only since the construction of the BIBB-Occupational Fields[22] it has been possible to model the supply and the demand of occupations and to compare the results with each other.

If someone likes to focus on the future labour market as a whole, it is not only necessary to compare both labour markets but also – and this is the third recommendation – *to link both sides with each other*. However, it is still possible to gain meaningful insights by balancing the demand and supply forecast of two independent models based on the same database and taxonomy because labour market imbalances can be identified (e.g. a gap between supply and demand for a specific occupation can indicate a possible skill shortage). But one should not interpret a situation where supply and demand equal each other as an ideal state with full employment. This would only be the case if we assumed perfect labour markets with no friction. In reality, we would observe anticipatory reactions that would resolve the situation. In this case, it is expected that wages will increase relatively if a skill shortage occurrs in a certain occupation or they will fall relatively in the case of a skill oversupply. Raising wages will mount pressure on employers, so they will try to improve their production processes for productivity gains. In the worst case, if production is no more profitable, production potentials will also be reduced. On the supply side, raising wages will increase the incentive to enlarge the work time volume and on a longer time horizon changing wage patterns will also have an effect on the vocational choices of the youth and the occupational choices of the economically active population.

Because the interaction of labour supply and demand in an integrated labour market model will be more difficult if the labour market is deeply disaggregated, I would fourthly recommend to first create both models independently and thereafter to combine both models. This has also been the procedure of the Federal Institute for Vocational Education and Employment (BIBB) and the IAB. However, experience shows that the acceptance of the results suffers slightly if supply and demand do not interact with each other because people assume that two independent models do not reflect the real development adequately.

These are the four recommendations with regards to assuring a transparent methodology for a new forecasting system (*Editor's note: system of employment forecasting in Poland*), which should be used for policy recommendations. However, if such a new model is planned, there are also other things that should be considered in the construction process. In the BIBB-IAB-Qualification and Occupational Field Projections the first communications between the project partners took place at the beginning of 2007. In 2008, we finally had the first results based on a newly defined occupational field structure. We then compared the results to other similar forecasts, improved the data generation process, changed some mi-

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22 For more detailed information please see the next Chapter.

nor part of the classifications, and had to run the models another two times until we finally published our results in June 2010 (Helmrich and Zika 2010). However, this is not representative because we had no external client and no pressure of time. But this process shows that *the necessary time to establish a forecasting system should not be underestimated*. The first results should never be published, they always have to be reviewed and possibly there is a need to adjust not only the estimation procedure but also to think over the data sources to gain the information that is really needed.

The last recommendation concerns the scope of the forecasts, meaning the interpretation of the forecasting results. Sometimes they get misinterpreted by the target group. *Long term forecasts are always conditional forecasts*. The results are only expected to come true if certain clearly specified conditions are met and hold over time. In this case, we speak of 'if-then' propositions. Long term forecasts cannot provide a picture of the future and give a likely and not susceptible development. Therefore, it is not a measure of their quality whether the future develops as projected. On the contrary, they are meant to be considered in the political decision process in a way that undesired trends are avoided. In this light, it is even desirable for forecasts to 'destroy themselves'. Projections must therefore be seen from a point of usefulness and helpfulness. This will be the case if they are interpreted with reservation and used to go against possible mismatches on the labour market. Nevertheless, sometimes people have to be reminded of this characteristic of forecasts to avoid 'overinterpretation' of the results.

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5. EMPLOYMENT FORECASTING IN GERMANY – AN OCCUPATIONAL FLEXIBILITY MATRIX APPROACH

5.1. Introduction

Since the beginning of the 1960's, the German Education Council (Bildungsrat) had the aim to investigate long term developments of the German new labour force supply by applying scientific methods. In the 1980's this task has been assigned to the German Bund-Länder Commission for Educational Planning and Research Promotion (BLK).

The BLK had been based on article 91b of the German Constitution and had published regularly long term developments of the labour market supply and demand since 1988, generally with a time horizon of round about 20 years. The calculations itself had usually been undertaken by well-respected institutes, which are still active in this field of research (1988 and 1996 Prognos, IAB; 2001 FIT and the Professors Weißhuhn and Wahse; 2006 FIT and IZA; see as well the previous Chapter). However, those studies only rudimentary contrasted supply with demand, e.g. on qualification level only, mainly because of lack of a conjoint data base[23].

The BLK was closed in 2007 and the duties were passed over to the Joint Science Conference (Gemeinsame Wissenschaftskonferenz – GWK). However, the GWK has not pursued the objective of labour demand and supply forecasts. This is why, the Federal Institute for Vocational Education and Training (BIBB) started a cooperation project with the Institute for Employment Research (IAB) to close this gap. The cooperation project is named QUBE (QUalifikation und BEruf in der Zukunft – qualification and occupation in the future) and besides the BIBB and the IAB there are as well two other institutes involved: the Fraunhofer Institute for Applied Information Technology (FIT) and the Institute for Economic Structures Research (GWS). The BIBB-IAB Qualification and Occupational Field

[23] There are also some studies one the regional level but due to very specific classifications, methods and data sources they cannot be combined and are not comparable to each other.

Projections are coordinated projections of supply and demand in the German labour market up to the year 2025/2030 with the objective of identifying potential future problem areas in qualification levels and occupations. Therefore, the projections both on the demand side and the supply side are based on the same data and taxonomy. First results of the BIBB-IAB Qualification and Occupational Field Projections have been published in 2010 (Helmrich and Zika 2010).

By considering the occupational flexibility of the labour force, the QUBE consortium is able to contrast demand with supply. Of course, this kind of balancing has to be assessed cautiously because demand and supply projections do not interact with each other at the current state of the methodology. However, the idea behind the projections is the development of an instrument for early identification of skill needs and for analysing matching processes on the labour market. Whereas the IAB focuses on influences from the demand side, the BIBB has its research interest on the supply side. It is expected to gain insides how changes of the educational system will affect the economically active population and what kind of measurements should be taken to assure an optimally trained new labour force supply.

5.2. Data and taxonomy of the BIBB-IAB qualification and occupational field projections

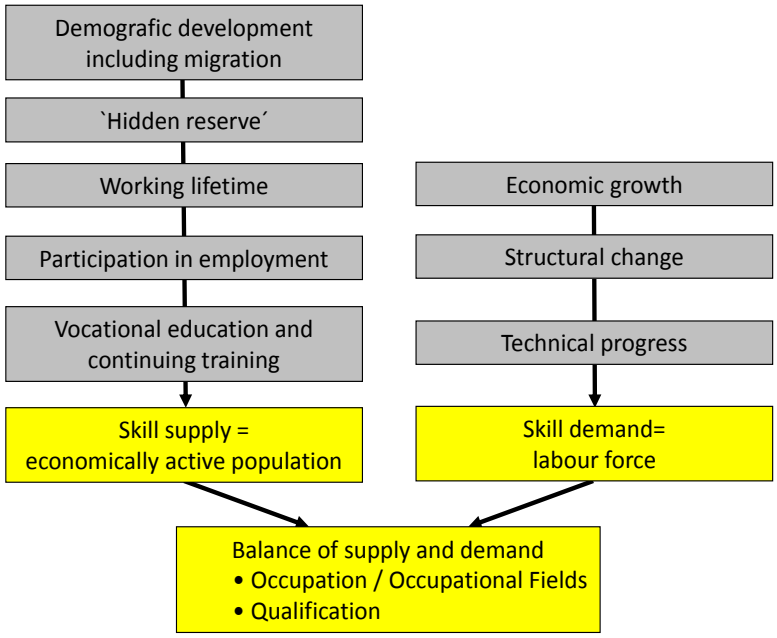
To identify potential future problem areas in qualification levels and occupations, demand and supply forecasts in the BIBB-IAB Qualification and Occupational Field Projections are based on the same data and taxonomy. The data basis and the taxonomy will be described in the following. Thereafter, we will explain the methods of demand and supply forecasts of the model set-up.

5.2.1. Data basis

Available data included in official statistics, which encompasses a sufficient cross-section of the working population whilst exhibiting the necessary degree of differentiation, forms the starting point for projections regarding the supply of and demand for workers. If we take the model shown in Figure 5.1 as our basis, the supply of the working age population is controlled by demographic components on the one hand and by levels of participation in employment on the other. This also results in a qualifications and occupationally related supply of skilled workers depending on participation in education and training.

Figure 5.1

Components of the labour demand and supply projection



Source: BIBB.

These requirements restrict the amount of official data available. The statistics on employees subject to mandatory social insurance contributions produced by the Federal Employment Agency do not include civil servants, the self-employed, family members who help out in businesses or staff working a small number of hours each month (persons in marginal employment). In addition to this, no inventory count exists which maps the training specialism of persons in active employment.

Although educational data included within the official statistics (higher education, vocational education and training) is based on inventory counts and shows the new labour force supply from the educational system for the labour market, it does not provide any information on participation in employment, on active employment or on persons without a formal qualification.

The microcensus is the sole source of official representative statistics on the population and labour market in Germany. It provides information on such aspects as population structure, the economic and social position of the population, employment activity, job search and representative data on the specialism of the highest vocational qualification obtained for the entire working age population in Germany across all educational areas. ‘The microcensus serves to provide statisti-

cal information on the population's economic and social conditions and on employment, the labour market and education (multi-purpose sample). It updates the results of the population census. It is also used to evaluate other official statistical surveys, such as e.g. the sample survey of income and expenditure. The Labour Force Survey of the European Union (EU Labour Force Survey) is integrated in the microcensus'.[24]

The microcensus is, however, a sample of the population rather than an inventory count. It is an official representative statistic of the population and labour market, in which 1% of all households in Germany participate each year (ongoing household sample). A total of around 370,000 households comprising 820,000 persons take part in the microcensus. The large sample size is one of the reasons; the microcensus has now become one of the most important official data sources for empirical educational research. The large scope of samples in the Scientific Use File encompasses more than 500,000 cases and permits differentiated analyses of smaller sub-groups on the basis of such criteria as various general and vocational qualifications within the population. There is a statutory requirement to provide information to the microcensus, resulting in a very high participation rate of around 97 per cent of selected households. Together with the annual survey cycle of the microcensus, this makes the data extremely valuable for analyses of social, economic and occupational change in particular.[25]

5.2.2. Adjustment of data to national accounting level

Alongside information on occupations learned and exercised, which only the micro-census provides to a satisfactory extent, consideration is also accorded to additional information particularly supplied by the National Account System and the Coordinated Population Forecast. The stated data sources are partially based on different surveys, whereby the marginal distributions of the actively employed population are not congruent between the various sets of statistics. The problem within this context is constant underestimation of persons in active employment in the microcensus (approximately 2 million in 2005) compared to the calculation of the number of persons in active employment in the National Account System (see Köhne-Finster and Lingnau 2008). This discrepancy is not negligible and gave rise to the alignment of the data via an iterative marginal total adjustment procedure[26]. This process involved a re-extrapolation of the figures for the number of

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[24] German Federal Statistical Office; http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/EN/Content/Statistics/Mikrozensus/Aktuell.psml (last access: 06.01.2012).

[25] CEDEFOP coordinates a European-level medium-term forecast of skilled worker requirements according to qualification level and occupations. In Germany, the microcensus forms the national basis for this 'Labour Force Survey'. In its capacity as national representative, BIBB is involved in this work on the supply side.

[26] For more details, see Bachem and Korte (1979).

persons in active employment produced by the microcensus to the figures for the number of persons in active employment resulting from national accounting in accordance with 59 branches of trade and industry, whereby the respective marginal totals of the population as a whole for the characteristics of age, gender, educational level (ISCED) and initial vocational qualification within the microcensus were kept constant. This restrictive approach ensures that the structure of the microcensus, which is central to the projections, is retained.

5.2.3. Initial vocational qualification (occupation learned)

The aim of the 'initial vocational qualification' concept, which has been developed by BIBB, is to map the vocational qualification of the labour force in accordance with the specialism of the highest initial or continuing training qualification achieved within a standardised classification system. This represents the first time that all prerequisites have been in place with regard to being able to map the vocational qualification of all persons within the working age population aged 15 and above in accordance with a uniform classification system which integrates all areas of vocational training.

The fact that it has been possible to implement the concept of the initial vocational qualification, which is based on the alignment of approximately 3,500 positions contained within the catalogue of initial and continuing training and higher education specialism used for the microcensus to the 2,287 occupational classes in the 1992 Federal Statistical Office Classification of Occupations, means that microcensus data from 2005 onwards can now be used to picture horizontal and vertical occupational flexibility according to specialism. All vocational qualifications acquired within the educational system can for the first time be set in relation as an occupation learned to occupations exercised within the employment system.

5.2.4. Occupation exercised and qualifications

Alongside the initial vocational qualification, the occupation exercised is the key benchmark for representing the demand. The occupation exercised is the result of the matching process on the labour market and represents realised supply in the correlation between supply and requirements. Occupation exercised is available within the microcensus for all persons in active employment recorded and for unemployed persons in the form of their most recent occupational activity. This characteristic is also present in the 1992 Classification of Occupations (KldB92).

On the level of qualifications, the population was differentiated into four skill levels (as measured by highest formal qualification) following the ISCED classification framework (OECD 1997) – see Chapter 4.2.2.

5.2.5. Taxonomy: BIBB-Occupational-Fields

Data relating to active employment is of particularly great relevance for the projection of future labour force requirements. In the microcensus, such data was collected for occupation exercised on the basis of the Classification of Occupations (1975 or 1992), and has also been recorded for occupation learned since 2005. The degree of detail of information in the micro-census on occupation exercised or on the specialism of initial or continuing training on the basis of the Classification of Occupations is, however, too finely meshed for longer-term qualifications and labour market projections in particular. Projections which encompass developments on the labour market within a time frame of up to 15 years are in academic research terms not capable of serious implementation at the level of individual occupations. For this reason, the Working Group on Qualifications and Labour Market Projections at BIBB has used the 369 occupational categories (3-digit code) of the KldB92 produced by the Federal Statistical Office as a basis for consolidation into 54 occupational fields (Tiemann et al., 2008).

This process uses the central criterion applied by the Federal Statistical Office for the grouping of occupations 'which are essentially similar in terms of their occupational task and activity regardless of formal school-based or vocational training and of their standing within the occupation or the company' (Statistisches Bundesamt, 1992: 16). Affinity of activity is thus the key criterion for delineation between occupations. The criteria deployed for aligning occupations to occupational categories included the particular characteristics of materials processed, a specific occupational milieu, a specific object of occupational activity etc. (Tiemann et al., 2008: 5). In defining the BIBB occupational fields, the occupational groups (2-digit code) were studied with regard to similarities in terms of activities exercised within their encompassing occupational categories (3-digit code) and grouped accordingly (see Table 5.1). In this way, it was ultimately possible to define 54 occupational fields for the qualifications and labour market projections and for the analysis of occupational changes and flexibilities in particular (changes between occupation learned and occupation exercised). These occupational fields (OF) were further aggregated in relation to a superordinate trend prediction to form 12 major occupational fields (MOF) and 3 top-level occupational domains (OD).

Table 5.1

Definition of the BIBB-Occupational Fields, Major-Occupational Fields and Occupational Domains according to the main focus of activity

3 top-level Occupational Domains	12 Major Occupational Fields (main focus of activity microcensus)	54 Occupational Fields	Main focuses of activity microcensus
Production-related occupations Occupational fields: 1–13, 15, 17, 18, 20, 42	Raw material extraction occupations (*2*)	1, 2	Harvesting (*2*), supplying (*3*), processing and manufacturing (*4*), repairing (*6*), controlling and maintaining machines (*1*)
	Processing, manufacturing and repair occupations (*4*, *6*)	3, 7, 9, 10, 11, 13, 15, 18, 20, 42	
	Occupations involving the control and maintenance of machines and plants (*1*)	4–6, 8, 12, 17	
Primary service occupations Occupational fields: 14, 16, 19, 27–30, 32–34, 36, 37, 39–41, 43, 53, 54	Occupations involving the trading and sale of goods (*5*)	27, 28, 30	Commercial activities (*5*), office activities (*7*), general services such as cleaning (*19*), entertaining guests (*12*), warehousing (*18*), transport (*18*), security (*20*)
	Occupations involving traffic, warehousing, transport, security, guarding (*18*)	19, 32, 33, 34, 41, 43	
	Hotel and restaurant and cleaning occupations (*12*, *19*)	14, 16, 53, 54	
	Office, commercial service occupations (*7*)	29, 36–37, 39, 40	
Secondary service occupations Occupational fields: 21–26, 31, 35, 38, 44–52	Technical and scientific occupations (*9*, *7*, *8*)	21–26, 38	Researching (*8–9*), developing (*8–9*), organising (*10–11*), managing (*10–11*), applying and interpreting the law (*13*), providing support (*16*), healing (*16*), caring (*16*), advising (*15*), teaching (*14*), journalism (*17*), entertainment (*17*)
	Legal, management and economic occupations (*11*, *13*, *15*)	35, 44	
	Artistic, media, humanities and social science occupations (*17*, *10*, *9*)	31, 45, 46, 51	
	Health and social occupations, body care providers (*16*)	47–49, 52	
	Teaching occupations (*14*)	50	

Source: Bott et al., 2010; own illustration.

5.2.6. Statistical population

The starting point is the whole population (Germans and foreigners) whose place of residence is in Germany. A relevant restriction which should be mentioned at this point is that those whose place of work is abroad despite the fact that they are resident in Germany have had to be excluded. At the same time, however, given the circumstance that those who live abroad and work in Germany are not recorded in the microcensus (principle based on place of residence), it has not thus far proved possible to calculate this ‘minor border traffic’ sufficiently.

Assuming a total statistical population of approximately 82.5 million persons, these are sub-divided into three major groups:

1. Non-working age population aged up to 15 (around 11.5 million persons);

2. Working age population (around 55.1 million persons). From the age of 16 and above, everyone is potentially an active worker in accordance with their (vocational) qualification (irrespective of their actual propensity to seek employment). Pupils, students, trainees and others who have not learned an occupation are considered unskilled. Occupation learned is represented via the highest vocational qualification acquired. Economically inactive persons not available to the labour market are also included and are considered together with occupation learned insofar as relevant.

Persons of working age together with their respective rates of employment are the only objects of interest for the projection. These are divided into persons in active employment and non-employed persons. The following information is available for these groups of persons:

– Age

– Gender

– Initial vocational qualification (coded according to KldB92, including persons without training)

Active employment also enables the respective rate of employment and occupation exercised to be determined;

3. Non-working age population aged 65 and over (around 15.9 million persons). Older persons leave active employment in accordance with age related or occupationally specific rates of employment. Since active employment is also recorded after the statutory age of retirement, these persons are also included in the projections.

To make the available structural information for demand and supply forecasting in Germany clearer, Table 5.2 shows a breakdown of the German population according to relevance for the labour market. All fields *marked light grey* reflect the essential information for the supply forecast: economically active and inactive population by age, gender, skill level and vocational education and training (VET) within 12 major occupational fields (MOF)[27]. The necessary information for the demand forecast is *marked dark grey*: persons in employment within 59 economic sectors and 12 MOFs. The distribution of the labour force from education into employment within 12 MOFs is represented by an occupational flexibility matrix (*marked black*). For the forecasting period, the amount of potential unemployed persons can be derived by simple definition: labour force minus persons in employment.

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[27] Mainly for presentational but also for methodological reasons, initially results are only reported on the level of the 12 major occupational fields (MOF), which are similarly based on the BIBB occupational fields (OF) (Bott et al., 2010)

Table 5.2

Structural information for demand and supply forecasting

					Demand within 59 economic sectors Persons aged over 15 in employment within 12 MOF, disaggregated by 4 skill level **1 2 3 4 5 6 7 8 9 10 11 12**	Unem-ployed		
Supply by age cohorts and gender	**Persons aged under 16 (Pre-school, general schooling)**	**Qualification (4 skill levels) and vocational education and training (VET)**	VET within 12 MOF (ISCED 3b-6)	1	**occupational flexibility matrix**	By definition: (labour force) – (persons in employment)	Economically inactive	Following retirement, aged over 65 (some still part of the workforce)
				2				
				3				
				4				
				5				
				6				
				7				
				8				
				9				
				10				
				11				
				12				
			No VET (ISED 0-3a)					
			(Still) in training					
	~11,5 million				~36,1 million	~36,1 million	~36,1 million	~36,1 million
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>age cohorts and status>>>>>>>>>>>>>>>>>>>>>>>>								

Data source: Microcensus 2005 of the German Federal Statistical Office; own illustration.

5.3. Methodology of the supply forecasts

The labour supply projection was calculated with two independent models with the aim of model plurality, both of which, like the demand projection, were based on the same classification schemes and data generation runs. These consist of the BIBB-DEMOS model from GWS, which has certain points of overlap with the IAB-INFORGE model and the BIBB-FIT model, an established model from FIT, already in use for the well-known forecasts by the 'Bund-Länder Commission for Educational Planning and Research Promotion' (BLK 2001).

In addition to the information on educational participation and participation in employment from microcensus data, the absolute change and relative fluctuation of age cohorts, in which women and men are shown separately, are derived from the 12th Coordinated Population Forecast by the German Federal Statistical Office (Statistisches Bundesamt, 2009). We use variant 1W1 with slightly rising life expectancy, positive net immigration of 100,000 persons annually and constant birth rates. Although migrants appear in the microcensus in a time-delayed manner and

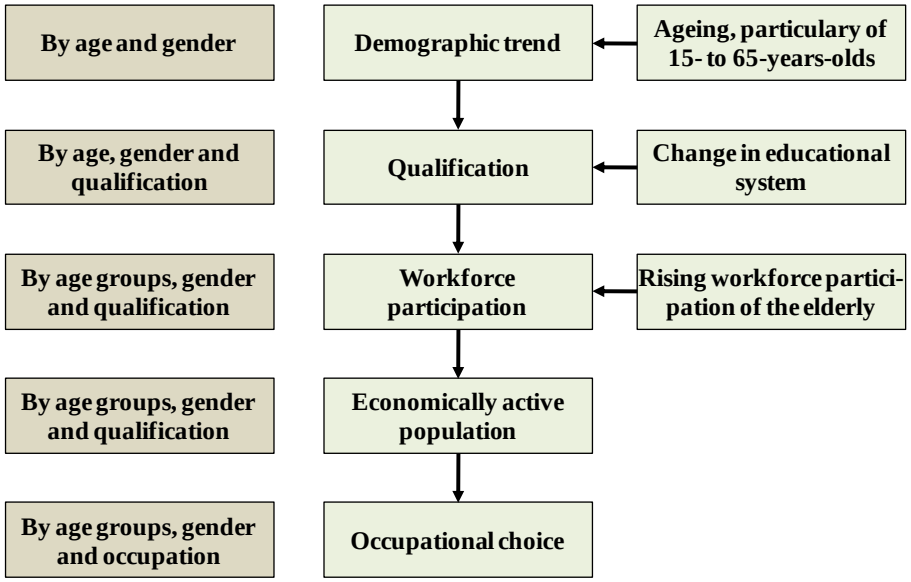
can be included in the projections in future, no knowledge of their qualifications has until now been available[28]. For this reason, they are treated in the same way as the indigenous population in the projections. Both models allow for the adjustment of the new standard pension age from 65 to 67 but still take account of active members of the workforce over this age. The forecasts in 2010 and 2011 (1. and 2. wave) are calculated with the described models. In 2012, we will combine both supply models and endogenise supply and demand (see section 5.5).

5.3.1. BIBB-DEMOS model

The BIBB-DEMOS model (Drosdowski et al. 2010) determines the labour supply, taking several interconnected processes into account. The demographic trend determines the distribution across age-cohorts and gender as well as the size of the potential labour force, namely the number of people aged over 15. Connected to this is the qualification process (4 skill levels), which is notable for a rising level of qualification, particularly among women, and which also determines the length of time taken for education.

Figure 5.2

Schematic illustration of the BIBB-DEMOS-model



Source: Drosdowski et al. 2010: 128.

[28] It is possible that immigrants and emigrants do not display the same qualifications as persons in active employment living in Germany. No significant data is, however, available to conduct an analysis of this topic. Most studies of German emigrants concentrate on those who are in possession of higher levels of qualification (a summary of these studies is provided by PROGNOS (2007: pp11 ff.)).

The decision to participate in the workforce is not only age- and gender-specific but also dependent on the formal qualifications achieved. Workforce participation is also subject to changes over time. On the basis of this information, the choice of an educational specification, an initial vocational qualification within the determined 54 occupational fields, is made. It is ultimately the outcome of a gender-, qualification- and age-specific distribution (see Figure 5.2).

5.3.2. BIBB-FIT model

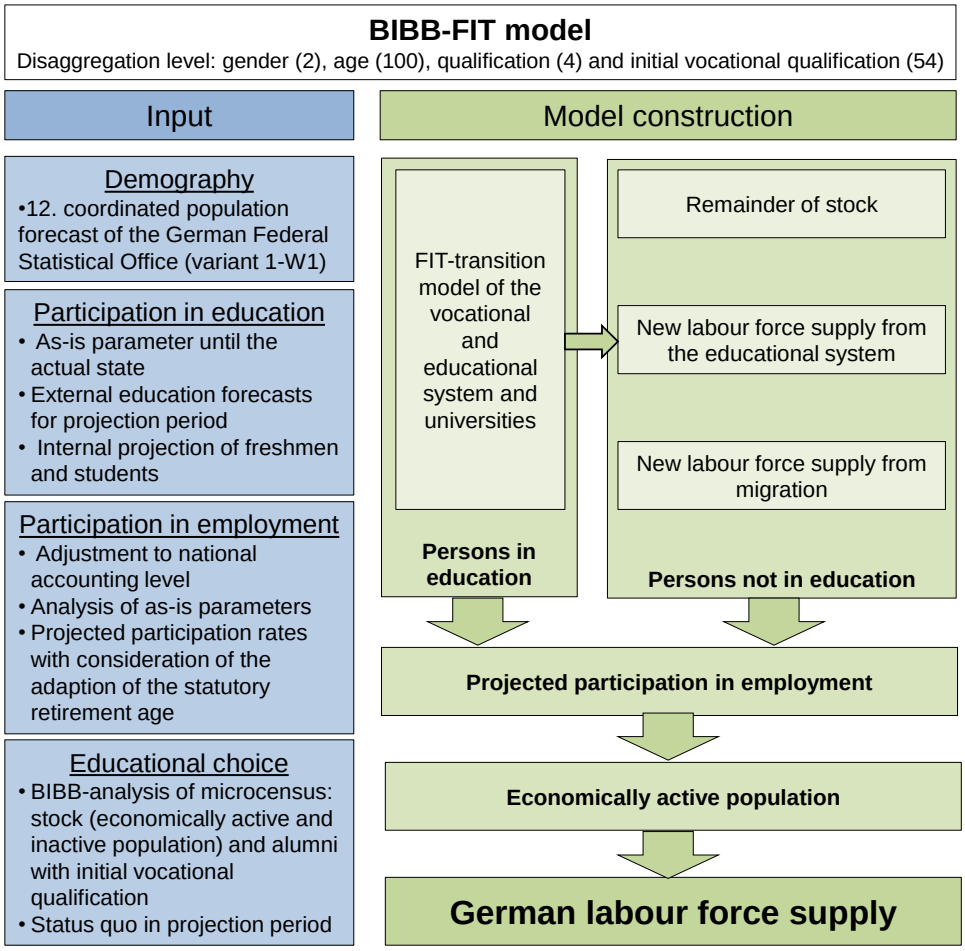
The BIBB-FIT projection is based on several transition models in which, taking a baseline population as a starting point, future stocks of labour force are modelled by means of entries and exits. The chosen approach thus relies on three basic elements: a population projection, a transition model of the education and training system to quantify the new labour force supply, and an analysis of workforce participation to determine the remainders.

The projection of the new labour force supply from the VET system in terms of 4 skill levels and 54 occupational fields is based on modelling the VET system including higher education establishments in a way that reflects the numbers enrolled at the individual training establishments as well as the transitions to and from the individual educational establishments and the labour market. This model builds largely on concepts and results from the IAB system of educational accounting (*Bildungsgesamtrechnung, BGR;* Reinberg and Hummel (2002)) as well as on the benchmarks of the projection of school pupils and leavers by the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder (*Kultusministerkonferenz*, KMK) and of the KMK projection of university entrants from the year 2009 (KMK 2009).

The prospective new labour force supply from the education system and migration is, however, only one of the factors that influence the future qualification structure. It will also increasingly be determined by those who exit from employment. Here, in particular, the assumptions made about future qualification-, age- and gender-specific workforce participation also come to bear. The rapid expansion in workforce participation in past years is extrapolated only moderately in the projection. To differentiate between occupations, classification of both the existing labour force and the new labour force supply according to occupational field was undertaken and extrapolated for the projection period (see Figure 5.3).

Figure 5.3

Schematic illustration of the BIBB-FIT model



Source: FIT.

5.3.3. Bringing demand and supply together

The microcensus sample 2005 was the first year of the microcensus surveys that allowed the reconstruction of an 'initial vocational qualification' of the labour force by coding the specialisation of persons during their education into the occupational classification scheme KldB 92 (see section 5.2.3). Using this information, it was possible to compute, on the one hand, shares of people who worked within the MOF they have originally been trained in – the so-called stayers – and, on the other hand, shares of people who moved away from their initial occupation

into another MOF – the so-called movers. This occupational mobility is reflected by an occupational flexibility matrix (*see black box in* Table 5.2 and Table 5.5) which is helpful in bringing demand and supply projections together. The occupational flexibilities are assumed to be stable for the whole forecasting period[29] for 4 skill levels and 3 age cohorts (15 to 34, 35 to 49 and 50 +; see also Maier et al. 2010). Hence, future participants of the labour force are distributed into the 12 MOFs according to their education-specific ('initial vocational qualification'), skill-specific (highest formal qualification) and age-specific occupational flexibility. The results of the projections are described in the following section.

5.4. Results of the BIBB-IAB qualification and occupational field projections

The overall results of the demand and supply forecast can be seen in Table 5.3. Whereas the demand of labour is slightly rising from 2010 until 2020 before it goes down slowly, both supply projections forecast a strong decrease of labour supply from 2009. A theoretical labour shortage will either occur in 2023 (BIBB-FIT model) or right after the end of the projection period (BIBB-DEMOS model).

Table 5.3

Demand and supply of labour – in million

	Year				
	2005	**2010**	**2015**	**2020**	**2025**
Persons in employment (labour force) (IAB-INFORGE)	38.9	39.8	40.2	40.2	39.7
Economically active population (15+) BIBB-FIT	43.3	43.2	42.5	41.2	39.3
Economically active population (15+) BIBB-DEMOS	43.3	43.7	43.3	42.3	40.4

Source: Helmrich and Zika 2010: 19; own illustration.

Of course, it must be kept in mind that the demand and supply forecast do not interact with each other. Thus, for example, a shortage of economically active persons has no effect on the persons in employment. This is rather unrealistic because either the demand or supply side is bound to cause reactions on the other side. However, because the necessary adaptive reactions could not yet be quantified, the results may seem 'unrealistic', in total and in some labour market segments toward the end of the forecasting period. Nevertheless, such results can be considered useful as they help to identify future problem areas if the development of labour supply and demand continues as in the past.

[29] This may seem rather unrealistic in view of changing demand for and supply of skills in the future, but as no long-range information on occupational mobility (from initial vocational qualification) is available for Germany, this is the only possible and most pragmatic approach at the moment.

5.4.1. Results of skill level projections

Results on the level of skills are represented in Table 5.4. To make the results internationally comparable, ISCED 5b and ISCD 5a and 6 are grouped together into one category: 'tertiary sector'. Here, the major differences of the supply projections come to bear. Whereas BIBB-DEMOS extrapolates a long term qualification trend and therefore only a slight increase in persons at ISCED 5 and 6, BIBB-FIT puts a stronger focus on recent developments in the German educational system. The shortened duration of schooling at university-track secondary schools and the resulting double cohorts of school leavers entitled to higher education are reflected in a rising supply of academically qualified new entrants to the workforce, if a constant ratio of university entrants is maintained. Compared to new entrants into the labour force, persons leaving the workforce have a higher share of completed VET (ISCED 3b and 4). In consequence, the supply of persons with ISCED 3b and 4 will diminish in contrast to persons with ISCED 5 and 6.

Table 5.4

Results of qualification projections – in millions

Persons in employment/labour force (IAB-INFORGE)					
	2005	**2010**	**2015**	**2020**	**2025**
ISCED 1,2 & 3a	5.9	5.7	5.6	5.5	5.3
ISCED 3b & 4	20.6	21.3	21.5	21.6	21.3
ISCED 5a, 5b & 6	10.0	10.2	10.4	10.4	10.3
(Still) in training but working	2.3	2.5	2.7	2.7	2.7
In Total	38.9	39.8	40.2	40.2	39.7
Economically active population (15+) BIBB-FIT					
ISCED 1,2 & 3a	7.3	7.1	6.7	6.3	5.8
ISCED 3b & 4	23.1	22.9	22.2	21.0	19.5
ISCED 5a, 5b & 6	10.5	11.0	11.5	11.9	12.1
(Still) in training but willing to work	2.5	2.2	2.1	2.0	1.9
In Total	43.3	43.2	42.5	41.2	39.3
Economically active population (15+) BIBB-DEMOS					
ISCED 1,2 & 3a	7.3	7.3	7.1	6.9	6.6
ISCED 3b & 4	23.1	23.4	23.2	22.5	21.5
ISCED 5a, 5b & 6	10.5	10.7	10.9	10.8	10.5
(Still) in training but willing work	2.5	2.3	2.1	2.0	1.9
In Total	43.3	43.7	43.3	42.3	40.4

Source: Helmrich and Zika 2010: 21–26; own illustration.

If the status quo persists, people without completed VET will continue to be affected by high underemployment. As far as the medium-skilled level is concerned, the results indicate that there will be a future shortage of labour occurring either between 2015 and 2020 (BIBB-FIT) or towards the end of the projection period (BIBB-DEMOS). The results do not indicate whether there will be a skill

upgrade in the demand of certain jobs or whether the highly-skilled will be employed inadequately if they try to fill the gap on the medium-skilled level. The status quo forecasts only tell us that there will be either an extremely tight labour market for the highly-skilled (BIBB-DEMOS) or an over-supply (BIBB-FIT) if the demand and supply of skills develop as in the past but independently from each other.

5.4.2. Results of occupational field projections[30]

If we look at the demand for labour in the 12 defined MOFs and we consider only persons with a completed educational specialisation for those 12 MOFs, we can see that there was already a massive theoretical labour shortage at the beginning of the projection period in 'occupations involving the trading and sales of goods', 'occupations involving traffic, warehousing, transport, security, guarding', 'hotel, restaurant and cleaning occupations' and 'office, commercial service occupations' (see *dark bars* in Figure 5.3). Otherwise, there was also an excess of labour supply in 'processing, manufacturing and repair occupations' and 'technical scientific occupations'. This is possible because occupational flexibilities and persons without a completed VET qualification are not considered in Figure 5.3.

The occupational flexibility matrix is an essential tool to compare the results on the demand and supply sides on the occupational level. The mobility matrix (Table 5.3) shows that persons with not completed VET[31] (ISCED 0–3a) mainly move into 'processing, manufacturing and repair occupations' (16.1%), 'occupations involving the trading and sales of goods' (11.3%), 'occupations involving traffic, warehousing, transport, security, guarding' (15.1%), 'hotel, restaurant and cleaning occupations' (25.5%) and 'office, commercial service occupations' (10.8%). Except for 'processing, manufacturing and repair occupations', persons with no completed VET mainly move into occupations, where the demand could not be satisfied by medium- or highly-skilled persons (see Figure 5.3). The great inflow of low-skilled workers into 'processing, manufacturing and repair occupations' goes hand in hand with a great outflow of 15.6% persons originally trained in this MOF into 'occupations involving traffic, warehousing, transport, security, guarding'. The gap between demand and supply in 2005 in 'occupations involving traffic, warehousing, transport, security, guarding', stated in Figure 5.3, was therefore filled by low-skilled persons and persons with vocational education in 'processing, manufacturing and repair occupations'. This also explains the excess labour supply in 'processing, manufacturing and repair occupations': more than

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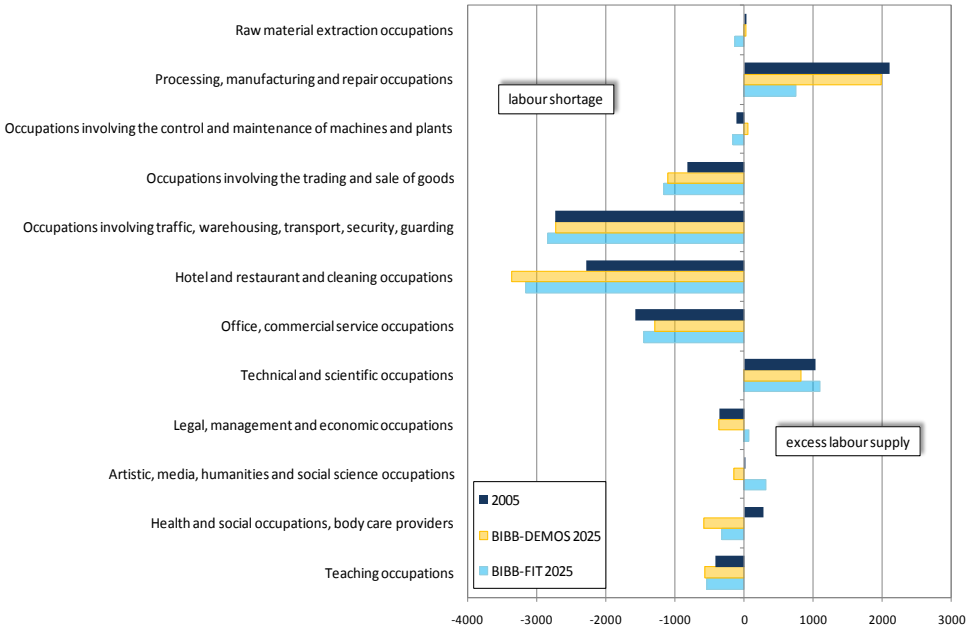
30 This section presents the results of our forecast published in 2010. Newer results will soon be available on www.qube-projekt.de. However, they do not differ significantly from the results published in 2010.

31 People in this category cannot be assigned to a skilled initial vocational qualification.

half of persons who had originally been within this MOF did not work in their MOF, but moved into other occupational fields instead. Likewise, in 'technical and scientific occupations', only 52% of the employed persons in 2005 with a technical and scientific background worked within the MOF of 'technical and scientific occupations'. However, the flexibility matrix does not contain information why those people left their trained occupation. Occupational mobility can occur for several reasons, e.g. unemployment in the occupation people have been trained for, or better wages in other occupations (see Maier et al., 2010: 156 and the following). The occupational flexibility matrix thus gives no explanation for the mobility but makes it possible to show which kinds of opportunities are connected with a vocational education in a certain occupation and where competitive situations between occupations can occur.

Figure 5.3

Total demand in MOFs and supply of trained persons (ISCED 3b-6)



Source: BIBB-IAB Qualification and Occupational Field Projections, www.qube-projekt.de; own illustration.

Table 5.5

Occupational mobility

No. of MDF	Vocational education and training (VET) (ISCED 3b-6) in one of the following "major occupational fields" (MOF)	Percentage values for change from VET-MOF into other MOFs												
		MOF 1	**MOF 2**	**MOF 3**	**MOF 4**	**MOF 5**	**MOF 6**	**MOF 7**	**MOF 8**	**MOF 9**	**MOF 10**	**MOF 11**	**MOF 12**	**Σ MOF**
1	Raw material extraction occupations	**49.5**	8.6	3.0	6.3	12.8	6.1	5.1	2.6	2.1	0.7	2.3	0.9	100.0
2	Processing manufacturing and repair occupations	1.9	**46.3**	7.8	6.2	15.6	5.7	4.2	7.4	2.0	0.9	1.5	0.5	100.0
3	Occupations involving the control and maintenance of machines and plant	1.3	14.0	**44.3**	5.2	11.9	4.7	4.4	7.8	2.0	2.4	1.7	0.4	100.0
4	Occupations involving the trading and sale of goods	0.8	2.9	1.2	**50.4**	6.2	9.5	19.8	1.3	3.4	1.1	3.1	0.4	100.0
5	Occupations involving traffic, warehousing, transport, security, guarding	1.1	6.1	2.0	4.3	**65.3**	3.8	11.5	2.2	1.4	0.5	1.3	0.5	100.0
6	Hotel and restaurant and cleaning occupations	3.1	5.0	2.6	9.7	8.2	**56.4**	7.3	1.1	1.8	0.5	3.7	0.7	100.0
7	Office, commercial service occupations	0.5	1.2	0.5	8.6	3.7	3.5	**71.3**	2.0	4.8	1.1	2.3	0.5	100.0
8	Technical and scientific occupations	0.7	8.9	3.3	5.0	4.1	2.3	8.0	**52.0**	7.3	3.2	1.7	3.5	100.0
9	Legal, management and economic occupations	0.2	0.8	0.2	7.3	2.3	1.5	26.0	4.2	**49.3**	4.1	1.4	2.7	100.0
10	Artistic, media, humanities and social science occupations	0.3	2.2	0.8	6.1	2.3	2.8	10.2	5.1	5.9	**46.9**	4.3	13.0	100.0
11	Health and social occupations, body care providers	0.4	2.1	0.4	3.9	1.7	4.0	6.3	0.8	1.1	0.9	**74.6**	3.7	100.0
12	Teaching occupations	0.3	1.2	0.3	1.9	1.5	2.1	4.3	1.2	1.3	2.2	4.5	**79.3**	100.0
0a	No completed VET (ISCED 0-3a)	3.2	16.1	6.0	11.3	15.1	25.5	10.8	2.5	1.7	1.9	5.2	0.8	100.0
0b	(Still) at school/ in training	2.1	19.8	5.4	14.5	5.8	13.0	17.2	4.8	0.7	3.1	12.2	1.3	100.0

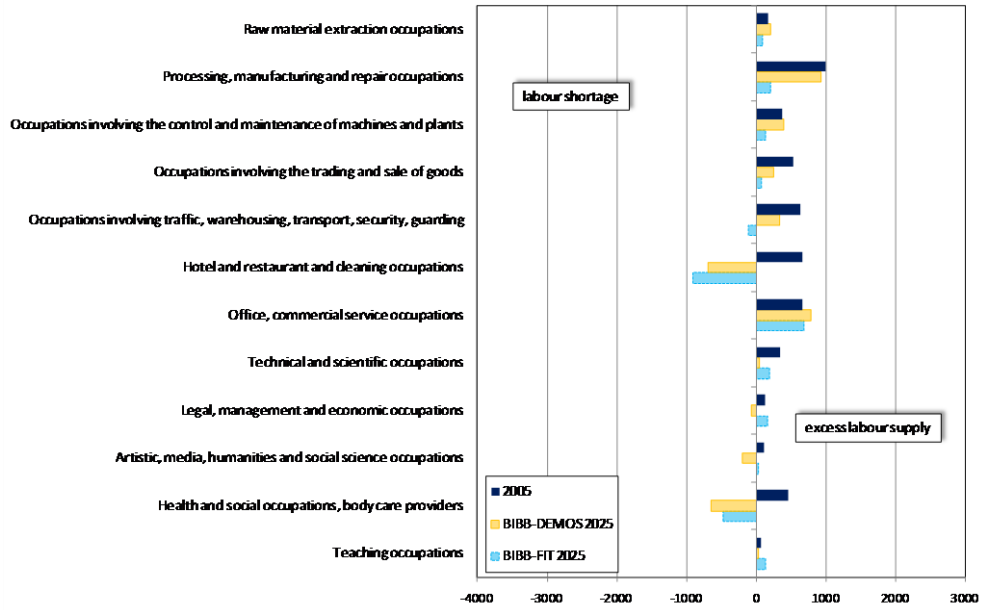
Source: Microcensus 2005 of the German Federal Statistical Office; Maier et al., 2010: 170.

Guide to reading: 7.3% of persons with vocational education in 'technical and scientific occupations' move into 'legal, management and economic occupations' (*light grey cell*).

Considering the occupational mobility processes, as computed for the year 2005, the results of occupational projections in 2025 can be interpreted as follows (see also Figure 5.4): there will be a possible shortage of labour occurring in 'occupations involving traffic, warehousing, transport, security, guarding', 'hotel, restaurant and cleaning occupations', 'legal, management and economic occupations', 'artistic, media, humanities and social science occupations' and 'health and social occupations, body care providers'. Tight labour market situations can occur in 'raw material extraction occupations', 'technical and scientific occupations' and 'teaching occupations'. Of course, the results have to be assessed with caution as they are not the outcome of an endogenous forecast of demand and supply. Nevertheless, the additional information concerning the mobility processes is helpful for a better understanding of the outcome.

Figure 5.4

Demand and supply including occupational mobility (ISCED 0–6)



Source: BIBB-IAB – Qualification and Occupational Field Projections, www.qube-projekt.de; own illustration.

The projections are based on per capita data and assume no adaption of work-time volume for the future, which could help to overcome the theoretical labour shortage in occupations involving traffic, warehousing, transport, security, guard-

ing' and 'hotel, restaurant and cleaning occupations'. 'Legal, management and economic occupations' already profit from a great inflow of persons with a different educational background. It is therefore possible that a labour shortage may be countered by a rise in occupational mobility in this occupation. Similar adaption processes may be plausible for 'artistic, media, humanities and social science occupations'. Labour shortage in 'health and social occupations, body care providers' has to be seen in a different light: due to the need for specific education within this MOF and the resulting restricted mobility into and out of these occupations, it seems that labour shortage can only be avoided by means of increased numbers of persons vocationally educated in 'health and social occupations, body care providers'.

5.5. Next steps: Integrated supply model

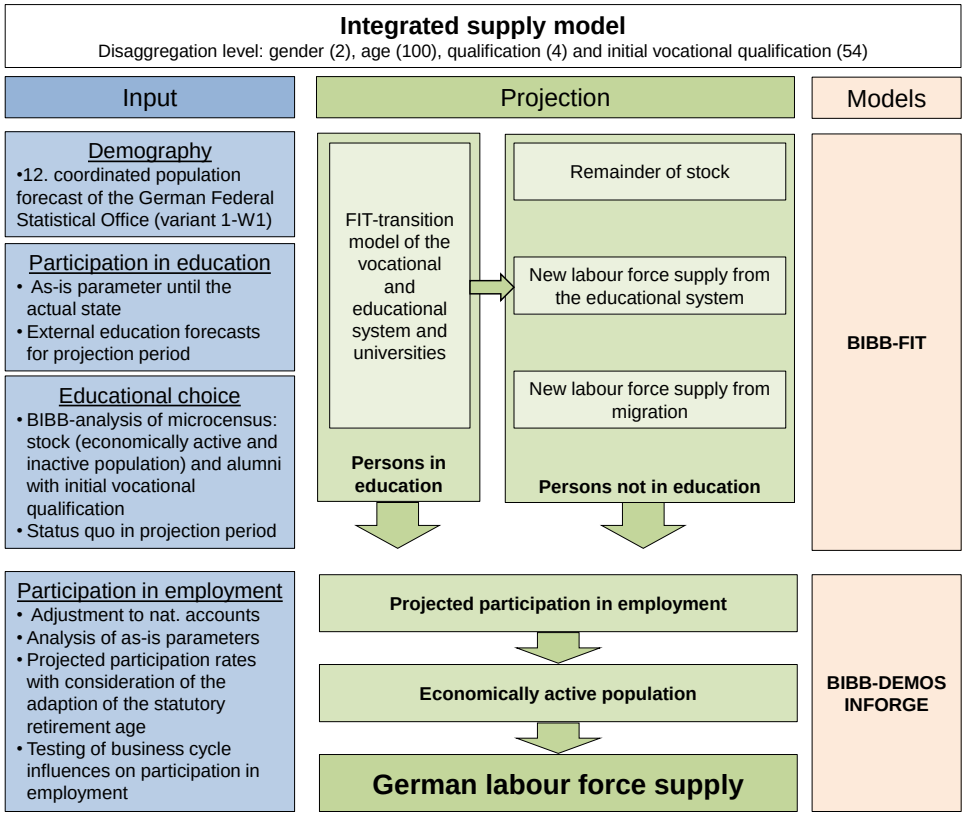
Because we did not consider any market adjustment processes at the current state of the project, we relied on two supply forecasts, based on the same classification schemes and data generation runs, to investigate the effects of different methodological approaches. This did not only lead to methodological improvements of both models, it also helped us on an evaluation of the point of view: if both models came to a similar result with a different methodology, we could be sure, that the forecasts pointed in the right direction. If we obtained different results, we had to analyse the variant assumptions of both models, namely participation in education (long term trends vs. latest development) and participation in employment (e.g. participation rates of women and the elderly). If the assumptions of both models seemed plausible, we considered the differences in the results like two different scenarios. However, as both models learned from each other during the project phase we will now combine them to one model and then establish an interconnected supply and demand model. The new structure of the supply forecast is described in Figure 5.5.

We will use the BIBB-FIT model for the supply projection of the population, differentiated into age cohorts, gender, qualification and occupation in heads until 2030. This has the advantage of explicitly modelled population and education flows that allow us to calculate different scenarios concerning the development of the educational system. The results of each year will then be used as starting data for the BIBB-DEMOS model.

Based on econometric estimated, alleviated trends, the BIBB-DEMOS model projects the participations rates differentiated for age cohorts, gender and qualifications. Furthermore, we will model the adaption of the statutory retirement age from 65 to 67 by passing on the participation rates from the 55–59 year olds to the 60–64 year olds.

Figure 5.5

Schematic illustration of the integrated labour supply model



Source: QUBE-project.

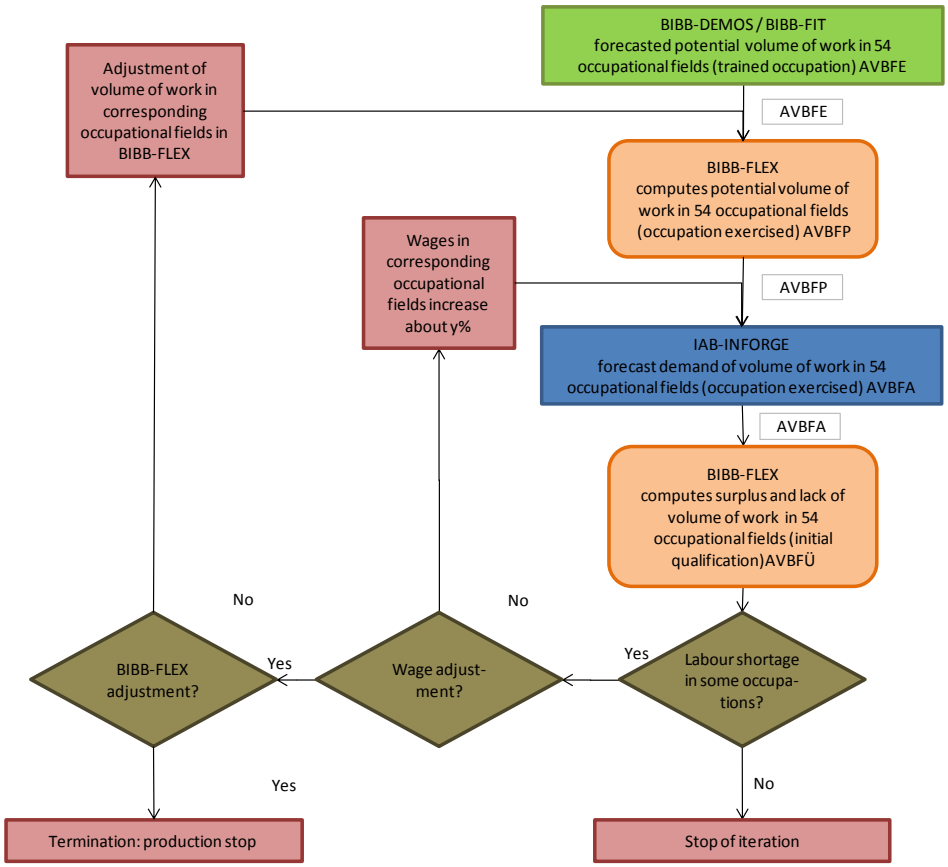
Through integration of the combined supply model into an integrated supply and demand model, we will also have a reaction from the new entrants in the vocational and educational system towards a changing demand on a long run.

The planned modelling structure of the integrated supply and demand model is described in Figure 5.6. To describe it in the simplest way – it will be a comparison of the initial vocational qualification and the occupation exercised: If the demand of an occupational field increases faster than the potential supply of persons with a qualification for this occupational field, we will observe wage increases in this occupation. In consequence, we will have a feedback on unit labour costs and therefore adaption processes within the enterprises to ensure productivity (for a more detailed explanation, please see Chapter 4.5). If this iterative process will not lead to a solution for the segmented labour market, we will observe

exogenous adaption processes, namely a changing occupational flexibility pattern. Exogenous interventions into this adaption process are only allowed if they are based on plausible assumptions, founded on empirical evidences.

Figure 5.6

Simplified illustration of endogenous interaction of the labour market supply and demand model



Source: QUBE-project.

5.6. Evaluation of the quality of the forecasts and discussion

The planning phase of the BIBB-IAB-Qualification and Occupational Field Projections took place at the beginning of 2007. In 2008, we had the first results based on the newly defined Occupational Field structure. With an ultimate man-

power of 10 persons, we finally published our results in June 2010 (Helmrich and Zika 2010). During this time, the four involved institutes contributed to the project with their specific competencies: the IAB had years of experiences in forecasting the demand of labour, the GWS had a completed model to project the economic development including the labour market, the FIT had well known experiences in modelling the supply of skills and the BIBB complemented the consortium by providing a common and unique data base and taxonomy as well as the initial vocational qualification. Even though there have already been good data sources from the microcensus and the employment history of the IAB, only the conceptualisation of the 54 homogeneous BIBB Occupational Fields and the construction of the initial vocational qualification allowed the consideration of occupational mobility behaviour in labour market forecasts. The occupational flexibility matrices can therefore be considered as the core of the BIBB-IAB-Occupational Field projections.

Of course, this planning and construction process of round about 3 years is not representative because we had no external client and no time pressure. In our case, we also set value on the evaluation of the methodology and the results to ensure the quality of our project. This means that we carried out three seminars/workshops (some of them with international attendance) during the first project phase to evaluate:

– the data sources (Summer 2007)
– the model structure (Autumn 2007) and
– the first results (Autumn 2009)

As mentioned in section 5.2.5, we only published our results on qualification level and on the level of the 12 major occupational fields, because we were not sure about the data quality on a deeper disaggregation level. Only now, after the second run of our projections and with a better data source (the new run also includes the German microcensus years 2006 to 2008), we are confident enough to publish the results as well on the level of the 54 occupational fields if desired. It also has to be mentioned that the first two initial data runs could not be published due to inconsistencies and implausible results.

In addition to the workshop/seminars and to the internal evaluation of the supply side through comparing both supply models, we also ensure constant evaluation through presentations, publications and exchange on both national and international level (e.g. we are members of the CEDEFOP skills net and also national experts in the CEDEFOP project ‘skill need and skill supply in Europe’). Because the research of the BIBB is always carried out with a practical focus, we are also keen to present our results to the social partners (trade unions and employer’s representatives) to get their opinion how they think about the projected developments. However, we finance our forecasts from the households of the BIBB and the IAB to stay independent from other influences. We always publish under assumptions what we think will be the most likely, given the past and recent developments. But we are also open to other opinions to consider them in al-

ternative scenarios; e.g. at the moment we are calculating different scenarios for the Ministry of Education and Research.

With regard to the planning process, we are trying to renew our forecasts every two years, because on a long term period we do not think that the labour market (especially the supply side) will change very fast. However, the time between the publications of the results will give us some time to investigate possible mismatching processes in more detail. As already mentioned in the introduction, we see forecasts as an instrument to identify possible problem areas in qualifications and occupations. If we identify an occupational field that seems problematic (e.g. health occupations), we have a closer look on the current development in this occupational field by analysing the unemployment rates, vacancies and (if possible) wage developments. Furthermore, we are able to have a closer look on job advertisements for the interesting occupations and if necessary, we also conduct employer surveys to find out about recruitment processes of the employers. Therefore, the projections of supply and demand are considered to be the first tool to identify and to analyse possible skill shortages in occupations and tasks. We consider this procedure as an adequate tool to gain references for vocational and educational planners, how to assure an optimally trained new labour force supply.

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Further information is also available on www.qube-projekt.de

Arnaud Dupuy

6. FORECASTING EXPANSION DEMAND BY OCCUPATION AND EDUCATION IN THE NETHERLANDS

6.1. Introduction

The project "Education and the Labour Market", abbreviated to POA in Dutch, concerns the making of forecasts of labour market developments every two years. The labour market developments are differentiated by about 127 groups of occupations and 102 types of education. Forecasts are given for a period of five years. Every second year the forecasts are made. They are reported in an informative written report for policy makers in ministries and other governmental, semi-governmental and other organizations involved in labour market issues and especially in the match between education and the labour market. There is also a digitalized dataset made available for own use, like the insertion of labour market data into all kinds of information products for study advise. During the year the forecasts are made, the models used are re-estimated on actualized input data and new scientific insights in how the labour market works. The other year is spent on preparing the specific topics presented in the different chapters of the report, the evaluation of forecasts made in the past, and the development of new labour market indicators and of new submodels.

The research is carried out by a team of about 10 researchers (4 full-time equivalents), headed by Dr. Frank Coervers. There is an advisory committee of professional experts headed by an independent chairman (university professor). Financial matters are discussed and negotiated in a committee of the financing partners.

The project was originally financed on a 5 year base. Later on a 3 year base. Nowadays, the budget and activity plan is negotiated every year. The budget is split into two parts: a base part and an additional part consisting of the delivery of information for specific users. The base part is financed now by the ministries for education and agriculture, the public employment office (UWV WERKbedrijf), and some institutes with specific tasks in the field of education or the labour market (or the match between both). Additional activities are financed by institutes producing and publishing information products for students choices, and now also by the public employment office. Parts of the dataset are sold to individual clients (for example schools, employers and other research institutes).

Purposes of the forecast

The first report of forecasting published in 1989 formulated the primary and secondary goals of the Information System for Education and the Labour Market.

"The ROA Information System for Education and the Labour Market has, at least for now, the primary goal of generating information which can be useful in choosing a course of study or an occupation. However this information system could in principle also be useful for capacity planning in the education system, and policies relating to the labour supply, the economic structure and technology, as well as the personnel policy of both the government and businesses" (De Grip et al., 1989: 1).

The original objective of generating information which can be useful in choosing a course of study and for vocational guidance implied that i) the structure of the information system needs to be suitable such that the data which are generated can assist in the educational or vocational decisions of an individual student, and ii) the information must be:

1. relevant for the students;
2. relevant at an individual level;
3. presented in such a way that students can interpret it properly.

The relevance for students means that the forecast should relate to factors which can be important in making educational or vocational choices. That is, the forecast must provide understanding of the labour market situation which a student will encounter from the moment of entering the market after the completion of studies. This requirement thus determines the period to which the forecast must refer – the period in which students will have just left school – and the group in the labour market for which they must be relevant – the school-leavers.

Since the goal is to assist in educational and vocational decision-making, the forecast must be usable in making an individual choice regarding a particular type of education or occupation. For the student facing the choice of a course of study, it is relevant to know what situation he or she may face in the labour market at the end of his education. Some developments may be very relevant, in a general sense, for a description of the labour market, but only usable for an individual if they are translated to the individual level. For instance, the total growth in employment for a particular educational category is interesting for those making policy decisions, but for a student it is more important to know what his or her individual chance of getting a particular sort of work at the end of the course may be.

For the structure of the forecast system to be usable for educational and vocational guidance, the information must be presented in an interpretable form. If they are to be usable for students, the forecast must be expressed in terms which are comprehensible for someone who is not entirely adept in labour market interpretations. The forecast results should, as far as possible, be expressed in

generally understood concepts with a minimum of statistical or economic jargon. A translation is especially important for statistical judgments regarding the reliability of the forecast. Improvements in the ease of interpretation of the labour market data can however come in two ways: it may also be sensible to improve students' understanding of the functioning of the labour market so as to improve the comprehensibility of labour market information.

Experience has shown that the forecasts are of importance not only for students but also for:

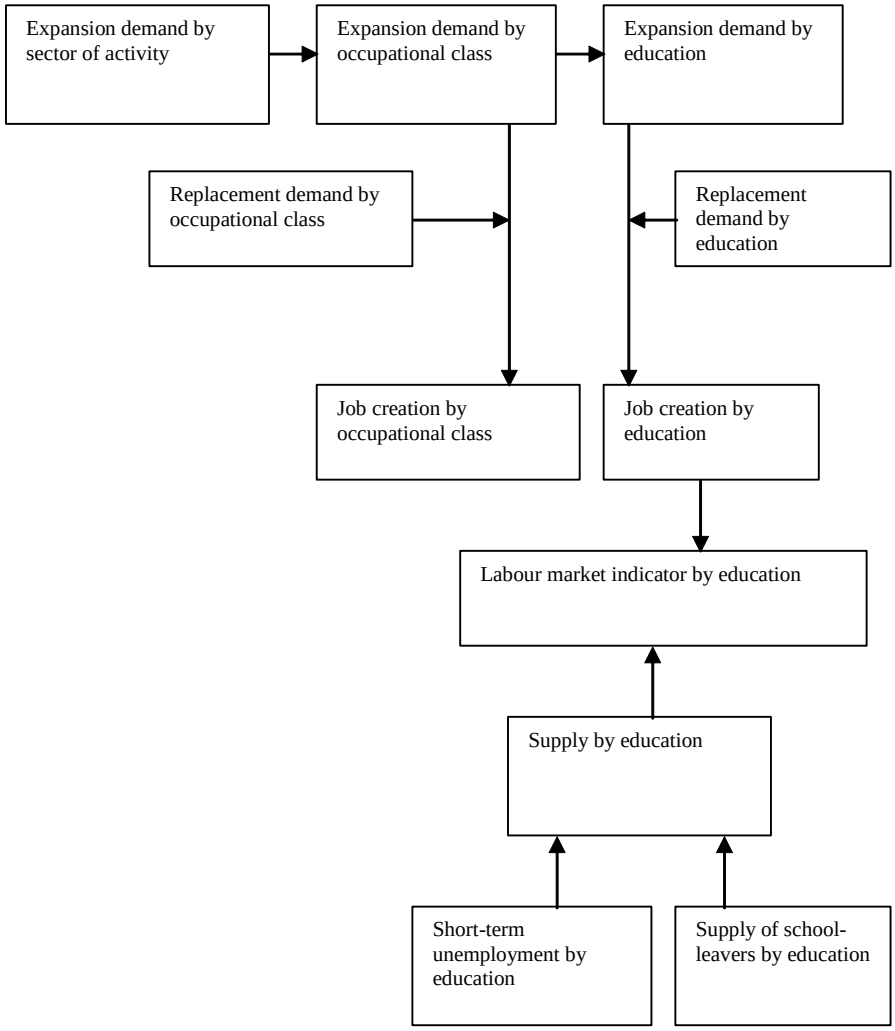
- Public and private employment offices to facilitate labour market exchange and guide training policies;
- The Ministry of Labour, career counselors and individuals parents for educational and training choices;
- The Ministry of Education, schools and Universities for educational planning;
- The Ministry of Labour for Active labour market policies for unskilled, women, youngsters, elderly, ethnic minorities, etc.;
- Employers for Human resource management, recruitment and employability;
- The Ministry of Economic Affairs for policies regarding economic and technological development;
- Individual researchers for Scientific research on labour market dynamics.

Structure of the forecast

Figure 6.1 gives a schematic overview of the structure of the forecasting method. On the demand side, the forecast of employment in economic sectors, which are obtained from the Central Planning Bureau (CPB), provide an external source of information. These forecasts are based on the so-called Athena model of CPB. At that time, these forecasts covered 22 economic sectors. The predicted numbers employed in these economic sectors are then translated into the employment in 127 occupational classes. This predicted level of demand for occupations, when compared with the situation in the reference year, yields the expected expansion demand for each occupational class. This is supplemented with a forecast of the expected replacement demand. Together, the expansion and replacement demand comprise the expected number of job openings. It is assumed that it is the number of job openings which is the relevant quantity for educational and vocational decisions. New entrants to the labour market cannot in practice simply crowd the people already working out of their jobs. On the basis of a breakdown of past flows into the labour market, a calculation is also made of how many of these job openings are available for school-leavers.

Figure 6.1

Structure of the forecasting model of the Information System on Education and the Labour Market



Source: own illustration.

The expansion demand for each occupation is translated, by means of a distribution model[32], into the expansion demand per type of education. The replacement demand for the various types of education is calculated separately,

[32] The model is described in details in the Section 6.3.

because this cannot be derived from the replacement demand per occupation. Together, the replacement and expansion demand make up the total demand for new entrants with a particular educational background.

Supply forecasts by education

In addition to the forecast of demand, a forecast is made for each type of education of the expected supply of school-leavers entering the labour market between the reference year and the last year of forecast. For each type of education, forecasts have been made of the potential flow of school-leavers onto the labour market. Several data sources have been used for these forecasts. The Ministry of Education and Sciences makes annual forecasts of the number of school-leavers from full-time and part-time education. These so-called `Reference forecasts' are differentiated by sex and age, but they are at a higher level of aggregation than ROA's categorization of types of education.

The forecasting model used is based on a transition-matrix based on the composition of full-time education and a classification of the population by level of education. Flow coefficients relate the 'origin' of students in year *t* to the 'destination' of these students in year *t+1*. By means of these flow coefficients, future numbers of students from each educational category can, step-by-step, be forecast. However, such a straightforward approach would suppose that students' choices remain unchanged during the entire forecasting period. Therefore, the flow coefficients of students who get a certain qualification are considered as strategic flow coefficients. These strategic flow coefficients are the dynamic elements of the model as they are determined by trend extrapolations of the most recent data.

As the Ministry's forecasts of school-leavers are at a higher level of aggregation with regard to the types of education, distribution keys are needed to break down these forecasts. These distribution keys are formulated from various additional data sources.

Besides those leaving school with a qualification, the reference forecasts cover students who end their studies without a diploma. With the help of education matrices for the years prior to the reference year, these school-leavers can be re-assigned to any preliminary course from which they had obtained a diploma.

A forecast is also made of the flow from post-initial education onto the labour market. This flow indicates the effects of lifelong learning on the educational structure of labour supply. Data about the inflow of `newcomers' in the labour market from post-initial education are derived from the Educational Accounts of Statistics Netherlands which builds on the underlying data from the Labour Force Survey. Due to data restriction we simply assume that in the forecasting period the proportion of workers with a particular educational background that completes a post-initial training course which gives them another educational background is the same as in the reference year for which we have data on the participation in post-initial training.

6.2. Expansion demand by occupation segments[33]

The forecast of expansion demand by sector provided by CPB and EIM (Business and Policy Research) are used as the basis for the forecasts of expansion demand by occupational segments. To generate forecasts of expansion demand by occupations, we proceed as follows:

1. First, we estimate a model of employment dynamic across sectors and occupations using the method depicted in the section 6.2.1;

2. Then, using forecasts of the exogenous variables of this model (employment by sectors, stock of R&D, stock of capital and Value added by sector) and the coefficients estimated in section 6.2.1, we derive forecasts in year $t + k$ of employment series by occupations and sector, say l_{ijt+k} ;

3. We then aggregate for each occupational segment over all sectors to obtain our forecasts of expansion demand by occupational segments, say $L_{jt+k} = \sum_i l_{ijt+k}$.

This method clearly requires first to estimate the coefficients of the model. The model requires to have access to employment time series by industry and occupation. We use data from the Labour Force Survey of the Netherlands since 1988, distinguishing between 13 sectors of industry and 43 occupations.

In the model, the employment series by sector and occupation have both a long and short run relationship with value added, capital stock and R&D stock at the sector level. The industrial data on value added and capital investments (both machinery and structures) are based on the National Accounts of Statistics Netherlands. Time series on investments in research and development (definition according to the Frascati Manual of the OECD) are published by Statistics Netherlands. These data are mainly based on R&D and innovation surveys among businesses, research institutes and universities. To calculate stocks of capital and R&D we applied the widely used Perpetual Inventory Method (PIM). Time series of investments in capital and R&D are used since 1970, with a depreciation rate of 0.08 and 0.15 respectively. The initial stock of capital and R&D is calculated as the value of investment in the first year divided by the deprecation rate plus the growth rate of investment in the first three years of the time series.

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[33] For more detailed information, we refer the reader to Corvers and Dupuy (2010). Note also that occupation is always indexed by *j* in this Chapter but index *i* is used for sector in Section 6.2 and education in Section 6.3.

6.2.1. Econometric model

Consider the following economic model of occupational employment within sectors:

$$l_{ijt} = \alpha_{ij} + \beta_{ij} t + \underline{x}_{it}^{'} \underline{\delta}_{ij} + \varepsilon_{ijt} \quad (1)$$

$$\Delta \underline{x}_{it} = \underline{\xi}_{it} \quad (2)$$

$$\underline{\xi}_{it} = \sum_{os} \underline{\gamma}_{os}^{i} \varepsilon_{ost-1} + \sum_{s} \Gamma_{s}^{i} \underline{\xi}_{st-1} \quad (3)$$

$$\varepsilon_{ijt} = \sum_{os} \eta_{os}^{ij} \varepsilon_{ost-1} + \sum_{s} \underline{\xi}_{st-1}^{'} \underline{\theta}_{s}^{ij} \quad (4)$$

where l_{ijt} is log employment in occupation j in sector i in period *t*, $\underline{x}_{it}$ is a 3×1 vector of explanatory variables for sector *i*, i.e. log capital, log R&D and log value added. ε_{ijt} is an error term for occupation j in sector i. $\underline{\xi}_{it}$ is a 3×1 vector of errors. The long run parameters are a constant α_{ij}, a trend β_{ij}, and a 3×1 vector of coefficients $\underline{\delta}_{ij}$ relating long run employment to sector capital stock, R&D stock and value added. The short run parameters are $\underline{\gamma}_{os}^{i}$ for all *o*, *s*[34] and *i* and $\underline{\theta}_{s}^{ij}$ for all *s*, *j* and *i*, 3×1 vectors of parameters specific to each combination of occupation and sector, η_{os}^{ij} for all *o*, *s*, *i* and *j*, a constant specific to each occupation sector combination and Γ_{s}^{i} for all *i* and *s*, which is a 3×3 matrix of parameters specific to each sector.

Equation (1) depicts the long run employment structure of the economy whereas equations (2), (3) and (4) depict the short term dynamics. This model is known in the econometric literature as a multiple cointegrating model (see e.g. Stock and Watson 1993 and Mark et al., 2005). In this model, l_{ijt} and x_{ijt} are stochastic processes both integrated of order 1, with cointegrating vectors $\underline{\delta}_{ij}$ specific to each combination of occupation and sector.

We estimate the restricted model using System Dynamic OLS (or SDOLS) regression techniques and in particular implement the two-step procedure

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[34] Where *o* is an index for occupation, and *s* for sector.

proposed by Mark et al. (2005). In the first step, we purge for the endogeneity problem caused by equations 3 and 4 by regressing:

i) l_{ijt} onto $\Delta \underline{x}_{it}$ to get a predicted $\hat{l}_{ijt}$ for occupation j in sector i and

ii) regress each of the explanatory variables x_{it}^{k} onto the change in all explanatory variables of all sectors, i.e. $\left(\Delta \underline{x}_{1t},...,\Delta \underline{x}_{St}\right)$.

This last regression allows us to take into account the fact that changes in the stock of capital, the stock of R&D and value added in one sector will generally contaminate the stock of capital, the stock of R&D and value added in other sectors. Therefore, for each explanatory variable *k* in sector *i* at time *t* we have a prediction $\widehat{x}_{it}^{k'}$. Stacking over *k* yields $\underline{\widehat{x}}_{it}$.

In the second step, we regress the errors $l_{ijt} - \widehat{l}_{ijt}$ of regression i) from the first step onto the errors $\underline{x}_{it} - \underline{\widehat{x}}_{it}$ of regressions ii) of the first step, that is:

$$l_{ijt} - \widehat{l}_{ijt} = g_{ij} + (\underline{x}_{it} - \underline{\widehat{x}}_{it})(\underline{h}_i + \underline{h}_j) + v_{ijt} \qquad (5)$$

where *v* is a white noise, g*ij* are occupation*sector fixed effects, whereas *hi* and *hj* are specific slopes for, respectively, occupations and sectors.

Using the estimates of the model and the predicted values of the stock of R&D, the stock of capital and the value added at *t*+5, we can estimate l_{ijt+5} and hence get a forecast of $L_{ijt+5} = \exp(l_{ijt+5})$. Aggregating over sectors for each occupation yields a forecast of demand $L_{jt+5} = \sum_i l_{ijt+5}$.

6.2.2. Results

First, as reported in Table 6.1, on average, the intersectoral dynamics account for 20% of our predicted occupational employment series. Although, large variations are observed across sectors. While our predicted employment series in the Metal industry, Paper, plastic rubber and other industries, Energy, Building trade and Hotel and catering are merely due to intrasectoral dynamics (share of intersectoral dynamics is less than 10%), our predicted occupational employment series in the Agricultural, Chemical, Transport, Banking and insurance and Governance and education sectors are to a large extent affected by intersectoral dynamics, 61%, 36%, 30%, 25% and 34% respectively.

The long run structural parameters of the model characterizing the occupational structure within sectors are reported in Table 4 in Corvers and Dupuy (2010). We interpret these parameters as the reduced from expression of a production function at the sector level. Within sectors, optimal labour demand in each occupation depends on output level, the stock of capital and the stock of R&D. The $\underline{h}_i$ and $\underline{h}_j$ parameters then reflect the elasticity of employment by sector and occupation with respect to the stock of capital, the stock of R&D and value added in that sector.

Table 6.1

Average share of short run intersectoral dynamics in the model's predictions of employment series by sector and occupation

Sectors	Share of inter-sector dynamics	Correlation[a]
1	0.61	0.49
2	0.13	0.93
3	0.36	0.79
4	0.02	0.99
5	0.04	0.98
6	0.04	0.98
7	0.04	0.98
8	0.17	0.88
9	0.30	0.78
10	0.25	0.83
11	0.08	0.96
12	0.18	0.89
13	0.34	0.70
Total	0.20	0.86

[a] Correlation between the predictions of the full model and the predictions without intersectoral dynamics.

The first block of parameters refers to the sector specific elasticities. For each explanatory variable, the F-statistics reported in Table 4 in Corvers and Dupuy (2010) indicate that these elasticities are block-significant. The elasticity with respect to value added is the largest in the building industry[35] 0.8+3.6=4.4 (significant at 5%) and the smallest in Governance and education, -3.9+0.8=-3.1. At first sight, negative elasticities with respect to value added might appear counter intuitive. However, they might arise for two reasons. First, negative elasticities with respect to value added might indicate that the production function

[35] The coefficients are relative to the reference sector × occupation, i.e. unskilled occupation in the Agricultural sector.

at the sector level is non-homothetic so that, holding input prices constant, at each output level a different mix of inputs (labour, capital and R&D) is optimal. Intuitively, think of higher isoquants as being more convex, meaning that substitution between inputs on higher isoquants is more difficult. Then, at constant relative prices, increases in output level may be achieved with a decrease in some inputs depending on technology. This means that output expansion in the Governance and Education sector for instance, could lead to increases in the stock of capital and/or R&D at the expense of employment. Although theoretically possible, it is unlikely that output expansion would be met with cuts in employment in practice. A more probable explanation for negative elasticities with respect to value added is that this elasticity in fact reflects an elasticity with respect to wages since wages are part of value added. In an attempt to test this possibility, we used wage sum data at the sector level. Unfortunately, wage sum is highly correlated with value added. Including wage sum in the model causes multicollinearity problems and therefore does not help interpreting the sign of the parameters. For this reason we interpret the elasticity with respect to value added as the combined effects of demand shifts due to changes in the output level and changes in relative wages.

In contrast, the employment elasticity with respect to capital is the largest in Governance and education 6.6 (significant at 1%) and the smallest in Agricultural sector -2.5 (significant at 5%). This means that labour and capital are strong complements in production in the Governance and education sector with labour increasing by 6.6% when capital stock is increased by 1% and strong substitutes in the Agricultural sector as labour input decreases by 2.5% when capital stock raises by 1%. The elasticity with respect to R&D is the largest in the trade sector, 0.5 (not significant) and the smallest in the Paper, plastic, rubber and other industries, -1.6 (significant at 1%). Labour and R&D appear to be substitutes in the Paper, plastic, rubber and other industries with labour decreasing by 1.6% as R&D stock increases by 1%.

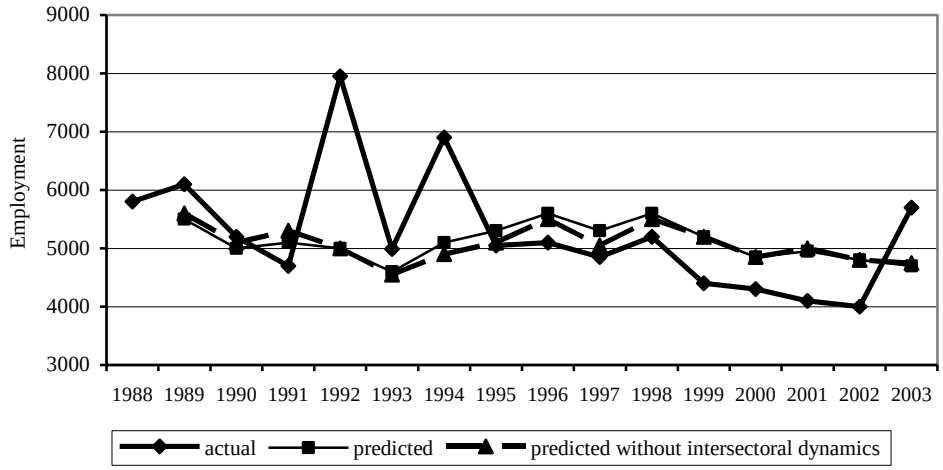
The second block of parameters presented in Table 4 in Corvers and Dupuy (2010) refers to those occupation-specific elasticity parameters, that are significant at 1%. However, we also report the number occupations for which the elasticity parameter is significant at 5% for each of the three explanatory variables. It is interesting to note that employment in high-skill occupations, in general, has a negative and significant elasticity with respect to value added but a large and significant elasticity with respect to R&D. Output expansion in a sector leads to a decrease in employment in high-skill occupations within that sector. However, this effect can be partly or fully compensated by the complementarity of high-skilled workers with new technology as indicated by the positive elasticities of employment in high-skill occupations with respect to R&D. Another interesting result to note is that in particular the intermediate-skill occupations have a positive and significant elasticity with respect to capital, indicating labour-capital complementarity in production.

6.2.3. Illustration

We illustrate our main results by presenting the changes in employment for the high-skill professional technical occupation in two sectors, namely the Chemical and Transport sectors. Figures 6.2 and 6.3 show the actual and predicted employment series of this occupational class in the Chemical and Transport sector respectively.

Figure 6.2

Employment dynamics of high-skill professional technical occupations in Chemical industry



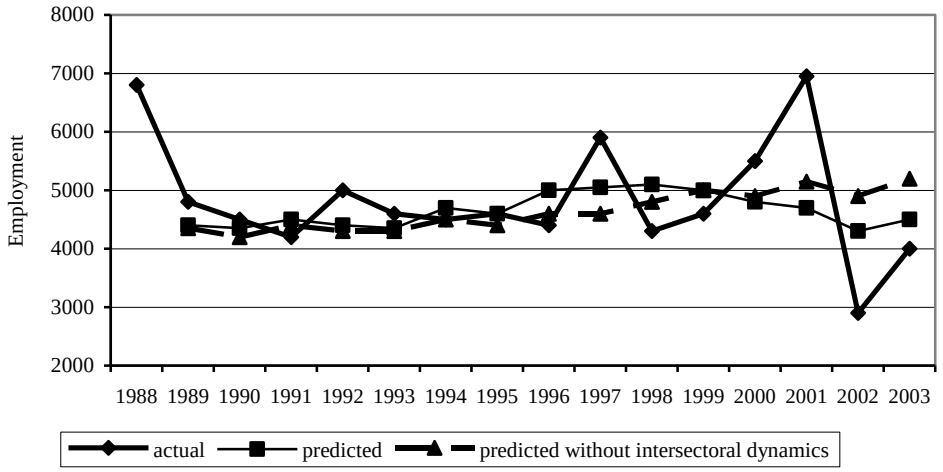
Source: own calculations.

We distinguish between employment predictions with and without intersectoral dynamics. The difference between both predictions indicates the contribution of intersectoral dynamics conditional on the contribution of intrasectoral dynamics. This contribution is virtually insignificant when intra and intersectoral predictions are highly correlated and explain the same share of the employment dynamics.

As shown in Figure 6.2, for high-skill professional technical occupations in the Chemical industry there is no clear advantage of including intersectoral dynamics in the prediction of employment. This is confirmed by the large correlation between the employment predictions with and without intersectoral dynamics, i.e. 0.87. In contrast, as shown in Figure 6.3, for the high-skill professional occupation in the Transport sector, the intersectoral dynamics seems to be very important in the prediction of employment.

Figure 6.3

Employment dynamics of high-skill professional technical occupations in Transport sector



Source: own calculations.

In fact, they account for more than 85% of the full model predictions. Moreover, the correlation between both the full model predictions and the predictions without intersectoral dynamics is rather low, i.e. 0.37. Therefore, including intersectoral dynamics in the estimation model improves significantly the employment prediction for the high-skill professional technical occupations.

6.3. Expansion demand by education[36]

6.3.1. Methodology – theoretical background

Suppose aggregate output in the economy, say Y_t, is produced by combining intermediate occupational outputs, say Y_j with $j = 1, \ldots, N_i$ where N_i is the number of distinct occupations in the economy, with a CES technology:

$$Y_t = \left(\sum_j \delta_{jt} Y_{jt}^{\beta} \right)^{1/\beta}$$

[36] Beware that in this section, *i* indexes relates to education and not sector as it was the case in the previous section.

where δ_{jt} are efficiency units of occupational output j at time t and $\sigma = \frac{1}{1-\beta}$ is the ease to substitute intermediate outputs.

The occupational output is produced by combining workers with different educational backgrounds in various proportions as follows:

$$Y_{jt} = \left(\sum_i \lambda_{ijt} L_{ijt}^{\beta_e} \right)^{1/\beta_e}$$

where λ_{ijt} are efficiency units of workers with education *i* in occupation *j* at time *t* and $\sigma_e = \frac{1}{1-\beta_e}$ is the ease to substitute workers with various educational backgrounds within occupations. L_{ijt} is demand in occupation *j* of workers with education *i* at time *t*.

Equating marginal productivity to wages by education w_{it}, that is assuming perfect competition in the labour market, yields the demand by occupation and education as:

$$L_{ijt} = Y_t \left(UC_t(w_t)\right)^{\sigma} \left(UC_{jt}(w_t)\right)^{\sigma_e - \sigma} \delta_{jt}^{\sigma} \left(\frac{\lambda_{ijt}}{w_{it}} \right)^{\sigma_e} \forall i, j$$

with

$$UC(w_t) = \left(\sum_j \delta_{jt}^{\sigma} \left(UC_{jt}(w_t)\right)^{1-\sigma} \right)^{1/(1-\sigma)}$$

and

$$UC_{jt}(w_t) = \left(\sum_j \lambda_{ijt}^{\sigma_e} w_{it}^{1-\sigma_e} \right)^{1/(1-\sigma_e)}$$

where *UC* stands for unit costs and $w_t = \left\langle w_{1t}, ..., w_{N_i t} \right\rangle$ where N_i indicates the number of education.

Suppose technology is constant so that δ and λ are constant over time. Changes in (log) the demand of workers with education *i* in occupation *j* over time are bi-proportional and given by:

$$\Delta \ln L_{ijt} = \Delta \ln Y_t + \sigma \Delta \ln(UC(w_t)) + (\sigma_e - \sigma)\Delta \ln UC_{jt}(w_t) - \sigma_e \Delta \ln w_{it}$$

$$= \Delta \ln Y_t + \sigma \Delta \ln(UC(w_t)) + \ln R_j + \ln S_i$$

where R_j are the ccupation-specific changes: $\ln R_j = (\sigma_e - \sigma)\Delta \ln UC_{jt}(w_t)$, and S_i stands for education-specific changes: $\ln S_i = -\sigma_e \Delta \ln w_{it}$

This means that when technology is constant over time, changes in the allocation of workers with education *i* in occupation *j* (that can only be induced by changes in the wage structure) can be measured using the RAS method.[37]

Suppose now that technology does change over time but only δ_j may change. These types of shifts are neutral in terms of education but non-neutral in terms of occupational output. By neutral in terms of education, we mean that the sectorial or technical changes do not complement nor substitute workers with some particular education within occupations. All workers, irrespective of their education, are affected the same way. Think of a new machine that enhances marginal productivity in occupation *i* at *t*+1 and could be operated as productively by any type of worker. The changes in the (log) demand for workers with education i in occupation j are still bi-proportional and read as:

$$\Delta \ln L_{ijt} = \Delta \ln Y_t + \sigma \Delta \ln(UC(w_t)) + (\sigma_e - \sigma)\Delta \ln UC_{jt}(w_t) + \sigma \Delta \ln \delta_{jt} - \sigma_e \Delta \ln w_{it}$$

$$= \Delta \ln Y_t + \sigma \Delta \ln(UC(w_t)) + \ln R_j^* + \ln S_i$$

where *R*j* are the ccupation-specific changes:

$$R_j^* = (\sigma_e - \sigma)\Delta \ln UC_{jt}(w_t) + \sigma \Delta \ln \delta_{jt}$$

However, the occupational component is different from 0 even at constant wage structure, i.e. $w_{it} = w_{it-1}$ for all i, because of the term $\sigma \Delta \ln \delta_{jt}$ in $\ln R_j^*$. Hence, given constant wage structure, shifts in the demand for workers has the so-called fixed coefficient structure.

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[37] See Stone and Brown (1964), Evens and Lindley (1973), Kadas and Klafzky (1976), van Eijs and Borghans (1996) and Dupuy and Borghans (2005).

$$L_{ijt} \equiv FC_{ijt} = L_{ijt-1} \times \frac{L_{.jt}}{L_{.jt-1}} \tag{6}$$

where FC_{ijt} is the demand for workers with education i in occupation j were the wage structure constant and technology neutral in terms of education but non neutral in terms of occupations between t and $t-1$.

However, technical changes in general may be non-neutral to educational groups of workers within occupations and therefore λ_{ij} may vary over time. The changes in (log) relative demand for workers with education i in occupation j are not bi-proportional anymore and read as:

$$\begin{aligned}
&\Delta \ln L_{ijt} = \Delta \ln Y_t + \sigma \Delta \ln(UC(w_t)) + (\sigma_e - \sigma)\Delta \ln UC_{jt}(w_t) \\
&+ \sigma \Delta \ln \delta_{jt} - \sigma_e \Delta \ln w_{it} + \sigma_e \Delta \ln \lambda_{ijt} \\
&= \ln R_j^* + \ln S_i + \ln A_{ij}
\end{aligned}$$

where A_{ij} are the occupation*education specific changes: $\ln A_{ij} = \sigma_e \Delta \ln \lambda_{ijt}$

This means that, at constant wage structure and assuming that the log-linear relationship between the non-neutral technical changes and changes in employment are accurately approximated by a linear relationship, shifts in the demand for workers, can be expressed as follows:

$$L_{ijt} \equiv D_{ijt} = FC_{ijt} + c_{ijt} \tag{7}$$

where c_{ijt} is a term indicating skill-biased technical and organizational changes. In the empirical analysis, the change in c_{ij}, i.e. $c_{ijt} - c_{ijt-1} = u_{ij}$ is assumed to be constant at least within subperiods (constant between 1979–1992, as in early expansion demand forecasts,[38] and constant between 1996 and 2003 in the expansion demand forecasts for the period 2004–2010[39]).

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38 See ROA (1995).

39 See ROA (2005).

6.3.2. Empirical methodology

Our aim is to translate forecasts of expansion demand by occupation, indexed by *j*, into forecasts of expansion demand by education, indexed by *i*. First, we see that summing up equation (7) over *j*, the demand for workers with education *i* reads as:

$$D_{it} = FC_{it} + C_{it} \tag{8}$$

Using t as the reference year, suppose we aim at forecasting demand by education in $t+5$. While using L_{ijt}, the employment matrix by education and occupation in the reference year, say t, and the forecasts of expansion demand by occupation at $t+5$, one can easily derive FC_{ijt+5} using equation (6) and sum over occupations to derive FC_{it}. However, one cannot derive directly D_{it+5}, the demand for workers by education at $t+5$, since C_{it+5}, the effect of technological change on the demand for workers with education *i*,[40] is unknown. In the remaining of this section, we aim at identifying the magnitude of C_{it+5}.

First note that summing up equation (6) over i leads to:

$$\begin{aligned} D_{.jt} &= FC_{jt} + C_{jt} \\ &= L_{.jt} + C_{jt} \\ &\Leftrightarrow \\ C_{jt} &= 0 \end{aligned}$$

Second, remember that equation (7) describes demand at time t given the wage structure at time $t-1$ that is given the supply structure at time $t-1$. Since the supply structure may change over time, there will in general be a gap between demand as depicted in equation (8) and supply. By definition, this gap is given as:

$$G_{it} = D_{it} - S_{it}$$

where $S_{it} = L_{i.t}$.

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[40] The difference $C_{it+1} - C_{it}$ is termed the speed of skill upgrading for education *i* between *t* and t+1.

Using this definition, the demand for workers with education i in occupation j at time t is therefore given by:

$$L_{ijt} = D_{ijt} - \alpha_{ij} G_{it}$$
$$\Leftrightarrow$$
$$L_{ijt} - FC_{ijt} = c_{ijt} - \alpha_{ij} G_{it} \quad (9)$$

with $\sum_j \alpha_{ij} = 1$ and where the second equation holds after rearranging and using equation (7) to substitute for D_{ijt}.

Using past observations of L_{ijt}, the employment by education and occupation, i.e. a series of L_{ijt} for all i and j, one can calculate FC_{ijt} and derive a measure of the right hand side of equation (9). If G_{it} was known, this would enable us to estimate equation (9) using OLS techniques to get estimates of c_{ijt} and α_{ij}[41] However, while the set of α parameters are identified through the OLS estimation, only the relative c parameters are identified, not their level, i.e. the sum of the parameters is unknown. This means that setting $C_i = 0$ for instance, one can retrieve the conditional estimates of c_{ij} via OLS regression of equation (9). However, one could also have set $C_i = C$ and retrieve the same relative c_{ij} parameters. To identify C_i, we need an additional equation. Before we proceed, it is important to note here that our choice of C_i gives us knowledge of G_{it}: if we set $C_i = C$, we identify G_{it} as $FC_{it} + C - S_{it}$, where $FC_{it} = \sum_j FC_{ijt}$ and S_{it} is the supply in education i at t. This means that given our arbitrary choice of C, we identify the variable on the left hand side of equation (9) and hence can estimate using OLS techniques the coefficients c_{ij} and α_{ij}.

The missing equation to identify C can be obtained using the potential relationship between the parameters $\alpha's$ and $c's$. Suppose we have the function $c_{ij} = f(\alpha_{ij})$. Using the linear approximation to f and denoting $\bar{c}_{ij}$ the estimates

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[41] Due to the relative short span of observations, we simply write $c_{ijt} = c_{ij} \times t$. This means that $c_{ijt+5} - c_{ijt} = 5 \times c_{ij}$. The coefficient c_{ij} is therefore interpreted as the additional demand per year.

of c_{ij} conditional on $\tilde{c}_i = \sum \bar{c}_{ij} = 0$, the C_i's can be identified by regressing $\bar{c}_{ij}$ on α_{ij} for all i using OLS techniques:[42]

$$\bar{c}_{ij} = const_{ij} - \gamma_i \alpha_{ij} + e_{ij} \tag{10}$$

Indeed, summing equation (10) over j yields $\tilde{c}_i = 0 = \sum_j \widehat{const_{ij}} + \hat{\gamma}_i$.

One problem with this estimation is that the $\alpha's$ are estimates of the first step estimation procedure and are therefore measured with errors. As suggested in Judge et al. (1985), IV estimation techniques can be used to overcome this problem. One would proceeds in two steps:

1. Construct an instrument for $\alpha's$, for instance a variable containing the rank of the $\alpha's$, and regress the $\alpha's$ on its instrument. Derive the in-sample prediction of the $\alpha's$, $\hat{\alpha} = (1 : Rank_\alpha)\hat{\beta}$ where 1 is a vector that contains ones and $Rank_\alpha$ a variable containing the rank of the $\alpha's$.

2. Replace α by $\hat{\alpha}$ and use LS techniques to estimate equation (10).

The estimation results for the Netherlands using the Labour Force Survey data from 1979 to 2003[43] and 128 distinct occupations are presented in Table 6.2. The striking result is the deceleration of the speed of skill upgrading since the mid 90s at all levels of education relative to primary education and the twist between higher vocational graduates and university graduates, from positive shifts in the relative demand for university graduates at a yearly rate of 1.15% to negative shifts at a yearly rate of -0.59%. Recent developments in the labour market show evidence that not only the speed of skill-upgrading is lower than in the 80s but also the nature of skill-upgrading has shifted from generic to specific skills.

A very interesting example of which is found in the banking sector.[44] Since ATM's perform tasks that were previously performed by low skilled workers, the direct effect of the introduction of ATM's was to decrease the demand for low skilled workers in the banking sector and indeed, between 1984 – the

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[42] There are an infinite number of possible shapes for the function indicating the relationship between $c's$ and $\alpha's$ that satisfy $\bar{c}_i = 0 = \sum_j (f(\tilde{c})_{ij} \times \hat{\gamma}_i)$.

[43] The Labour Force Survey was first conducted every two years from 1979 to 1988. Since 1988, it is conducted on a yearly basis.

[44] Hunter et al. (2001) give a very detailed picture of the effects of the introduction of ATM's in the bank sector. They not only consider the effect of the introduction of this new technology on employment within the bank sector but also consider the effect reorganization that followed as a direct consequence the introduction of ATM's. See also van Reenen and Caroli (2001). Therein the authors show that organizational changes complement technological changes.

introduction of the ATM in the banking sector in the US – and 1995, the employment of low skilled workers dropped by 41,000 in the banking sector. However, the use of new technologies was complemented by a work reorganization that led tellers (the old job title "Teller" has been replaced by a new job title "Customer Service Representative") to take over routine tasks[45] previously performed by Personal Bankers so that Personal Bankers could focus on sales exclusively. As a result, the number of employed tellers stabilized rather than dramatically decreased since the mid-90s.[46] This example clearly indicates that although new technologies might lead to rapid skill-upgrading, organizational changes that complement these new technologies might contribute to slowdown the skill-upgrading.

Table 6.2

Skill-upgrading coefficients for the periods 1979–1992 and 1996–2003

Periods	1979–1992	Relative	1996–2003	Relative
Education	%		%	
Primary	-4.48	-	-0.15	-
Lower secondary	-1.08	3.40	-0.40	-0.25
Upper secondary	0.94	5.42	-0.33	-0.18
Higher vocational	1.46	5.94	0.86	1.01
University	2.61	7.09	0.27	0.42

Source: own calculations.

Once we have estimated c_{ij} we can calculate $c_{ijt+5} = c_{ij} \times (t+5)$, and aggregate over j to obtain C_{it+5}. Plugging this into equation (8) yields a forecast of expansion demand by education, i.e. $D_{it+5} = FC_{it+5} + C_{it+5}$.

6.4. Conclusions

In order to evaluate the forecast of expansion demand by occupation, we use both quantitative and qualitative methods. The quantitative method compares the forecasting errors (difference between forecasts and realization) of our model with an alternative model (Same As Before for instance). The qualitative method is however, more intuitive as it takes into account a range of forecast rather than the forecast at their face-value. To this aim we assign to each forecast a qualitative

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45 For instance, changing addresses, issuing cards and adding new accounts etc. Note that these tasks are impossibly done by machines and rather easily performed by humans.

46 Note that a partial explanation for the Tellers employment stabilization is a steady decrease of the average number of hours worked.

characterization, i.e. very low: $ED \leq -3$, $-3 < ED \leq 3$ low, $3 < ED \leq 11$ average, $11 < ED \leq 22$ high and $ED > 22$ very high, where ED is expansion demand, and the limiting values represent the expansion demand as percentage of occupational employment. For instance, Table 6.3 gives a cross-tabulation of the characterization of the realisations and the forecast made for the period 1997–2002. From the 127 occupational classes, 23 have been assigned the right characterisation, the characterisation of the realisation.

Table 6.3

Qualitative evaluation of expansion demand by occupational class (relative forecast)

	Realisation					
Forecast	**Very low**	**Low**	**Average**	**High**	**Very high**	**Total**
Very low	0	3	1	1	4	9
Low	9	1	3	5	2	20
Average	16	9	7	11	6	49
High	3	3	3	6	13	28
Very high	3	5	1	3	9	21
Total	31	21	15	26	34	127

Source: own calculations.

This means that 18% of the forecast has the right characterisation. If we add to this amount all occupational classes for which the characterisation of the forecast differ by just one category with the characterisation of the realisation, we have 77 occupational classes. This means that 61% of the occupational classes has been assigned either the right characterisation or a characterisation differing by just one category. Note that 9% of occupational groups with less than 10,000 workers had the right characterisation and 37% had the right characterisation or almost. Wrong characterisations seem to occur more often for small occupations.

The main practical concerns regarding expansion demand are changes in the classification of occupations and sectors of industry. Indeed, the models both in Section 6.2 and Section 6.3 rely on the estimation of parameters identified from time series of employment by sector and occupation and occupation and education respectively. Hence changes in the classification lead to shorten the series used or jeopardise the consistency of the estimates. For instance, CBS changed the sector classification in 1994. In order for us to use the LFS data from 1988 to 1993, we had to estimate "what the LFS data for that period would have looked like" were the sector classification used in that period the same as the new one. This was possible to some extent since in 1994 data were generated using both the new and old classification. However, this has probably led to measurement errors and therefore errors in the forecast of expansion demand.

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KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

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This book describes systems of forecasting labour demand used in selected Member States of the European Union. The analysis of these systems, which may be seen as examples of the so called best practices, has led to the formulation of recommendations for the new Polish model and system of employment forecasting that is being built within the EU co-funded project „Analysis of the processes on the Polish labour market and in the area of social integration in the context of conducted economic policy", Task 2 „Establishing the integrated forecasting and information system providing employment forecasts". The recommendations are of general as well as of specific nature, and stem from experiences related to the implementation of forecasting systems in the EU countries.

The book contains six chapters and an introduction. In the first chapter the approach to forecasting skills need in the UK, based on the project Working Futures, is presented. It elaborates also on the strengths and weaknesses of this approach. The second chapter describes the framework of forecasting demand for labour implemented in Finland, that is based on the Long Term Labour Force Model (LTM) and the Mitenna model. The system of forecasting labour demand used in the Czech Republic is presented in the third chapter. The system has been developed in line with the CEDEFOP's methodology and enables making forecasts for different countries, including Poland – as a result, preliminary employment forecasts for Poland are a part of the chapter. Chapter four and five describe the German forecasting system. The IAB/INFORGE model used in forecasting labour demandand the latest developments within the framework of the QUBE project, which introduced the concept of the occupational flexibility matrix, are discussed there. In the last chapter the methodology of forecasting expansion demand by occupation and education in Holland is elaborated.

Project *Analysis of the labour market processes and social integration in Poland in the context of economic policy* is carried out by Centrum Rozwoju Zasobów Ludzkich in the partnership with the Institute of Labour and Social Studies.
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